INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE

REPORT OF THE ELEVENTH MEETING OF COMMUNICATIONS, NAVIGATION AND SURVEILLANCE/ METEOROLOGY SUB-GROUP (CNS/MET SG/11) OF APANPIRG

BANGKOK, THAILAND 16– 20 JULY 2007

The views expressed in this Report should be taken as those of the Sub-group and not for the Organization. This Report will be submitted to the APANPIRG/18 Meeting and any formal action taken will be published in due course as a Supplement to the Report of the APANPIRG Meeting.

Approved by the Meeting
and published by the ICAO Asia and Pacific Office

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1. Introduction

1.1 The Eleventh Meeting of the Communications, Navigation and Surveillance/Meteorology Sub-group (CNS/MET SG/11) of Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG) was held at the ICAO Asia and Pacific Regional Office, Bangkok, Thailand, from 16 to 20 July 2007.

2. Attendance

2.1 The meeting was attended by 90 experts from 21 States, IATA, IFALPA and SITA. A list of participants is at **Attachment 1.**

3. Opening of the Meeting

3.1 Mr. L.B. Shah, Regional Director, ICAO Asia and Pacific Office, in welcoming the participants, provided an overview of the various activities that had taken place in the CNS and MET fields since the Tenth Meeting of the Sub-group, such as publication of the Global Plan, the outcome of Second Meeting of ATN Implementation Coordination Group, the Sixth Meeting of ADS-B Study and Implementation Task Force, Regional Preparatory Group Meeting for WRC-2007, AIDC Review Task Force and SIGMET Seminar. He emphasized the importance of transition from system based air navigation to performance based air navigation. He highlighted other activities being taken up in the next few months such as the Workshop on the Development of Business Case for the Implementation of CNS/ATM Systems scheduled in the week of 23 July and Performance Based Navigation Seminar scheduled for 11 to 14 September 2007.

3.2 He stressed on the need to progress the tasks of the Sub-group and establish a time frame to achieve the objectives.

3.3 Mr. Jeffrey Bollard, Chairman of the CNS/MET Sub-group, welcomed the participants and highlighted the main issues to be addressed by the meeting. He pointed out the challenges related to the implementation of the new Global Air Navigation Plan.

4. Officers and Secretariat

4.1 Mr. Jeffrey Bollard, Chairman of the Sub-group, presided over the meeting. Mr. Shun Chi-ming, from Hong Kong, China chaired the MET Working Group of the Sub-group.

4.2 Mr. Dimitar H. Ivanov, Regional Officer, MET, Messrs. Li Peng and Sujan Saraswati Regional Officers, CNS, acted as Secretaries of the meeting.

5. Organization, Working Arrangement, Language and Documentation

5.1 The working language was English inclusive of all documentation and this report. The Sub-group met as a single body on 16, 19 and 20 July 2007 to deal with subjects of common interest in both CNS and MET fields. On other days the CNS and MET Working Groups met separately to deal with specific tasks. Several ad-hoc groups were established during the meeting to deal with navigation, surveillance and meteorology related issues which met on 17 and 18 July 2007.

5.2 A list of Working Papers and Information Papers presented at the meeting is at **Attachment 2.**

6. Terms of Reference of the CNS/MET Sub-Group

1) Ensure the continuing and coherent development of the ASIA/PAC Regional Air Navigation Plan and the ASIA/PAC Regional Plan for the New CNS/ATM System in the CNS/MET field;

2) Review and identify deficiencies that impede the implementation or provision of efficient CNS/MET services in the ASIA/PAC Region;

3) Monitor CNS/ATM system research and development, trials and demonstrations in the fields of CNS/MET and facilitate the transfer of this information and expertise between States;

4) Make specific recommendations aimed at improving CNS/MET services by the use of existing procedures and facilities and/or through the evolutionary implementation of CNS/ATM system; and

5) Review and identify inter-regional co-ordination issues in the fields of CNS/MET and recommend actions to address those issues.

7. Conclusions and Decisions - Definition

7.1 The Sub-groups of APANPIRG record their actions in the form of Draft Conclusions, Draft Decisions and Decisions with the following significance:

a) Draft Conclusions deal with matters, which, in accordance with the Sub-group's Terms of Reference, require the attention of States or actions by ICAO in accordance with establishment procedures;

b) Draft Decisions relate solely to matters dealing with the internal working arrangements of APANPIRG and its contributory bodies; and

c) Decisions relate solely to matters dealing with internal working arrangement of the Sub-group only.

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Agenda Item 1: Adoption of agenda

1.1 The agenda adopted by the meeting was as follows:

Agenda Item 1: Adoption of agenda

Agenda Item 2: Review follow-up action on:

1) reports of CNS/MET SG/10 and APANPIRG/17 Meetings
2) relevant action items of 43rd DGCA Conference
3) third Edition of Global Air Navigation Plan (APANPIRG Decision 16/59 refers)

Agenda Item 3: Aeronautical Fixed Service (AFS):

1) review report of the Second Meeting of the ATN Implementation Coordination Group (ATNICG/2)
2) review report of the AIDC Review Task Force and AIDC Plan
3) discuss other AFS related issue

Agenda Item 4: Aeronautical Mobile Service (AMS):

1) air-ground communication
2) implementation of datalink Flight Information Service (DFIS) Applications
3) discuss other AMS related issues

Agenda Item 5: Navigation:

1) review strategies for Precision Approach and Landing Guidance Systems and GNSS implementation
2) implementation of GNSS Approach with Vertical Guidance (APV)
3) discuss implementation of Performance Based Navigation
4) discuss other radio navigation issues

Agenda Item 6: Surveillance:

1) review report of the Sixth Meeting of ADS-B Study and Implementation Task Force
2) review strategy for the surveillance systems
3) discuss other surveillance related issues

Agenda Item 7: Aeronautical electromagnetic spectrum utilization:

1) review results of the Second Regional Preparatory Group (RPG) meeting for WRC-2007
2) review result of the Fourth APT Regional Preparatory Group Meeting

Agenda Item 8: Implementation of the World Area Forecast System (WAFS):

1) review the outcome of WAFSOPSG/3 and SADISOPSG/12 meetings
2) review the status of implementation of ISCS and SADIS
3) review the status of implementation and utilization of the WAFS products

Agenda Item 9: Exchange of OPMET Information:

1) review report of OPMET/ M TF/5 Meeting
2) review regional requirements for OPMET information (FASID Tables)
3) regional planning for BUFR coded OPMET information

Agenda Item 10: ICAO Advisory & Warning Systems:

1) review implementation of International Airways Volcano Watch (IAVW) including the outcome of IAVWOPSG/3 meeting
2) review implementation of tropical cyclone advisories and warnings
3) SIGMET related issues

Agenda Item 11: Other MET issues:

1) MET/ATM coordination
2) MET support for operations at aerodromes and terminal areas

Agenda Item 12: Review CNS/ATM systems planning and implementation:

1) Key Priorities for CNS/ATM Implementation and Regional Performance Objective (PO)
2) review and update CNS/ATM Implementation Planning Matrix
3) CNS related issues
4) MET related issues

Agenda Item 13: Review of deficiencies in the CNS and MET fields:

1) status of CNS deficiencies (APANPIRG Deficiency List)
2) status of MET deficiencies (APANPIRG Deficiency List)

Agenda Item 14: Future Work Programme

Agenda Item 15: Any other business

Agenda Item 2: Review follow-up action on:

1) report of CNS/MET SG/10 and APANPIRG/17 Meetings
2) relevant action items of 43rd DGCA Conference
3) third Edition of Global Air Navigation Plan (APANPIRG Decision 16/59 refers)

Report of the CNS/MET SG/10 and APANPIRG/17 Meetings

2.1 The meeting carried out a review of the actions taken by APANPIRG and Air Navigation Commission (ANC) on Decisions and Conclusions formulated by the Tenth Meeting of the CNS/MET Sub-group held in Bangkok from 17 to 21 July 2006. The meeting noted with satisfaction actions taken and the significant progress achieved by the States and the Secretariat. It was noted that actions on 85% of the Conclusions and Decisions of the APANPIRG/17 were completed or closed. The status of the follow up action as reviewed by the meeting is provided in **Appendix A** to the Report.

Outstanding Conclusions

2.2 The meeting reviewed a list of outstanding Conclusions up to APANPIRG/16 (2005), which is provided in **Appendix B** to the Report. The meeting noted that of the 5 outstanding Conclusions, actions on 2 Conclusions had been closed. The remaining 3 ongoing items would require further action and were expected to be completed by the July 2008.

Relevant Action Items of the 43rd DGCA Conference

2.3 The 43rd Conference of Directors General of Civil Aviation (DGCAs), Asia and Pacific Regions (DGCA/43) was held at Bali, Indonesia in December 2006. The meeting noted the theme subjects for 43rd and 44th DGCA Conference and the action items agreed by the Conference. Two of the Action Items of direct interest to the Sub-group were as follows:

Action Item 43/1 Resolution of Deficiencies

2.4 Recognizing the adverse impact on safety, efficiency and regularity of air transport and noting the development of a regional performance objective on elimination of deficiencies expressed in APANPIRG Conclusion 17/54, the Conference strongly urged the Asia Pacific States listed in the APANPIRG List of deficiencies to establish action plans with fixed target dates for resolution of all safety related deficiencies and notify ICAO Regional Office by mid 2007 of their plans and urged all Asia Pacific States to collaborate in resolving the safety related deficiencies according to the established action plans.

2.4.1 The meeting was informed of the follow-up action taken by the Secretariat. It was noted however, that the response received from the States on the establishment of fixed target date for resolution of identified deficiencies was low.

Action Item 43/7 - Preparation for WRC-2007

2.5 Recognizing the crucial importance of protecting the aeronautical frequency spectrum at the World Radiocommunication Conference in 2007 (WRC-2007), the Conference strongly urged Asia Pacific States to participate in the Asia-Pacific Telecommunity (APT) Preparatory Meetings and the Regional Preparatory Group Meeting for WRC-2007 in Bangkok in early 2007 and urged Civil Aviation Administrations to work closely with the relevant national authorities to ensure support to the ICAO position at the WRC-2007.

2.6 The meeting recognized that action items 43/1 and 43/7 were already covered by the work of the Sub-group and APANPIRG. Many designated contact points who were responsible for WRC-2007 preparations participated at the second ICAO Regional Preparatory Group meeting for WRC-2007. A number of participants from aviation Administrations had been included in the national delegation for the Fourth Meeting of APT APG.

Global Air Navigation Plan

2.7 Secretariat made a presentation on the Global Air Navigation Plan and Asia/Pacific Air Navigation Plan. The significant features of Global Air Navigation Plan (Doc 9750 – the Third Edition – 2007) as well as the salient differences between the Third Edition and the earlier edition of the Plan were identified.

2.8 The global air navigation plan emphasized the importance of the human resource development and training. It was proposed to encourage States to conduct Foundation Training and Training for Implementation Planners in the areas recommended in the Global Air Navigation Plan.

2.9 IATA was of the view that some States may not have the resources to conduct the foregoing training. The requirement would be met as long as such States could get the relevant personnel trained as per the Plan guidelines.

2.10 In view of the foregoing, the meeting formulated a draft Conclusion as follows:

Draft Conclusion 11/1 - Foundation Training and Training for Implementation Planners

That, States be encouraged to organize Foundation Training and Training for Implementation Planners in the areas recommend in the Global Air Navigation Plan.

2.11 The paper also reviewed the Asia and Pacific Air Navigation Plan (Doc 9673) and the Asia/Pacific Regional Plan for the New CNS/ATM Systems and proposed discontinuation of the later in view of the need to harmonize the regional planning process with the new global plan. It was noted that some planning information provided in the Asia/Pacific Regional Plan for the New CNS/ATM system was similar to those contained in the FASID. It was also envisaged that the relevant regional planning and implementation material contained in the Regional Plan for New CNS/ATM Systems will be progressively incorporated in the Asia and Pacific Basic ANP and FASID. It was therefore proposed to discontinue the Asia/Pacific Regional Plan for the New CNS/ATM systems and formulate the following draft Conclusion for consideration by APANPIRG/18.

Draft Conclusion 11/2 - Discontinuation of Asia/Pacific Regional Plan for New CNS/ATM Systems

That,

a) in order to harmonize regional planning process with the Global Air Navigation Plan, the Asia/Pacific Regional Plan for New CNS/ATM Systems be discontinued; and

b) ICAO be invited to develop detailed proposals for incorporating the useful information contained in the Regional Plan for the CNS/ATM Systems into the Asia Pacific Air Navigation Plan (Doc 9673) and completed by 2009.

Follow-up actions on the ALLPIRG/5

2.12 The meeting recalled that CNS/MET SG/10 had reviewed the summary report of ALLPIRG/5 Meeting and reviewed the Decision adopted by APANPIRG/17. The meeting also reviewed the follow-up action taken on the Conclusions 5/2, 5/4, 5/5, 5/13, 5/16, and 5/17 of ALLPIRG/5. The meeting noted that some of identified specific tasks in the Conclusions are being incorporated into the work programme of the Sub-group and some had been either undertaken or addressed by the Secretariat. The status of the follow-up actions is provided in the **Appendix C** to the Report.

Agenda Item 3: Aeronautical Fixed Service:

1) review Report of the Second Meeting of the ATN Implementation Coordination Group (ATNICG/2)
2) review report of AIDC Review Task Force and AIDC Plan
3) discuss other AFS related issues

Review Report of the Second Meeting of the ATN Implementation Coordination Group (ATNICG/2)

3.1 The Second ATNICG Meeting was hosted by Hong Kong, China from 28 May to 1 June 2007 and was attended by 75 participants from 18 States, ARINC, SITA and 8 Industries. The meeting considered 25 Information Papers and 23 Working Papers and formulated 2 Decisions, 1 draft Decision and 3 draft Conclusions.

3.2 The meeting reviewed the TOR of ATNICG and did not consider the need for change. The meeting reviewed the Subject/Tasks List updated by ATNICG/2 based on the progress made and endorsed the following draft Decision:

Draft Decision 11/3 - Revision to the Terms of Reference and the Subject/Tasks List of ATNICG

That, the Revised Subject/Tasks List of the ATNICG provided in **Appendix D** to the Report be adopted.

AMHS Implementation in CAR/SAM Regions

3.3 The Meeting noted the progresss of AMHS implementation activities in the Caribbean and South America Regions (CAR/SAM). The meeting noted a strategy for implementation of AMHS over TCP/IP utilizing IPv4 to replace their Aeronautical Fixed Telecommunications Network (AFTN) switches. IPv6 was recommended for inter-regional connectivity. During the transition phase, it was proposed to use a dual stack transition mechanism where both IPv4 and IPv6 are implemented in all the Routers and incrementally in AMHS systems.

Use of IPv6

3.4 The ATNICG/2 expressed concerns for implementation of IPS using IPv6 in the near term. SARPs for IPS developed by Aeronautical Communication Panel (ACP/1) will become applicable in the end of 2008. There is an on-going task for Working Group N of ACP to develop guidance material for implementation. Additional guidelines on the use of IPS may also need to be further developed for regional implementation. It was noted that AMHS Products capable to support IPv6 were very limited and implementation of IPv6 in the near term was not considered practical in the ASIA/PAC Region.

Cost of Leasing Low Speed Circuit

3.5 The meeting noted that more than 100 low speed AFTN circuits are implemented in the CAR/SAM region. The costs of keeping the low speed circuits would be same or even higher than leasing 64 Kbps or higher signaling speed circuits. The same was confirmed in some countries in the ASIA/PAC Region. Therefore, States had been encouraged to upgrade the signaling speed to increase the channel capacity to support ATSMHS. However, it was noted that some AFTN switches used by States were able to support maximum channel speed up to 19.2 Kbps only.

Interregional Connection

3.6 The meeting noted that interregional connection between Chile and New Zealand is specified in the AMHS transition plan of the CAR/SAM Region. However, there is no such link that has been planned in the ASIA/PAC FASID Table CNS-1B. The traffic to/from CAR/SAM region from/to ASIA/PAC Region will be via USA. Therefore, requirement of interregional connection with CAR/SAM Region using IPv6 would only be required for consideration by USA and CAR/SAM Region. The Secretariat was requested to contact CAR/SAM region to identify and coordinate the issue of inconsistency in the planning of interregional connection for ATN/AMHS implementation.

Binary Universal Form for the Representation of meteorological data (BUFR)

3.7 The meeting recalled that in accordance with the *Working Arrangements between ICAO and WMO (Doc 7475)*, the codes used for ground-to-ground dissemination and exchange of OPMET information (METAR/SPECI and TAF) lies with WMO and it is therefore not possible for ICAO to choose the code by itself. The BUFR code form is contained in WMO publication No.306, Manual on Codes Volume I. The meeting was informed that the migration plan to aeronautical MET codes which is still valid included enabling use of the BUFR code form on bilateral basis as of November 2007 and full implementation of the BUFR code form in 2016 for all the exchangers of the OPMET data. It was noted that the WMO Commission for Basic Systems (CBS) Expert Team (ET) on data representation and codes recently concluded that only the aviation community could evaluate the capability of its information technology (IT) infrastructure and its own ability to support code changes. The meeting recalled that ATNICG/1 had confirmed AMHS would be able to support the requirements for BUFR coded messages through a File Transfer Body Part (FTBP) solution. It was noted that another ET was being established to develop guidance for the use of XML. It could be expected that the BUFR transition would be frozen until the result of discussion of new ET are known. Agreement by the Air Navigation Commission to this course of action will be sought later in 2007.

First Meeting of Aeronautical Communication Panel (ACP/1)

3.8 The meeting noted the outcome of ACP/1 which was held in Montréal, from 10-18 May 2007. The report of the meeting is available on the following ACP website:
http://www.icao.int/anb/panels/acp/wgdoclist.cfm?MeetingID=188

3.9 Some of the outcome effects on ATN/AMHS related issues are as follows: Recommendation (3/1), inviting ICAO to amend Annex 10, Volume III, Part I, Chapters 1 and 3. Draft SARPs that would be introduced in Annex 10 include material based on the internet protocol suite (TCP/IP). Such introduction would need to take place in a manner that already on-going ATN/OSI implementations, both ground-ground and air-ground, would not become obsolete. Technical material for the ATN/IPS would use standards developed by the Internet Society (ISOC) and the Internet Engineering Task Force (IETF).

3.10 The meeting noted the ongoing updating of the Manual of Technical Provisions of the ATN and its publication in several parts of the Manual on detailed technical specifications of the ATN/OSI Doc 9880.

3.11 Further work in particular with regard to the air-ground part of the ATN including the future use of CPDLC application over the ATN/IPS was identified. Further work on security of ATN particularly in air-ground data links was identified. It was clarified that use of IPS to support air/ground communication was desirable and feasible. However it is not clear at this stage whether IP can be supported over VDLM2. The meeting noted the other relevant outputs of the ACP/1.

Updates on the Development of Technical Provisions for AIDC

3.12 In following up the outcome of First Meeting of OPLINK Panel, the ACP WGN Meeting held in Bangkok 2007 reviewed and approved updates and amendments to technical provisions for AIDC as contained in the Doc 9705. It was anticipated that the updated material for the AIDC technical provisions will be published in a new ICAO document, *Manual on detailed technical specifications of the ATN/OSI* (Doc 9880), Part IIA. It was noted that Part I (CM and CPDLC) and Part IIA (AIDC) of Doc 9880 have been approved and have been placed on the ACP website. Updates of the relevant material on ATSMHS and upper layer communications service (ULCS) are in progress and are expected to be published in the near future.

Guidance Document for AMHS Conformance Testing

3.13 The meeting reviewed the final draft of AMHS Conformance Document presented by Singapore on behalf of a group of States established by ATNICG consisting of China, Hong Kong China, Indonesia, Singapore, Republic of Korea and United States. ATN/AMHS Conformance document describes requirements to ensure interconnectivity and interoperability. The document was adapted with a baseline from the Eurocontrol Conformance Document. The adaptation of the Eurocontrol Manual focuses on the use of AMHS with additional ATN router testing procedure which was developed based on the router testing and trials conducted between Hong Kong China and Japan. In view of the foregoing, the meeting endorsed the following draft Conclusion:

Draft Conclusion 11/4 - Guidance Document for AMHS Conformance Testing

That, the Guidance Document for AMHS Conformance Testing as provided in **Appendix E** to the Report be adopted and published as First Edition for use in the Asia and Pacific Region.

ATN/AMHS Implementation Planning Status

3.14 Under this agenda item, the meeting reviewed the ATN/AMHS implementation and planning status presented by Australia, Bangladesh, China, Hong Kong China, Fiji, India, Indonesia, Japan, Republic of Korea, Singapore, Sri Lanka, Thailand and USA.

3.15 The Secretariat demonstrated a web based database on the implementation and planning status in ICAO APAC website where information on focal contact point, planning and implementation status and link data is provided. An implementation forum has also been created in the same ICAO APAC web page. The planning information and implementation status of ATN/AMHS in the Region as mentioned in the previous paragraph including the information received before the meeting from Malaysia, Macau-China and the Philippines were consolidated and reflected in the form of an ATN Connection Chart at the following ICAO APAC web page under the Regional Planning Projects: http://www.icao.or.th/apac_projects/atn_amhs.html

3.16 The meeting reviewed with interest the Chart uploaded with the latest implementation planning information. It was encouraging to see the progress of implementation of ATN/AMHS made by States in the region.

Use of Internet for ATN/AMHS Functional and Interoperability Testing

3.17 The meeting noted the experience gained by Hong Kong, China in the use of Internet as an alternative communications means to the public X.25 PSDN, IDD or leased circuits for ATN/AMHS functional and interoperability testing at reduced costs. It was concluded that the public Internet is a flexible means for conducting short-term ATN and AMHS technical trials to verify functionality and interoperability of systems from different equipment manufacturers. Use of the Internet for ATN/AMHS trials also supports multi-partite trials on the message relaying functions and ATN link changeover/re-routing trials that cannot be practically/effectively achieved by using public X.25 PSDN, leased circuits and/or IDD connections. Using public internet for testing was further confirmed and supported by China, Japan, Thailand and USA. Only concern expressed was the security if it is made available for operational use.

Interregional Coordination and AMC Coordination Meeting

3.18 The meeting noted that as a follow-up action to the ATNICG WG/1 meeting, an ATS Messaging Co-ordination Meeting was held in Brussels from 27 to 29 March 2007. The main objective of the meeting was to evaluate the capability and functions of the AMC and to analyze the possibilities for the establishment of similar functions in the ASIA/PAC region during the short and the medium terms. Representative from China, Hong Kong-China, Singapore, Thailand and USA visited the ATS Messaging Management Centre at Eurocontrol and attended the coordination meeting. The meeting recognized that common procedures and co-ordination should be formulated globally as a matter of urgency for harmonized implementation, especially when most of the States will implement the ATN infrastructure and AMHS in 2007/2008 timeframe.

ASIA/PAC Interim AMHS Address Management Database

3.19 The meeting noted the offer made by Eurocontrol for a global database service to be provided to all ICAO Regions. It was agreed by APANPIRG that the work on the proposed establishment of ASIA/PAC database in Bangkok should progress. The ASIA/PAC database could share data and synchronize data between databases. In following up the directives from APANPIRG, Aerothai has developed an interim AMHS database based on specifications and suggestions from Hong Kong, China and Japan. The database application is provided using web technology.

Using European AMC Database in the short term

3.20 Considering that many States in the region plan to implement AMHS by 2008, the AMHS address registration and other related information is needed before the end of 2008. The meeting agreed that, in the short term the AMC database is the only one that can be made available in the Asia/Pacific region. It was recognized that data verification within the region before submission to EUROCONTROL was essential. Data should be submitted by operational staff at the COM centres. Therefore it is logical to have one focal point for consolidation of information within the region.

3.21 AEROTHAI was requested to act as an information consolidator for the Asia/Pacific Region and for coordination with EUR region, until the AMHS coordination and management centre (ACMC) in the ASIA/PAC Region is established. AEROTHAI will act as External COM Center for the Asia/Pacific region and relay AMHS information to AMC following the AMC AIRAC updating cycle. This will be the interim arrangement.

3.22 In this connection, the meeting noted that in response to the report of AFSG/10 meeting, ICAO Headquarters agreed in principle to the Conclusion 10/11 of AFSG/10, to provide a timely and comprehensive global solution for both formal AMHS address allocation and operational address management. The institutional arrangement is expected to follow the pattern already established for the global management of 5 letter name codes (5LNC), which is based on an agreement between ICAO Headquarters and Eurocontrol.

ATSMHS Coordination and Management Centre

3.23 The meeting noted the medium term solution proposed by ATNICG for AMHS address management. Medium-term target is to continue the effort for establishment of a regional AMHS Coordination and Management Centre (ACMC) in the Asia and Pacific Region that can automatically exchange data with the AMC.

ATS Inter-facility Data Communication Plan

3.24 The meeting reviewed the FASID Table for AIDC CNS-1D updated by the second meeting of ATNICG and endorsed the draft Conclusion formulated by the AIDC Review Task Force. The updated FASID Table CNS-1D was further updated and is provided at **Appendix F** to the Report for consideration by APANPIRG/18. The meeting also noted that the Table would be renamed as FASID Table CNS-1E - ATS Inter-Facility Data Communication (AIDC) Implementation Plan. Accordingly the meeting endorsed the following draft Conclusion.

Draft Conclusion 11/5 - Amendment to FASID Table CNS-1E

That, FASID Table CNS-1E, ATS Inter-facility Data Communication (AIDC) Implementation Plan, be replaced with the updated Table in accordance with the established procedure.

ATN/AMHS Seminar/Workshop

3.25 The meeting considered that technical and operational trainings on AMHS are very important for the smooth implementation of ATN/AMHS in the Asia and Pacific Regions. Therefore, in a timely manner a workshop/seminar for the exchange of experiences gained and lesson learned should be conducted. The meeting recalled that the ATN Seminars were hosted by Aerothai once every two years on a regular basis. It is therefore expected that the next one will be in early 2008. Accordingly, the meeting endorsed the following draft Conclusion.

Draft Conclusion 11/6 - ATN/AMHS Implementation Seminar/Workshop

That, ICAO be invited to coordinate with the State concerned to conduct an ATN/AMHS Seminar/Workshop to address implementation issues in early 2008.

Revised ICD for AMHS

3.26 The meeting reviewed the revised AMHS Interface Control Document (ICD) to include the use of CAAS addressing scheme and IPM-88. Further more, the opportunity was taken to revise text concerning the network layer of the AMHS protocol stack to clarify sub-networks and the corresponding SNDCF protocols. The meeting agreed with the proposed changes as indicated in **Appendix G** to the report and formulated the following draft Conclusion.

Draft Conclusion 11/7 - Amendment to AMHS ICD

That, the revised AMHS ICD provided in the **Appendix G** to the Report be adopted as Edition 2 of ASIA/PAC AMHS ICD.

TCP/IP and OSI Gateway in USA

3.27 USA presented an information paper on the national network on convergence over TCP/IP using the RFC 1006 technique. The FAA has developed an RFC-1006 Gateway which resides in their ATN router. The RFC 1006 gateway translates from TCP/IP to OSI and vice versa. The FAA's implementation architecture will be transparent to a remote MTA and ATN router. The meeting further noted FAA's planned redundancy approach for the initial Salt Lake City configuration and the planned approach once Atlanta is upgraded with an AFTN/AMHS Gateway. For the Salt Lake City configuration of hardware redundancy of the AFTN/AMHS Message Switching Node, Router Redundancy, and Interface Redundancy was described. For the combined Salt Lake City and Atlanta configuration, redundancy using Manual procedures to redirect the RFC-1006 Gateway connections or X.25 circuits was introduced.

Conversion of X.25 to IP Network Protocol in the United States

3.28 USA informed the meeting that the FAA domestic telecommunication network migrates from X.25 network protocol to Internet Protocol (IP) network to reduce cost in long run and to reduce the variety of interfaces. It was noted that some of the data-link applications being used by FAA will migrate to IP environment. Methods have been adopted to overcome the issue of message assurance inherent in IP protocol. It was assured that FAA still supports the AMHS service based on X.25 subnet as specified in ICAO Doc 9705.

Next meeting of the ATNIC Group

3.29 Considering the need to further progress urgent tasks, the meeting agreed that the next Meeting of ATNICG Working Group will be hosted by Aerothai in Bangkok from 19 to 21 September 2007. Aerothai also offered to host the ATN/AMHS Implementation Seminar/Workshop in January 2008 in Chiangmai, Thailand. The next meeting of the ATN Implementation Co-ordination Group will be held in April 2008. The exact date and venue of the meeting will be coordinated with the States concerned and notified to the members of the ATNICG in the due course. The meeting expressed its appreciation and gratitude to the Department of Civil Aviation Hong Kong China for hosting the ATNICG/2 in Hong Kong China and for the excellent arrangements made for the meeting and the opportunity provided to visit the air navigation facilities at Hong Kong International Airport.

AIDC Review Task Force

3.30 The meeting reviewed the report of ATS Interfacility Data Communication Review Task Force Meeting (AIDC/TF) held in February in Bangkok, Thailand. The meeting was attended by 33 participants from 14 States. The meeting also reviewed the action taken by the ATM/AIS/SAR SG/17 meeting on the report of the Task Force. The meeting agreed to the changes proposed by the ATM/AIS/SAR Sub-group regarding the draft Version 3 ICD for AIDC. The meeting noted the changes proposed by the AIDC Review Task Force in Part II of the ICD regarding Communications and support mechanism. As result of review, the CNS/MET Sub-group jointly endorsed the draft Conclusion formulated by the AIDC Review Task Force for adoption of Version 3 of ICD for the AIDC.

Dissolution of the AIDC Task Force

3.31 The meeting recognized that the terms of reference established by APANPIRG/5 for the AIDC Task Force had been completed. The Task Force meeting held in 2003 was conducted based on relevant Decisions of APANPIRG for guidance, rather than on any specific terms of reference. This was also the case for the meeting conducted in February 2007. In view of the foregoing, the meeting agreed that, having completed the draft of Version 3 of ICD for AIDC, the

AIDC Task Force should be formally dissolved by APANPIRG. The meeting considered that there are still some outstanding matters with respect to ATN/AMHS Transition support as indicated in the section 3.2 of the Part II of the ICD which need to be further addressed. However, it was considered that such tasks could be included in the work programme of the ATN Implementation Coordination Group and CNS/MET Sub-group of APANPIRG. In view of the foregoing, the meeting developed the following draft Decision.

Draft Decision 11/8 - Dissolution of AIDC Task Force

That, having completed the Version 3 of the Asia/Pacific AIDC ICD in accordance with the APANPIRG Decision 17/13, the AIDC Task Force be dissolved. Any residual task with respect to ATN/AMHS transition support be dealt with by the ATNICG and CNS/MET Sub Groups of APANPIRG.

3.32 The meeting also noted the AIDC related developments by OPLINK Panel, Aeronautical Communication Panel and ATNICG.

Upgrade of AFS between the USA and Australia

3.33 The USA informed the meeting that the channel speed of the fixed circuit between Oakland, California, USA and Brisbane, Australia had been increased from 2.4 Kbps to 64 Kbps as previous bandwidth was insufficient to handle all message traffic. This action was undertaken to accommodate all circuit loading conditions and the inclusion of technical system improvements e.g. Air Traffic System (ATS) Message Handling System (AMHS) and Aeronautical Telecommunications Network (ATN). The circuit is planned to be placed in service by 19 July 2007. It was noted that the entire circuit between the United States and Australia is now provided by a single service provider. It was noted that the use of a single service provider for the entire end-to-end circuit will reduce the repair, restoration, and coordination problem. The information contained in the relevant FASID CNS Table and ASIA/PAC AFTN routing directory needs to be updated by the next consolidated amendment to the relevant documents.

Agenda Item 4: Aeronautical Mobile Service (AMS):

1) air-ground communication
2) implementation of data-link Flight Information Service (DFIS) Applications
3) discuss other AMS related issues

4.1 Under this agenda item, the meeting reviewed several information papers and working papers presented to the meeting.

Development of Data Link Harmonization Strategy

4.2 Secretariat provided an information paper on the draft strategy for data-link harmonization and issues and resolutions associated with providing data-link services to ATN equipped aircraft in an FANS-1/A environment as contained in ICAO Europe and North Atlantic Regional Office letter issued in May 2007. It was recommended that if States are considering implementing ADS-C, they should implement either FANS 1/A' ADS-C or implement the new "next generation" ADS-C under draft by the Data Link Steering Group (DLSG) in Europe. It was not recommended to implement other defined ADS-C, as it would be a divergent step and would not fix a number of known ADS-C shortcomings. If States are considering implementing CPDLC, recognizing Europe's implementation, implement CPDLC under "next generation" CPDLC as discussed in the DLSG. It was not recommended to pursue partial or divergent CPDLC evolutions. Overall idea is to get a next generation CPDLC and ADS that allow migration of both FANS 1/A and ATN to a single standard. It was noted that in Asia/Pacific Region FANS 1/A requirements are being implemented in accordance with the decisions of APANPIRG. IFALPA was of the view that harmonization was a very important issue. The meeting generally supported the draft strategy for the data link harmonization to create a single next step rather than additional and divergent interim steps. The meeting agreed that issues and resolutions associated with data link services should be appropriately addressed. It was suggested that a copy of the above referred letter be provided to the various FANS implementation teams within the ASIA/PAC Region. i.e. FIT-BOB, FIT-SEA, ISPACG and IPACG, for comments.

Aeronautical Mobile Service (AMS) – Strategy

4.3 Secretariat proposed a draft Aeronautical Mobile Service (AMS) Strategy for adoption by the meeting. The proposed strategy was based on the outcome of APANPIRG discussions at its Fourteenth Meeting held in August 2003 and outcome of ITU World Administrative Radio Conference (1979) regarding the allocation and utilization of frequency band 136 – 137 MHz.

4.4 It was noted that APAPNPIRG/14 had recognized the following guidelines which would serve the States in their preparations for AN Conf/11 to deal with Agenda Item 7 from Asia/Pacific perspective (paragraph 2.2.35):

- A channel spacing of 25 kHz will continue to be operational specification in ASIA/PAC Region as it is expected to satisfy requirements for the foreseeable future

- The VHF voice service, backed by CPDLC and HF will be the primary communication medium for transcontinental traffic; and a combination of CPDLC and HF voice will be the communication medium for oceanic traffic

- The requirements for basic voice communications will continue, supplemented by data link Flight Information Services (DFIS) applications including D-VOLMET, D-ATIS and PDC, which would significantly release pressure of VHF spectrum congestion.

4.5 The 136 – 137 MHz frequency band has been reserved exclusively for VHF data-link applications in the Asia/Pacific Region to meet the data link requirement. In view of the foregoing, the meeting formulated the following draft conclusion:

Draft Conclusion 11/9 - Aeronautical Mobile (R) Service Strategy

That, the Strategy for Aeronautical Mobile (R) Service in the Asia/Pacific Region shown in **Appendix H** to the report be adopted and published.

Data Link SATCOM Services

4.6 The status of the use of 30 NM Lateral and 30 NM longitudinal separations (30/30) in Oakland Oceanic FIR was presented by the United States. The findings of the 30/30 Scrutiny Group indicated that the initial trials were successful, with one exception. The exception was the reliability of the Perth Ground Earth Station (GES), which had suffered several outages over the course of the 30/30 trials. The associated operational impact of outages related to data-link services was discussed. It was expressed that there is a need to identify mechanisms to ensure adequate end-to-end performance of satellite communication systems which are used for the provision of Air Traffic Services like CPDLC, ADS-C etc. While the meeting supported the requirement of such mechanism, IATA was of the opinion that the service provider should assure continuity, redundancy and other operational parameters to continue such services, which are dependent on data-link availability. In this connection, Secretariat informed the meeting that some of performance requirements of such services are already included in the 'Required Communication Performance (RCP)'. It was agreed that the requirements should be covered in the contract with the service provider. USA was of the view that for such essential services, the architecture of the system should be specified to ensure specified level of continuity and availability. The meeting also noted the result of discussions on the subject by the ATM/AIS/SAR/SG/17 meeting and the Draft Conclusion 17/20.

Phasing-out of 121.5 MHz Satellite Alerting Services

4.7 Secretariat presented COSPAS – SARSAT decision to phase out the Satellite Alerting Services on 121.5 and 243 MHz from 1 February 2009. It was also informed that the Satellite Alerting service subsequent to 1 February 2009 will be available only to 406 MHz Emergency Locator Transmitter (ELT) equipped aircraft. The presentation described the Satellite Alerting services available on 121.5 MHz and 406 MHz and also brought out the relative advantages of service provided on 406 MHz over the service provided on 121.5 MHz. The requirement of registering all the ELT Beacons by States and different methodologies for registering the ELT were also discussed. The Secretariat was requested to bring to attention of ATM/AIS/SAR Sub-group the result of discussions by the meeting. In view of the foregoing, the meeting developed the following Draft Conclusion.

Draft Conclusion 11/10 - Registration of ELT Beacons

That, States be requested to designate a registering agency for registering ELT Beacons, coded with the country code of the State and unique code of that beacon in a database as specified in paragraph 5.3.2.2 of Annex 10 Volume III and the guidance provided in Appendix I to Chapter 5 'Emergency Locator Transmitter Coding' of the Annex.

Guidance Material for Procurement and Implementation of Data link Systems

4.8 The meeting recalled that the tenth meeting of the CNS/MET Sub-group had reviewed the draft guidance material for procurement and implementation of data link systems (including AFTN, ADS, CPDLC and AIDC) presented by New Zealand. It had been developed according to a decision of Regional Airspace Safety Monitoring Advisory Group (RASMAG). The guidance material focused on three primary areas including system procurement processes, implementation of systems and specification of data link systems. It was noted that the document had been prepared from users' point of view which would provide common understanding and quick reference for procurement and implementation of data link ATM systems. The document would serve as one of the regional guidance materials. The meeting reviewed the final draft of the document as provided in Appendix B to the RASMAG/7 meeting's report. The meeting suggested removing the last two sentence of the first paragraph of Chapter 5 of the guidance material starting with "Specifications produced by technical ….. operational suitability". The meeting also suggested that material for DFIS should be included in the Guidance material in the future. The meeting appreciated the efforts made in making this regional guidance material available. The meeting noted the action taken by the ATM/AIS/SAR/SG/17 meeting on the *Guidance Material.* The meeting agreed to support the *Guidance Material* and jointly endorsed the following draft Conclusion for consideration by APANPIRG/18.

Draft Conclusion 11/11 - Guidance Material for the Asia/Pacific Region ADS/CPDLC/AIDC Ground Systems Procurement and Implementation

That the Guidance Material for the Asia/Pacific Region ADS/CPDLC/AIDC Ground Systems Procurement and Implementation shown in **Appendix I** to the Report be adopted and published as regional guidance material.

Agenda Item 5: Navigation:

1) review strategies for Precision Approach and Landing Guidance Systems and GNSS implementation
2) implementation of GNSS Approach with Vertical Guidance (APV)
3) discuss implementation of Performance Based Navigation
4) discuss other radio navigation issues

Review of strategies for Precision Approach and Landing Guidance Systems and GNSS Implementation

5.1 A series of information papers were reviewed prior to the consideration of the strategies.

5.2 The introductory paper to the review of the strategies identified that the Global Air Navigation Plan (DOC 9750) as approved by the ICAO Council in November 2006 includes implementation of Performance Based Navigation (PBN). The introduction of PBN must be supported by an appropriate navigation infrastructure consisting of an appropriate combination of Global Navigation Satellite System (GNSS), self-contained navigation system (inertial navigation system) and conventional ground-based navigation aids. Attention was also drawn to the guidance material from the Navigation Systems Panel (NSP) on Ionospheric Effect on GNSS Operations and the Electronic Bulletin on the Conclusion of the study on the GNSS cost allocation that was issued by ICAO on 11 May 2007.

APEC GIT/11

5.3 The Eleventh Meeting of the Asia Pacific Economic Cooperation (APEC) GNSS Implementation Team (GIT/11), hosted by the Japanese Civil Aviation Bureau (JCAB), Ministry of Land, Infrastructure and Transport (MLIT), Japan was held in Tokyo, Japan from 25 to 28 June 2007. The meeting noted details of GNSS implementation activities and initiatives taken by each of the Economies represented at the GIT/11. Augmentation systems being developed and implemented within the Economies are Space Based Augmentation System (SBAS), Ground Based Augmentation System (GBAS) and Ground-based Regional Augmentation Systems (GRAS). Many Economies have implemented GPS RNAV procedures and others are continuing to work towards implementation. The automatic reporting of GNSS derived position information through ADS-B technology was also identified by some Economies as an innovation.

United States

5.4 The United States reported that the U.S. continues to aggressively work towards the operational implementation of GPS, its Wide Area Augmentation System (WAAS) and Local Area Augmentation System (LAAS) to complete the transition to satellite-based navigation.

5.5 The WAAS was commissioned on July 10, 2003 for use in all phases of air navigation in the WAAS service area (the continental United States and portions of Alaska).Presently, over 900 LNAV/VNAV published procedures are available which WAAS capable aircraft can fly. LNAV/VNAV is an approach procedure with vertical guidance with nominal minimums of a 350 feet decision height, 1½-mile visibility, 556m horizontal alert limit (HAL), and 50m vertical alert limit (VAL). FAA improved the precision approach capability provided by WAAS through terminal approach procedures (TERPS) optimization. This improvement took full advantage of the capabilities of the WAAS Signal-in-Space and provided a new approach procedure with vertical guidance called LPV. LPV provides more lateral precision over LNAV/VNAV resulting in lower approach minima for most runways. LPV procedures have nominal minimums of a 250 feet decision height, ¾ mile visibility without proper lighting (½ mile visibility with proper lighting), 40m HAL, and 50m VAL.

5.6 The FAA is working to increase the performance of the WAAS service/system by the addition of ground reference stations in Alaska, Canada, and Mexico. Once these sites become operational, it will have the effect of expanding the WAAS coverage in the north-eastern and the entire southern United States, much of Mexico and a majority of the Canadian airspace. Additional GEO satellite services are being acquired to assure service and improve overall system coverage through more optimized GEO orbital locations.

5.7 The FAA is continuing to pursue research and development of GBAS technology. Regulatory approval support is being provided for the CAT-I GBAS being developed to be SARPs - compliant by Honeywell and Airservices Australia. The system will be implemented in Sydney and also by Honeywell and FedEx in Memphis under FAA Non-Fed Approval process (FAR Part 171) for privately installed, owned and operated navigation systems. The FAA anticipates that the Memphis LAAS will be commissioned into the National Airspace System (NAS) at the end of the year 2008.

5.8 The United States is working within the NSP for the development of GBAS to support Cat II/III operations. Research is also being conducted on Terminal Area Procedures (TAP) to develop complex approaches to a precision approach in VFR conditions. TAP includes curved path, leading to a straight-in final for a precision approach and landing.

5.9 The meeting was informed about the United States Space-Based positioning, navigation and timing (PNT) policy and its implementation. This policy is applicable to all United States providers and users of space-based PNT, not only aviation. The policy was first issued in December 2004 and is managed by the National Space Based PNT Executive Committee co-chaired by the Deputy Secretaries of the U.S. Departments of Defense and Transportation. An advisory board which includes international representatives supports the Executive Committee. Compatibility, interoperability and meeting user needs are the goals of the policy.

Australia

5.10 Australia is engaged in a programme to field ICAO SARPs compliant Ground Based Augmentation Systems (GBAS) for Category I operations and also the development and certification of a Ground-based Regional Augmentation System (GRAS). Activities are being led by Airservices Australia with the Civil Aviation Safety Authority (CASA) as the independent regulatory authority.

5.11 Airservices in collaboration with Honeywell International, Sydney Airport Corporation Limited and Qantas commenced an operational trial of a GBAS at Sydney on 23 November 2006. The ground system installed is the Honeywell SLS 3000. The system provides precision approach guidance to the six runway ends at Sydney using one GBAS ground station. Qantas, operating Boeing 737-800 GNSS Landing System (GLS) capable aircraft have conducted 300 GLS approaches to Sydney during revenue services and have trained almost 600 flight crew to fly the approaches. Flight crew reports have been extremely positive and enthusiastic. In June 2007, the A380 flew a successful GLS approach during its visit to Sydney as part of its operational maturity campaign.

5.12 As reported earlier in the meeting, Airservices and Honeywell are working together to finalise a certified Cat I GBAS, designated as the SLS 4000. The SLS 4000 is being designed in full compliance with the ICAO SARPs and United States Federal Aviation Administration Non-Fed Specification FAA-E-AJW44-2937A. The FAA will, if satisfied complete a System Design Approval for the SLS-4000. Airservices will complete an installation at Sydney and seek approval from CASA to add the installed system to Airservices CASR 171 Certification. When added to the 171 Certificate, the system will have achieved full certification and will be available for unrestricted operation. As an interim step the initial production of SLS-4000 will be installed at lead sites whilst certification is being completed, these will be designated as “Red Label” systems. The Red Label systems are expected to be installed in mid 2008. Once certification is complete these systems will transition to “Black Label” systems. Commercially designated “Black Label” system will be available in early 2009.

5.13 Ground-based Regional Augmentation System (GRAS) is a long baseline augmentation system that provides integrity, differential correction and approach procedure definition to aircraft using a network of VHF ground based data broadcast stations. GRAS is described in ICAO Annex 10 SARPs. Airservices is again working with Honeywell to produce the GRAS. Commonality of architecture between GBAS and GRAS and the use of proven commercial-off-the-shelf (COTS) components is minimising the development effort and ensuring through-life supportability. GRAS like other long baseline systems such as SBAS provides augmentation throughout a wide service volume supporting enroute and approach with vertical guidance (APV). The use of the VHF broadcast stations allows the air navigation service provider to tailor coverage to economically service desired airspace. The first commercial installation of GRAS will be in northern Australia where Airservices will be installing a GRAS to complete certification and provide a demonstration facility. The first signal-in-space is expected in mid 2008 with certification completed in 2009.

5.14 The Civil Aviation Safety Authority Australia (CASA) as part of their industry information service and pilot training activities have issued a GNSS Booklet with accompanying DVD that provides information on the science behind the technology, human factors, GNSS IFR navigation approvals, GNSS operation and requirements, warnings and messages.

Japan

5.15 Japan informed the meeting that the initial phase of MSAS will be commissioned on 27 September 2007. Initial operational capability (IOC) of MSAS will be from en-route to NPA. Software modifications and additional monitoring stations are planned to achieve APV capability. Integrity of the MSAS has be assured commencing in the design phase and assessed through a test program with the operational tests not showing any major problems. MSAS capability of accuracy was less than 1 metre on en-route and on NPA. One location, Naha located in the southern part of Japan, found accuracy was more than 2 meters. The Naha performance was attributed to severe ionospheric activity.

Performance Based Navigation

5.16 The meeting was informed that ICAO has published a new two volume draft manual titled the Performance Based Navigation (PBN) Manual (DOC 9613). The PBN Manual is the result of activity undertaken by the Required Navigation Performance (RNP) Special Operations and Requirements Study Group (RNPSORSG) to completely rewrite the formerly titled Manual on RNP. The new manual describes the overarching concept of PBN that comprises both area Navigation (RNAV) and RNP Operations.

5.17 The ICAO Secretariat determined that the manual should remain as a draft until the completion of series of jointly-presented ICAO-FAA-EUROCONTROL seminars on the new manual. These seminars are scheduled for presentation in all ICAO Regions from September 2007 through June 2008. The next seminars will be held from 11 to 14 September 2007 in Bangkok, Thailand and 17-21 September 2007 in New Delhi, India. Participation in the seminar by all stakeholders in the PBN implementation process was highly encouraged. The seminar is designed to familiarize the participants with the PBN concept and the PBN Manual, so that they can begin the process of PBN implementation. The target audience would be ATM planners, air navigation service providers, air operators, aerodrome operators, regulators, air traffic controllers and procedure designers, among others. The Secretariat expects that feedback from seminar attendees on the concepts and implementation processes presented in Volume I of the new Manual, may result in refinement of the contents of Volume I. Additional information on the seminars and on PBN in general can be found at www.icao.int/pbn.

5.18 Volume II of the new ICAO PBN Manual contains detailed technical “Navigation Specifications” with standardized, harmonized airworthiness and operator requirements for several RNAV and RNP operations. These Navigation Specifications also contain detailed recommendations for pilot and controller training. These standardized Navigation Specifications draw from the extensive experience in technical requirements definition of States that have implemented PBN. It should be noted that the RNP Study Group will resume work in 2008 to develop additional Navigation Specifications, possibly for RNP 2 and Advanced RNP 1. These specifications will be included in a future edition of the PBN Manual.

5.19 The meeting was provided with a brief introduction about the concept of PBN including the benefits of this new system over the conventional sensor referenced navigation. The briefing also provides introduction to some of the terms used with reference to PBN.

5.20 The meeting noted information that the CAR/SAM States and International Organizations (IATA, IFALPA and IFATCA) have developed a roadmap intended to assist the main stakeholders of the aviation community to plan the future transition and their investment strategies. The CAR/SAM PBN Roadmap will be the basic material for the development of a broader CAR/SAM navigation strategy, which will serve as guidance for regional projects for the implementation of air navigation infrastructure, such as SBAS, GBAS, etc., as well as for the development of national implementation plans.

5.21 The meeting also noted the considerations of the ATM/AIS/SAR SG/17 meeting regarding the development of a regional PBN implementation plan.

5.22 Concern was expressed in the meeting that the attempt to rationalise regional plans through the incorporation of material from the Asia/Pacific Plan for the New CNS/ATM System in the Regional Air Navigation Plan and the Global Plan would be undone by the production of a Regional Plan for the Implementation of PBN. It was observed that the CNS/MET SG has already adopted the PBN concept into its planning consideration and also has reflected PBN into the regional strategies for Navigation Services and the implementation of GNSS. The approach of the CAR/SAM Region in the development of a roadmap, a strategy document by another name, to guide the adoption of PBN into the Regional Air Navigation Plan and State plans is considered an appropriate action. The meeting proposed that an Asia/Pacific Strategy for the incorporation of the PBN concept into existing regional plans be developed using the CAR.SAM Roadmap as guidance in the development of the strategy. The meeting formulated the following draft Decision:

Draft Decision 11/12 - Regional Strategy for Incorporation of the performance Based Navigation Concept into Regional Plans

That, CNS/MET Sub-group of APANPIRG develop a strategy for the incorporation of the Performance Based Navigation concept into the Asia/Pacific Regional Air Navigation Plan using the model of the CAR/SAM PBN Roadmap for presentation to APANPIRG at its Nineteenth meeting in 2008.

5.23 The Secretariat advised the meeting that experience in other regions had shown that the participation of all stakeholders in the development of PBN implementation plan was essential and that the establishment of a PBN Task Force would likely be the best vehicle to achieve the objective. While there was a support for establishment of a PBN Task Force, some States felt that the terms of reference proposed for the Task Force would overlap the core functions of both the ATM/AIS/SAR and CNS/MET Sub-Groups. It was therefore suggested that the Regional Performance Framework Task Force should consider the allocation of responsibilities for PBN implementation between the ATM/AIS/SAR, CNS/MET Sub-groups and RASMAG so that the respective Sub-groups could undertake the assigned tasks and initiate actions.

5.24 The meeting encouraged States to participate in the upcoming Seminars on Introduction to PBN and also to nominate a focal point of contact within a State responsible for PBN implementation. In view of the foregoing, the meeting formulated a Draft Conclusion as follows:

Draft Conclusion 11/13 – Designation of contact person for PBN implementation

That, States designate a focal contact person responsible for performance based navigation implementation and provide details of the contact person to ICAO accordingly.

Regional Strategies

5.25 The regional strategies for implementation of GNSS air navigation capability and the provision of precision approach and landing guidance systems were reviewed based on new information available and the continuing adoption of the PBN concept.

5.26 The Regional Strategy for the Provision of Approach, Landing and Departure Guidance Systems was considered and re-titled as the Strategy for the Provision of Navigation Services. The strategy was revised to include the new performance based navigation concept and recognized the value of departure guidance. The revised strategy is presented in **Appendix J** to the Report.

Draft Conclusion 11/14 - Strategy for the Provision of Navigation Services in the Asia/Pacific Region

That, the Strategy for the provision of navigation services provided in **Appendix J** to the Report be adopted and published.

5.27 The Strategy for the Implementation of GNSS Navigation Capability in the ASIA/PAC Region was revised taking into account the information provided in working and information papers and to include the PBN concept. The revised strategy is presented in **Appendix K** to the Report.

Draft Conclusion 11/15 - Revision of the Strategy for the implementation of GNSS Navigation Capability in the ASIA/PAC region

That, the revised Strategy for the Implementation of GNSS Navigation Capability in the ASIA/PAC region provided in **Appendix K** to the Report on Agenda Item 5 be adopted and published.

Flight Inspection

5.28 The meeting recalled the requirements stated in Standard 2.7.1 Annex 10 Volume 1 for ground and flight inspections of navigation aids and the guidance provide in the Manual of Testing of Radio Navigation Aids (Doc 8071). To assist States in meeting this obligation, ICAO publishes the Flight Calibration Catalogue for the Asia and Pacific Regions. The catalogue contains information on available flight inspection services within States in the region. The exchange of the information seeks to ensure quality and economic provision of the flight inspection services through the sharing of resources. The Eighth Edition of the catalogue was published by the ICAO Asia/Pacific Regional Office on 2 July 2007 and also posted on the ICAO website. States that do not have their own Flight Calibration Facilities were encouraged to consider using the services of other States for the calibration of their navigation aids.

Agenda Item 6: Surveillance:

1) review Reports of the Sixth Meeting of ADS-B Study and Implementation Task Force
2) review strategy for the surveillance systems
3) discuss other surveillance related issues

Review Report of the Sixth Meeting of ADS-B Study and Implementation Task Force

6.1 The meeting reviewed the outcome of the Sixth Meeting of ADS-B Study and Implementation Task Force.

6.2 An ADS-B Seminar and the Sixth Meeting of Automatic Dependent Surveillance – Broadcast (ADS-B) Study and Implementation Task Force (ADS-B SITF/6), hosted by Korean Civil Aviation Safety Authority (KCASA) and the Incheon International Airport Corporation (IIAC) were held in Seoul, Republic of Korea from 23-27 April 2007. The Seminar was attended by 210 participants and the Meeting was attended by 70 participants from 20 States, 1 international organizations, 1 data communications service provider and representatives from industries.
The report of both the meeting and the Seminar is posted at the following ICAO webpage: http://www.bangkok.icao.int/Meetings/meetings.html

6.3 The ADS-B SITF/6 meeting formulated 2 draft Decisions and 5 Draft Conclusions. The meeting considered 18 Information Papers and 11 Working Papers. Twenty five presentations were made at the ADS-B Seminar.

6.4 The objective of the ADS-B Seminar was to provide information to the participants on ADS-B planning and implementation. The Seminar covered the following list of topics on the ADS-B and was well received by the participants:

- Basic ADS-B Concept, applications
- Global Air Navigation Plan and development by ADS-B related panels
- APANPIRG and ADS-B SITF activities
- Introduction to Multilateration
- Ground stations and Service provider
- ATC Automation and ADS-B
- Avionics products review
- States and ANSP trials, projects and deployment plan
- Views of air space users
- Regulatory Considerations

6.5 In accordance with the new TOR adopted by APANPIRG/17, the ADS-B SITF/6 completed the following tasks.

- Development of the draft guidance material on comparison of the various surveillance technologies
- second amendment to the ADS-B Implementation and Operations Guidance Document
- the concept of use for Multilateration

6.6 The meeting also discussed the ADS-B managed service model and endorsed guidelines of performance parameters for using ADS-B managed serviced. The meeting also encouraged States to consider the benefits of a mandate for aircraft to be equipped with ADS-B OUT.

Developments by ADS-B Related Panels

6.7 The meeting noted that the effective dates of amendments to PANS-ATM as proposed by first meeting of OPLINK Panel including ADS-B based separation, etc. will be on 22 November 2007. As to the work of SAS Panel on ADS-B, the work to support 5 NM separations with ADS-B has been completed and has been published as Circular 311. Work has started to simultaneously obtain 3 NM separation approval for ADS-B and Multilateration. The expected date of publication is early 2009.

6.8 The meeting also noted that Aeronautical Surveillance Panel (ASP) had developed SARPs and supporting technical specifications for a new version of extended squitter messages (named as Version 1) in support of ADS-B which has improved elaboration of navigation and surveillance accuracy. The new and amended SARPs will be a part of Amendment 82 to Annex 10. Associated technical specification will be published as Technical Provisions for Mode S and Extended Squitter (Doc 9871) later this year. The meeting also noted the current work programme of ASP.

Subject/Tasks List of ADS-B SI Task Force

6.9 The meeting reviewed the TOR of the ADS-B SITF adopted by the APANPIRG/17. The meeting proposed a revised TOR for consideration by APANPIRG. The meeting also reviewed and updated Subject/Tasks List based on the progress made and new tasks identified. It was agreed that the issues emerged during the trial and implementation stages should be appropriately addressed by the Task Force. It was agreed that exchange of information on lessons learnt and experiences gained during the trial and implementation of ADS-B should be further encouraged. The meeting endorsed the following two draft Decisions formulated by the Task Force for adoption by APANPIRG/18.

Draft Decision 11/16 - Subject/Tasks List of ADS-B Study and Implementation Task Force

That, the Subject/Tasks List of ADS-B Study and Implementation Task Force provided in **Appendix L** to the Report be adopted.

Draft Decision 11/17 - Revision of the Terms of Reference of the ADS-B Study and Implementation Task Force

That, the revised Terms of Reference (TOR) of the ADS-B Study and Implementation Task Force shown in **Appendix M** to the Report be adopted.

The guidance material on comparison of various surveillance technologies

6.10 To meet one of the objectives specified in the revised TOR of the ADS-B Study and Implementation Task Force, the ADS-B SITF/6 developed a draft Guidance Material on comparison of the various surveillance technologies (GMST). The material was considered as a very useful document for planning surveillance infrastructure by States. The meeting, therefore, agreed to submit it for adoption by APANPIRG as a regional guidance material. In light of foregoing, the meeting endorsed the following draft Conclusion formulated by the ADS-B SITF:

Draft Conclusion 11/18 - The guidance material on comparison of various surveillance technologies

That, the guidance material on comparison of various surveillance technologies (GMST) provided in the **Appendix N** to the Report be adopted.

Amendment of ADS-B Implementation and Operations Guidance Document (AIGD)

6.11 The meeting noted a proposal to add new sub-paragraph into the AIGD. In order for controllers and pilots to be aware of different airborne ADS-B installations, their operation/limitations, including handling in exceptional cases and the impact these different installations can have on air traffic services, it was considered necessary to provide training to controllers on such issues. The meeting agreed to add the examples of radio telephony and/or CPDLC phraseology as recommended in the proposed amendment. It was confirmed by IATA that despite the desirability of such functionality, no separate ADS-B switch-off option exists in the transponder control panels of most aircraft. Therefore, if ADS-B is switched off, TCAS protection function could be disabled. It was recognized that crews need to be educated to respond UNABLE when requested to switch off ADS-B whenever such action disables the transponder. It was also agreed to add additional text into the paragraph 5.9.2.1 of AIGD regarding the explanation of flight plan and flight planning requirements.

In light of foregoing, the meeting endorsed the following draft Conclusion formulated by the ADS-B SITF:

Draft Conclusion 11/19 - The Second Amendment to the AIGD

That, the ADS-B Implementation and Operations Guidance Document (AIGD) be amended as shown in the **Appendix O** to the Report.

Guidelines on performance parameters

6.12 The meeting noted a proposal for States to consider using the managed service model as an alternate solution to deploy ADS-B service. It was recalled that the ADS-B managed service concept as developed by Airservices Australia and SITA Alliance was noted by APANPIRG/17. With a view to provide guidelines for consideration and reference by States, the meeting reviewed the performance parameters as contained in the **Appendix P** to the Report and developed the following Draft Conclusion:

Draft Conclusion 11/20 - Guidelines on performance parameters for using ADS-B managed service

That, States consider the performance parameters contained in **Appendix P** to the Report as service performance guidelines while finalizing acquisition of an ADS-B managed service agreement with a service provider

6.13 The meeting discussed a proposal and a draft conclusion for States to consider the benefits of a mandate for aircraft to be equipped with ADS-B OUT. The proposal was strongly supported by IATA. IATA pointed out that currently no DO260A compliant avionics is in use and implementation and protection of DO260 *Equivalent* avionics should seriously be considered. The meeting also took into account the comments from ATM/AIS/SAR Sub-group on the proposed draft

Conclusion. In view of the foregoing and with following considerations, the meeting developed a revised Draft Conclusion for consideration by APANPIRG/18:

- Traffic is growing in Asia Pacific Regions at a rate higher than any other regions in the world and flight safety needs to be maintained during the traffic increasing;
- IATA supports an ADS-B mandate commencing in 2010 in Asia and Pacific Regions;
- There is a need for early clear indications to avionics vendors, airframe OEMs, ANSPs, airlines, operators and regulators regarding the future of ADS-B;
- ATC surveillance is not available in many parts of the Region;
- States would invest in ADS-B ground infrastructure and ATC automation system integration of ADS-B if there was high expectation of avionics fitment;
- The availability of technical standards for 1090ES ADS-B OUT including Annex 10, RTCA DO260, DO260A, DO303 and EUROCAE ED126;
- The progress made by European in developing the draft NPA, the Australian NPRM and AC and the soon to be released FAA NPRM;
- The safety benefits that are expected to flow from fitment of ADS-B OUT;
- That 30% of flights by international aircraft in a number of states are already equipped;
- Additional benefits accrue to those aircraft, which are already fitted if fitment rates rise

Draft Conclusion 11/21 - Mandate Regional ADS-B Out implementation

That, States implement requirements for ADS-B Out avionics equipage with a target date of 2010 to enable ATC separation services using ADS-B sooner.

Note: The implementation would require aircraft equipped with avionics compliant with either

a) *Version 0 ES as specified in Annex 10, Volume IV, Chapter 3, Paragraph 3.1.2.8.6 (up to and including Amendment 82 to Annex 10) and Chapter 2 of draft* Technical Provisions for Mode S Services and Extended Squitter *(ICAO Doc 9871) (Equivalent to DO260) to be used till at least 2020.*

or

b) *Version 1 ES as specified in Chapter 3 of draft* Technical Provisions for Mode S Services and Extended Squitter *(ICAO Doc 9871) (Equivalent to DO260A)*

Concept of Use for Multilateration

6.14 The meeting reviewed with appreciation a draft Concept of Use of Multilateration developed by ADS-B SITF in accordance with the task assigned by APANPIRG/17 meeting. The meeting endorsed the Concept of Use without any amendment and agreed to submit it to APANPIRG/18 for adoption as a regional guidance document. Accordingly, the meeting endorsed the following draft Conclusion:

Draft Conclusion 11/22 - Concept of Use for Multilateration

That, the Concept of Use of Multilateration provided in **Appendix Q** to the Report be adopted as Version 1 for use as regional guidance material.

6.15 The meeting also noted the result of survey on the readiness of the ADS-B service for ATS providers conducted by the ADS-B Study and Implementation Task Force. The result of the survey as tabulated in the **Appendix R** to the Report was noted by the meeting.

States' activities and interregional issues on trials and implementation of ADS-B

6.16 The meeting noted the progress made in implementation of ADS-B and the information on the recent trials, planning activities provided by Australia, China, Hong Kong Chin, Fiji, Indonesia, Republic of Korea, Singapore and USA. The meeting noted and appreciated the information provided on ADS-B Implementation Policy for Europe as defined by the Eurocontrol CASCADE programme. The meeting also noted IATA's policy on ADS-B presented to the ADS-B Seminar.

Security Concern

6.17 The meeting noted the concerns as indicated in the report regarding perceived security issues with ADS-B. The meeting noted that it had been included in the Tasks List of the ADS-B SITF to address this issue.

Note of appreciation

6.18 The meeting expressed its appreciation and gratitude to the Korean Civil Aviation Authority (KCASA) and the Incheon International Airport Corporation (IIAC) for hosting the ADS-B Seminar, the excellent arrangements made for the meeting and for all activities organized during the meeting.

Time and Venue of Next Meeting

6.19 An ADS-B Study and Implementation Task Force Working Group meeting is scheduled to be held in October or November 2007 and the next meeting of ADS-B Study and Implementation Task Force is scheduled to be held in April or May 2008.

Regional Surveillance Strategy for Asia/Pacific Region

6.20 The meeting recalled the Decision 17/27 of APANPIRG which had tasked CNS/MET Sub-group to refine the Surveillance Strategy for Asia/Pacific Regions for consideration by APANPIRG/18 meeting.

6.21 The meeting reviewed the draft Surveillance Strategy prepared by the Secretariat based on the developments and information available. Accordingly the meeting developed the following Draft Conclusion for consideration by APANPIRG/18 meeting:

Draft Conclusion 11/23 - Surveillance Strategy for Asia/Pacific Region

That, the Surveillance Strategy for Asia/Pacific Region provided in **Appendix S** to the Report be adopted and published.

Automatic Dependent Surveillance – Broadcast (ADS-B) USA Roadmap

6.22 United States informed the meeting of the Programming Plan for the deployment of Automatic Dependent Surveillance – Broadcast (ADS-B) across U.S. National Airspace System (NAS). It was informed that ADS-B has been identified as the surveillance solution which can increase safety, capacity and efficiency of air travel in USA. The presentation included the schedule for implementation of ADS-B in USA. It was mentioned that the schedule had been worked out in such way that the implementation of ground segment, the air segment and regulatory frame work are all synchronized.

Agenda Item 7: Aeronautical electromagnetic spectrum utilization:

1) review results of the Second Regional Preparatory Group (RPG) meeting for WRC-2007;

2) review result of the Fourth APT Regional Preparatory Group Meeting

Regional Preparatory Activities for WRC-2007

7.1 International Telecommunication Union (ITU) organizes World Radiocommunication Conferences (WRC) to review and if necessary revise the Radio Regulations, the international treaty governing the use of the radio-frequency spectrum. The decisions taken in these conferences affect the radio frequency spectrum availability for civil aviation use. Next WRC is scheduled to be held in Geneva from 22 October to 16 November, 2007.

Asia-Pacific Telecommunity

7.2 Asia-Pacific Telecommunity (APT) is developing the Regional Common Position on WRC-2007 agenda items and has conducted four meetings so far. ICAO position supporting the interests of civil aviation was presented in the APT Conference Preparatory Group (APG) Meeting for WRC2007 held in November 2003, February/March 2005 and February 2006. The fourth meeting was held from 9 to 12 January 2007. The meeting was attended by 308 participants which included 15 participants from civil aviation representing 7 civil aviation administrations. ICAO observer in the meeting presented 7 information papers defending the civil aviation interests and ICAO position on various WRC-2007 agenda items. Each agenda item of WRC-2007 Conference was discussed at length and some draft regional common position or joint proposals were developed. The fifth and the last APG 2007-5 meeting was conducted by APT in the Republic of Korea during the same week the CNS/MET Sub-group Meeting was held.

Regional Preparatory Group Meeting

7.3 In line with the APANPIRG Conclusion 17/30, Second ICAO Regional Preparatory Group (RPG) meeting was held in Bangkok from 15 to 17 January, 2007 to work out an action plan to support ICAO position on the agenda points for the conference. The objective of the meeting was to provide necessary support to aviation experts in the Asia/Pacific Region in preparation for the fifth APT Preparatory Group Meeting for WRC–2007 (APG-2007-5) and also to finalize preparation for WRC– 2007. The meeting was attended by 20 participants from 13 States. Meeting discussed actions taken by 43rd DGCA Conference and APANPIRG/17 and the role of APT in this matter. The meeting also reviewed the draft updates to ICAO position developed by the ACP Working Group F for refinement of the ICAO Position in light of comments received from States and International Organizations and outcome of Aeronautical Communication Panel (ACP) and Spectrum Subgroup of Navigation Systems Panel (NSP) discussions. In addition to reviewing ICAO position on individual agenda items, the meeting developed materials in support of ICAO positions with respect to the APG 2007-4, CITEL, CEPT positions related to different methods suggested for allocation of frequency bands. The meeting developed this proposal for submission by Aviation Administrations to the Regional Telecommunication Organizations on various agenda items. The RPG/2 recommendations encouraged Aviation Administrations to make arrangements to participate in APT APG 2007-5 and WRC-2007 Conference and to utilize RPG/2 developed proposal during consultations with the respective Radio Regulators for inclusion of such materials in support of ICAO position in the State proposal.

7.4 Secretariat presented the updated ICAO position approved by the ICAO Council on WRC-2007 agenda items. It was informed that at the time when ICAO position on WRC-2007

Agenda Items was approved by the Council on 14 June 2005, studies were going on in the Navigation Systems Panel (NSP) and Aeronautical Communication Panel (ACP), in ITU and in regional telecommunication organizations, in particular on the protection of the microwave landing system (MLS) from interference, as well as assessment of spectrum required for future communication systems. The ICAO studies were completed by the end of 2006 and the position was updated accordingly. This updated position was reviewed by ANC on 20 February 2007 and approved by Council on 28 May 2007. The major changes made in the updated ICAO position include:

i) Agenda Item 1.5 'To consider spectrum requirements and possible additional spectrum allocation for aeronautical telecommand and high-bit rate aeronautical telemetry, in accordance with Resolution 230 (WRC- 2003);

ii) Agenda Item 1.6 'To consider allocation for the aeronautical mobile (R) service in parts of the bands between 108 MHz and 6 GHz, in accordance with Resolution 414 (WRC – 03) and to study current satellite frequency allocations that will support the modernization of civil aviation telecommunication systems, taking into account Resolution 415 (WRC – 03)' and

iii) Agenda Item 7.2 'To recommend to the Council items for inclusion in the agenda for the next WRC, and to give its views on the preliminary agenda for the subsequent conference and on possible agenda items for future conferences, taking into account Resolution 802 (WRC-2003).

Agenda Item 8: Implementation of the World Area Forecast System (WAFS)

1) review the outcome of WAFSOPSG/3 and SADISOPSG/12 meetings
2) review the status of implementation of ISCS and SADIS
3) review the status of implementation and utilization of the WAFS products

8.1 Review the Outcome of WAFSOPSG/3 and SADISOPSG/12 meetings

8.1.1 Under this agenda item, the meeting reviewed the executive summaries of the 3rd Meeting of WAFSOPSG, held at the ICAO Regional Office, Paris, France from 26 to 29 September 2006, and the 12th Meeting of SADISOPSG, held at the ICAO Regional Office, Bangkok, Thailand from 4 to 6 June 2007, which are available from the WAFSOPSG and SADISOPSG websites (http://www.icao.int/anb/wafsopsg/ and http://www.icao.int/anb/sadisopsg/).

8.2 Review the status of implementation of SADIS and ISCS/2

SADIS developments

8.2.1 The expert from the UK informed the meeting on the SADIS developments since CNS/MET SG/10. The following developments were highlighted:

a) Approved SADIS users who have internet capabilities, but do not have an active SADIS FTP account, were invited to contact the SADIS Provider State seeking access to the service. Details could be found in the SADIS FTP Service document available on the SADISOPSG website or through their State Met Authority;

b) All approved SADIS workstation vendors have software that can visualize the PNG formatted SIGWX charts and BUFR encoded SIGWX data, including the revised BUFR depiction scenario for jetstream depth. Users who cannot visualize these products were encouraged to contact their workstation/software vendor and obtain a software upgrade that includes these capabilities.

c) The SADIS Provider State, on behalf of ICAO, has completed a second evaluation of WAFS/SADIS workstation software in 2006. Eight WAFS visualization systems can now be considered compliant to the SADISOPSG software criteria. Details of these systems and the results obtained from the latest software evaluations are available from URL: www.metoffice.gov.uk/sadis/software/index.html. Users are invited to study the results of the software evaluations and consider using this information as a component to their future procurement processes for new or upgraded workstation software.

d) A Trust Fund was established by WMO to assist Least Developed Country (LDC) Members to ensure that their NMHS has sustainable access to WAFS products by the most appropriate means. The Trust Fund will be used to assist LDC Members to meet the target date of 31 December 2008 for the replacement of first generation SADIS installations, where all other reasonable means have been demonstrably exhausted, LDC Member States seeking more information about the Trust Fund should contact the WMO for further information.

SADIS strategic assessment tables

8.2.2 The meeting reviewed the draft Strategic Assessment Tables, 2007-2011, for Asia and agreed to forward the tables to SADISOPSG by adopting the following Decision:

Decision 11/24 – SADIS Strategic Assessment Tables

That, the Asia SADIS Strategic Assessment Tables, given in **Appendix T** to the Report, be adopted and forwarded to the SADISOPSG for planning the future SADIS bandwidth requirements.

8.2.3 The meeting pointed out that the projected OPMET data volumes would be affected by Amendment 74 to Annex 3 regarding TAF and SPECI which would become applicable in November 2008. The expert from the U.K. was requested to take this into consideration in updating the SADIS Strategic Assessment Tables next year. The meeting also noted that there was currently no plan by States in the Asia/Pacific Region to disseminate graphical advisories and SIGMETs in BUFR format.

ISCS developments

8.2.4 The meeting was informed of the findings of the annual ASIA/PAC survey of the operational efficacy of the ISCS/2 broadcast. The ICAO Secretariat, in consultation with the ISCS Provider State, distributed a questionnaire to the ISCS user States in the Region. The results from the survey were made available to the ISCS Provider State for the purpose of gauging the efficiency of operations and to identify problems. By the beginning of May 2007, 8 States out of 19 States under the ISCS/2 footprint had provided input to the survey.

8.2.5 From the survey results, the ISCS broadcast in the ASIA/PAC Region was considered generally meeting the operational requirements during the period under review. To improve the communication with the users and thus enhance the future surveys, the expert from the U.S. requested that the ISCS user States be invited to validate the operational points of contact for ISCS. It was also suggested that a list of the ISCS focal points should be maintained on the Internet. The meeting formulated the following draft Conclusion:

Draft Conclusion 11/25 – Update of ISCS Operational Focal Points

That,

a) ICAO Regional Office request ASIA/PAC ISCS user States to update the list of ISCS operational focal points shown in **Appendix U** to the Report; and

b) the ISCS provider State maintains the list of ISCS operational focal points on the ISCS website.

Note: The ISCS webpage is accessible at: http://www.weather.gov/iscs/

8.2.6 The expert from the U.S. presented the preliminary draft version of the ISCS User Guide and pointed out that the appendix on FTP access was still under preparation since the work to enhance the user interface of the ISCS FTP access had not yet been completed.

WAFS developments

8.2.7 The experts from the WAFCs presented a summary of recent and forthcoming developments to the WAFS. The following were highlighted:

a) Users were encouraged to regularly review the performance indicator information on the Internet (http://www.metoffice.gov.uk/icao/index.html and http://www.emc.ncep.noaa.gov/gmb/icao/ncep_scores.html), to access the WAFS Change Notice Board (http://www.icao.int/anb/wafsopsg/) and information on the backup test schedule and chronology of recent events on a regular basis;

b) Users should contact their workstation supplier to identify whether an update/upgrade of the visualization software and/or changes in working practices would be required to accommodate the upcoming changes in relation to: (i) update to the depiction of features on WAFS SIGWX tests (7 November 2007), (ii) Amendment 74 changes to ICAO Annex 3 (7 November 2007); and (iii) the advancement of the lead time of issuance of WAFS SIGWX forecasts (February 2008);

c) Users were advised to adopt the use of the BUFR encoded SIGWX data at the earliest opportunity, and utilize the PNG SIGWX charts as a backup to BUFR, noting in particular that the PNGs might not be available after 2010;

d) Users are also encouraged to monitor the transition plan from GRIB1 to GRIB2 WAFS data, the development of the new gridded products, including the proposed establishment of regional seminars, and the progress of high-resolution data, through the WAFSOPSG.

In view of the implications of the above-mentioned changes to WAFS users, the information presented by the WAFC Provider States is included in **Appendix V** to the Report.

8.3 Review the status of implementation and utilization of the WAFS products

Regional progress

8.3.1 The meeting reviewed the progress of WAFS implementation in the Asia/Pacific Region against the “Indicative Timetable for Implementation of WAFS” given in the “ASIA/PAC WAFS Implementation Plan and Procedures”. As regards the transition to BUFR coded SIGWX forecasts by States and removal of T4 facsimile SIGWX products from the satellite broadcast, the meeting considered that these tasks have been completed but the status of States’ use of BUFR encoded SIGWX forecasts would need to be monitored.

8.3.2 The meeting also reviewed the follow-up action to APANPIRG Conclusion 17/35, in which the Secretariat and WAFS/I TF extracted information on the implementation of SADIS 2G equipment from the results of the Assessment of the Operational Efficacy of the SADIS Broadcast 2006-2007, and supplemented it where necessary by information surveyed from States via emails in early July 2007. The latest status of States’ implementation of SADIS 2G in the Asia/Pacific Region is given in **Appendix W** to the Report. As the CNS/MET SG meeting next year would only be several months away from the transition deadline of 1 January 2009, the Secretariat and WAFS/I TF should repeat these efforts to provide an update of the status for CNS/MET SG/12.

8.3.3 The meeting noted that, in the "ASIA/PAC WAFS Implementation Plan and Procedures", the TCACs were encouraged to monitor the WAFS SIGWX forecasts that cover their areas of responsibility and advise the appropriate WAFC to ensure the accurate inclusion of the tropical cyclone symbol. The meeting considered that such close coordination between the TCACs and WAFCs would contribute to the improvement of the accuracy of the WAFS SIGWX forecasts as well as the harmonization between the forecasts of the two WAFCs, TCAC advisories and TC SIGMETs. It was agreed that a provision for the WAFCs to establish and maintain contact with the TCACs for the exchange of information on tropical cyclones in order to coordinate the inclusion of information on tropical cyclones in the SIGWX forecasts should be proposed for inclusion in Annex 3 in a manner similar to the existing provision on the coordination between the WAFCs and VAACs (Annex 3, 3.2.1 f). In this connection, the meeting formulated the following draft conclusion:

Draft Conclusion 11/26 – Co-ordination between WAFCs and TCACs

That, the WAFSOPSG be invited to consider including a provision in Annex 3 requiring the WAFCs to establish and maintain contact with the TCACs in order to harmonize the information on tropical cyclones in the WAFS SIGWX forecasts and the TCAC advisories.

8.3.4 In the light of the above discussions, and noting in particular the significant number of WAFS developments in the next few years, the meeting updated the ASIA/PAC WAFS Implementation Plan and Procedures, work programme and composition of the WAFS/I TF. As regards the composition of the WAFS/I TF, the meeting also agreed that the States should be invited to update the nomination of experts to serve in the TF. The meeting formulated the following Decision:

Decision 11/27 – ASIA/PAC WAFS Implementation Plan and WAFS/I TF

That,

a) the ASIA/PAC WAFS Implementation Plan and Procedures, work programme and composition of the WAFS/I TF be amended as shown in **Appendix X** to the Report; and

b) the States participating in the WAFS/I TF be invited to update the nomination of experts to the Task Force.

Other issues related to WAFS implementation

8.3.5 Hong Kong, China presented a user's feedback by a major airline operating polar flights regarding the accuracy of the WAFS temperature forecast over the polar region of the northern hemisphere. During the past winter, a flight encountered a sudden increase in temperature, and a corresponding loss in aircraft performance, over the polar region. This was believed to be caused by a sharp temperature inversion near the tropopause. The event was analyzed in consultation with WAFC London and the finding indicated that even if the model was perfect and was able to forecast the strong temperature inversion, the sharp change in temperature (which might occur over a vertical scale of only a few hundred feet) was unlikely to be identifiable from the WAFS GRIB forecasts due to the coarse vertical resolution. Additional vertical levels in the WAFS GRIB forecasts near the tropopause would help reveal the sharp temperature gradient if the numerical model forecasts were accurate. The meeting therefore formulated the following draft conclusion to address the issue:

Draft Conclusion 11/28 – Improvements of WAFS temperature forecasts near the tropopause over the polar regions

That, the WAFSOPSG be invited to consider ways to improve the provision of WAFS temperature forecasts near the tropopause over the polar regions.

8.3.6 The expert from Hong Kong, China also provided some initial observations on the gridded forecasts of icing and turbulence provided by WAFC London on a trial basis. Further evaluation of the trial forecasts, with reference to aircraft reports where possible, and training on utilization and interpretation of the products are considered important steps leading to the eventual operational use of these new products.

Agenda Item 9: Exchange of OPMET Information:

1) review report of OPMET/M TF/5 Meeting
2) review regional requirements for OPMET information (FASID Tables)
3) regional planning for BUFR coded OPMET information

9.1 **Fifth Meeting of the OPMET Management Task Force (OPMET/M TF/5)**

9.1.1 The Fifth Meeting of the ASIA/PAC OPMET Management Task Force (OPMET/M TF/5) of the CNS/MET Sub-group of APANPIRG was held in Bangkok, Thailand from 6 to 8 June 2007. The meeting was attended by 22 experts from Australia, China, Hong Kong China, India, Japan, Malaysia, the Russian Federation, Singapore, Thailand and the United States. The meeting was attended part time by Dr. Olli Turpeinen, C/MET, ICAO HQ, Montreal; Dr. Herbert Puempel, Chief Aeronautical Meteorology Unit, WMO, Geneva; Mr. Mike Williamson, representative of the EUR BMG and the SADIS Gateway, London; and Mr. Hans-Rudi Sonnabend, expert from IATA.

9.1.2 OPMET/M TF/5 Meeting reviewed the List of Action Items adopted by the OPMET/M TF/4 meeting. The List contained 9 major tasks in 5 implementation fields and 23 sub-tasks. All tasks were relating to the ICAO Strategic Objectives “A – Safety” and “D – Efficiency”. It was identified that 16 tasks have been completed and 7 were ongoing. Detailed information on the status of the tasks formulated by the fourth meeting, together with the new tasks agreed by the fifth meeting, is available in the full report of OPMET/M TF/5 meeting posted on the ICAO APAC website:
http://www.icao.or.th/meetings/2007/opmet_tf5/reportOPMET5.pdf .

9.2 Current status of OPMET exchange in the Region *OPMET data shortfalls*

9.2.1 The group noted with concern that, despite the overall improvement of OPMET data availability from the States in the Region, some METAR and TAF shortfalls persisted. Problems have been identified with the bulletins from the South-West Pacific Island States which were compiled by Nadi RODB, missing METAR from a number of AOP aerodromes in Indonesia, irregular OPMET data from Cambodia and Myanmar during night time.

9.2.2 Noting the importance of the regular provision of METAR and TAF for safety and efficiency, the group agreed that the lack of OPMET information from AOP aerodromes should be included in the APANPIRG List of Deficiencies and formulated the following draft conclusion:

Draft Conclusion 11/29 - MET Deficiencies Related to OPMET Data Shortfalls

Recognizing the importance of regular provision of OPMET data for the safety and efficiency of the air transport operations, systematic data shortfalls identified through the OPMET monitoring procedures be considered as deficiencies and added to the APANPIRG list of deficiencies with “urgent” priority.

9.3 **Operation of Regional OPMET Data Banks (RODB)**

First RODB Coordination Meeting

9.3.1 The group was informed of the outcome of the first RODB Coordination Meeting which was held in Singapore, Changi Airport, from 9 to 10 April 2007. The meeting was attended by experts from RODBs Bangkok, Tokyo and Singapore and ICAO Regional Office. The RODB coordination meeting reviewed the operation of the data banks, measures to resolve the existing deficiencies related to the availability of OPMET data, harmonization of the OPMET data on the

SADIS and ISCS broadcasts. The meeting concentrated on the methods for monitoring the OPMET exchange at the RODBs and reviewed the examples presented by RODB Singapore. The meeting developed further the methodology for regular monitoring of the OPMET exchange by the RODBs by using the availability, regularity and compliance indices as performance indicators.

New developments at RODBs

9.3.2 Singapore presented information about their plan of introducing a new service – web access to the RODB. This came in addition to the ftp service which had been introduced after the OPMET/M TF/5 meeting. The web access will be through a new user-friendly interface; access would be provided through on-line registration. It was clarified that the procedures for granting access to this new service would follow the same rules as for the access through AFTN. The plan was to start the new service in September 2007. The group congratulated RODB Singapore for continually searching innovative methods to provide improved services to the users.

9.4 Status of Inter-Regional Exchange

Update on inter-regional exchange by IROG Singapore

9.4.1 Singapore presented statistics of the service messages requesting missing data sent by SADIS Gateway Operator between January and May 2007. The number of such messages varied between 9 and 30 per month and the number of missing reports was between 9 and 37. These figures were considered quite reasonable in view of the large volumes of data sent daily by Singapore to London. Another analysis carried out by IROG Singapore showed that a number of SIGMET bulletins have been rejected by the SADIS Gateway due to different types of formatting errors. The meeting felt that the majority of these errors were caused by the lack of quality control procedures at the origin of the messages.

9.4.2 The meeting was informed that since June 2006, 13 new or amended bulletins (seven SA, four FT and two FC) have been included in the inter-regional exchange. All these changes have been announced through METNO messages sent via AFTN.

Harmonization of OPMET data on SADIS and ISCS

9.4.3 The meeting recognized that the OPMET data disseminated through the two satellite broadcasts, SADIS and ISCS, were different. A number of ASIA/PAC bulletins have been recompiled at Washington and distributed on the ISCS under different WMO header and different bulletin content. As a result, not all ASIA/PAC OPMET information sent to Washington was available on ISCS. It was emphasized that Annex 3 requirements related to the two satellite broadcasts were identical and it was expected that the same global OPMET data sets should be available on both SADIS and ISCS.

9.4.4 The meeting was informed that the Washington Data Bank did recompile the bulletins into collectives due to local procedures and requirements from the users. However, it was agreed that the ISCS broadcast as an international service should provide all required OPMET data. Concerns were expressed that during the recompiling at Washington DB the code words “METAR” and “TAF” at the beginning of the messages have been cut off and this created processing problems for the RODBs.

9.4.5 The meeting agreed that Washington DB should examine the existing formatting discrepancies and ensure dissemination on ISCS of all ASIA/PAC OPMET bulletins through coordination with RODB Tokyo and Singapore. The following draft conclusion was formulated in this regard:

Draft Conclusion 11/30 – Harmonization of the content and format of Asia/Pacific OPMET data on the ISCS broadcast

That, the ISCS Provider State, in coordination with RODB Tokyo and RODB Singapore, be invited to consider harmonizing the bulletin format and the content of the OPMET information on the ISCS broadcast in order to ensure that all ASIA/PAC OPMET data relayed to Washington Data Bank is disseminated by the ISCS broadcast.

9.4.6 Further harmonization of the OPMET information on the SADIS and ISCS broadcasts should be achieved by sending all notifications of changes to the ROBEX bulletins via e-mail from the Regional Office and via AFTN METNO messages issued by the ROBEX centres. To ensure this, the procedure in the ROBEX Handbook would be amended by adding the AFTN addresses of London and Washington in the distribution list for METNO messages.

9.5 New requirements for OPMET information (incl. Amendment 74)

9.5.1 The meeting discussed the necessary preparations to be carried out by the ROBEX centres and RODBs to ensure timely implementation of the changes in Amendment 74 to Annex 3. It was realized that most of the changes were straightforward, however, the changes to the new provisions related to TAF (the change of the period of validity and the new requirement for only one TAF valid for the aerodrome at any time) were serious and would affect the current ROBEX bulletins and related procedures. It was clarified in this regard that all changes related to the TAF would become applicable on 5 November 2008 and by that time the corresponding changes to the TAF code in the WMO Manual on Codes would be introduced.

9.5.2 It was recognized that the changed TAF provisions would affect the procedures for VOLMET broadcasts. Currently Annex 3 specified that 9-hr TAF should be used in the VOLMET broadcasts, however, this provision has been removed in Amendment 74. The concern was that if a 24 or 30-hr TAF was to be included in VOLMET, it would create problems due to the length of these TAFs and the limited transmission time for VOLMET. It was explained in this regard that there was a global trend towards replacing the VOLMET broadcasts with the D-VOLMET where the length of the TAF would not be a problem. The group felt that the regional requirements for HF VOLMET broadcasts should be reviewed including the requirements for the period of validity of TAF.

9.5.3 States would have to decide, in consultation with the airline users, appropriate TAF period of validity for each international aerodrome. IATA was working on aligning their requirements with the new provisions. It was realized that as a result of this process the current structure of ROBEX bulletins, including the co-existence of FC and FT TAF for the same aerodrome, was to be changed. OPMET/M TF had decided to form a project team to study the forthcoming changes and coordinate the future TAF ROBEX bulletins in time for the applicability date in November 2008. The members and work programme of the TAF Team should be coordinated by correspondence.

9.5.4 The meeting agreed that the preparations for the forthcoming changes in the TAF provisions should be initiated as soon as possible. The other organizations involved in the process, WMO and IATA, should assist in this process in order to ensure timely implementation of these provisions. The meeting formulated the following draft conclusion:

Draft Conclusion 11/31 – Implementation of Changes to TAF Provisions in Amendment 74 to Annex 3

Recognizing that changes to the provisions for TAF in Amendment 74 to Annex 3, which will become applicable on 5 November 2008, will require significant changes to the States' national practices and to the ROBEX TAF exchange:

a) the OPMET management Task Force should conduct a regional study to identify the States' plans for implementation in order to ensure timely update of the related ROBEX TAF procedures;

b) WMO should be requested to expedite the adoption of the necessary changes to the TAF code; and

c) IATA should be requested to provide the new users' requirements for the TAF period of validity for all aerodromes in FASID Table MET 1A as soon as possible.

Note: The regional study to be conducted by the OPMET/M TF should include identification of the requirements for TAF in the VOLMET broadcasts.

9.6 ROBEX Handbook

9.6.1 The revised version, January 2007, which included the changes introduced by the OPMET/M TF/4 (February 2006) was posted on the web site. This version included the new procedures relating to the quality control and monitoring, including the performance indicators for availability and regularity, as well as the bulletin updating procedure. OPMET/M TF/5 meeting reviewed and updated the ROBEX Tables for METAR and TAF (FT and FC). The updated tables will be posted on the web site. Tables for SIGMET and advisories have been removed from the ROBEX Handbook to avoid duplication with the Regional SIGMET Guide.

9.7 OPMET related FASID tables

9.7.1 The meeting reviewed the final draft of the new amendment for FASID Table MET 1A and some updates have been provided by the participants. The amendment proposal will be circulated to States soon after the meeting. The Secretariat informed that FASID Table MET 2A will be proposed for deletion since the procedures it was referring to were outdated and there was no need for such a table any more. FASID Table MET 2B was to be replaced by a very simple table indicating the requirements for distribution of SIGMET to all RODBs.

9.8 OPMET monitoring and quality control procedures

Singapore and SADIS Gateway OPMET monitoring exercises in 2007

9.8.1 As agreed by the RODB Coordination meeting, RODB Singapore carried out a limited monitoring exercise using first half of May 2007 data for calculating the threshold values and second half of May for actual monitoring. The results of this exercise are in **Appendix Y** to the Report.

9.8.2 The monitoring results of RODB Singapore have been compared with the results of monitoring exercises conducted by the EUR BMG and the SADIS Gateway carried out during the first half of February 2007. The results are presented in the graphs in **Appendix Z** to the Report.

9.8.3 It was noted that the SADIS Gateway monitoring was carried out over all aerodromes in SUG Annex 1 (both AOP and non-AOP), while the Singapore monitoring was carried out over the ROBEX Tables, which contain some but not all non-AOP aerodromes listed in SUG Annex 1. Also, the SADIS monitoring was presented with only two indices – availability and regularity. Nevertheless, the results of both monitoring exercises were quite similar and indicated that the achieved performance levels for the Asia/Pacific OPMET data needed improvement, in particular for METAR. The very low FC performance results were not considered as a major problem since there was no requirement in the ASIA/PAC Regional ANP for regular exchange of short TAF.

9.8.4 The following improvement measures were included in the future OPMET/M TF work programme:

- Pursue further specific data shortfalls with the States concerned (PAC Region and Indonesia were specifically mentioned);

- Review the SUG Annex 1 requirements and identify aerodromes that have to be deleted after coordination with the States concerned. This related to non-AOP aerodromes that were known not to produce any OPMET data and therefore should be excluded from SUG Annex 1.

SIGMET tests monitoring

9.8.5 The meeting reviewed the results of the SIGMET tests carried out in the ASIA/PAC Region in January and February 2007. The test results were discussed in detail under agenda item 10.

9.8.6 The meeting was presented with the results of a 14-day SIGMET monitoring carried out by the SADIS Gateway Development Team which indicated only 29% compliance with the Annex 3 requirement for inclusion of the FIR location indicator before the FIR name in the beginning of the SIGMET body text. The meeting noted from the presented monitoring results that a large number of SIGMET from ASIA/PAC Region was non-compliant with Amendment 73. It was informed that SADISOSG/12 meeting has already decided that States should be reminded to follow strictly the SIGMET format specified in Annex 3 (SADISOPSG 12/11 refers).

Plans for future SIGMET tests and other actions aimed at improving the SIGMET services

9.8.7 The meeting expressed full support to the continuous efforts for improving the availability of SIGMET by the ASIA/PAC States and thanked all those involved in the organization of the SIGMET tests.

9.8.8 It was noted that there had not been significant improvement regarding the availability of test SIGMET during the 2007 tests. Problems persisted with a number of States not taking part. The Secretariat informed in this regard that a regional performance objective had been set up to achieve 95% availability of test SIGMETs. To resolve the existing problems it was necessary to analyze the reasons for the shortfalls. In some cases, the States concerned had no capacity of providing SIGMET service (Cambodia, Nauru, Solomon Islands, Lao PDR and DPR Korea) and they should be advised to delegate the SIGMET service to a neighboring State under bi-lateral agreement.

9.8.9 After reviewing the results of all monitoring and validation exercises carried out recently, the group felt that there existed a number of discrepancies from the standard formats and persisting syntax errors. It was assumed that many of these errors were caused due to the lack of basic quality control procedures at the origin of the OPMET messages. At many stations OPMET messages were inserted manually directly on the AFTN terminal and sent without any control. Erroneous messages were causing serious problems at the RODBs and user's processing systems and resulted in discarding OPMET messages which could have negative effect on flight safety and efficiency. Therefore, the meeting felt that States should be reminded their obligations for exercising systematic quality control on the OPMET information promulgated to international exchange as specified in Annex 3, 2.2.4 and 2.2.5. The group formulated the following draft conclusion:

Draft Conclusion 11/32 – Enhancing Quality Control on OPMET Information by States

That, States be urged to undertake systematic monitoring and quality control of the OPMET information promulgated for international exchange in accordance with Annex 3, 2.2.4 and 2.2.5, to ensure full compliance with specified formats and contents of the messages, as well as, with the prescribed filing and transmission schedules.

9.9 Transition to BUFR coded OPMET information

9.9.1 The group was informed that the concerns related to the BUFR migration had been referred to WMO which considered them at the recent Commission for Basic Systems (CBS) and Commission for Aeronautical Meteorology (CAeM) sessions (2006) which felt that the issues should be urgently addressed by "an inter-Commission dialogue between the relevant expert teams (ET) of CBS and CAeM". As a result, the migration to BUFR code was discussed recently at two meetings: an ad-hoc WMO/ICAO meeting on the planned migration of OPMET data to table-driven code forms (Geneva, 13 April 2007), and the meeting of the WMO CBS Expert Team (ET) on Data Representation and Codes (Darmstadt, April 2007).

9.9.2 Alternative solutions, i.e. the possibility of replacing the traditional alphanumeric code forms (TACF) by an industry standard (e.g. XML code form), in lieu of the BUFR code form, were currently being considered. The ICAO position was that a major change like this should be subject to a business case. It appeared that the introduction of an industry standard format, such as the XML, would be cost-efficient when combined with the increased use of the Internet and the decommissioning of some of the outdated and slow AFTN lines, the maintenance of which was very costly and inefficient.

9.9.3 The further work on the issue would be undertaken by a CBS Expert Team which would set up a pilot project for an end-to-end exchange of METAR/SPECI and TAF in XML format from an aerodrome MET office to an aviation end user to evaluate the feasibility and efficiency of the XML code in an operational environment. This task should be carried out in 2008.

9.9.4 In view of the above developments, the group was informed that the MET Section ICAO HQ would prepare a WP for the 176th Session of the Air Navigation Commission (ANC) to seek the Commission's concurrence to suspend the work on BUFR migration until such time when the results of the pilot project concerning the use of the XML in an operational environment are made available. Consequently, the work on the regional planning for the transition to BUFR-coded OPMET data which has been pursued by the OPMET/M TF since 2005 should be put on stand-by until further advice from ICAO HQ.

9.10 **Issues raised by States**

9.10.1 Singapore expressed concern that following Amendment 74 the current practice of Singapore of issuing 9-hour TAF for VOLMET broadcast would have to cease. The 24-hour TAF would then be used for VOLMET instead. To ensure a smooth implementation, Singapore conducted trial broadcasts using 24-hour TAFs for a test period.

9.10.2 The Singapore Changi Airport VOLMET broadcast included a number of METARs, Singapore SIGMET and TAFs from Singapore, Malaysia and Indonesia. The messages coming via GTS/AFTN are converted by a Text-To-Speech engine (TTS) to speech with speech speed adjusted automatically to fit the 5-minute allotted time for the VOLMET broadcast. There were cases when the TAF and SIGMET messages were too long and the last TAF messages were truncated.

9.10.3 In view of the foregoing, the meeting was advised that the amended TAF provisions (including eventual cessation of the requirement for 9-hr TAF for VOLMET for some airports) would become applicable in November 2008 and by that time States would be provided with additional guidance on harmonized implementation based on the study to be conducted by the project team of the OPMET/M Task Force.

9.10.4 The meeting was informed about the plans of the Japan Meteorological Agency (JMA) to issue TAF four times a day with the period of validity of 27 hours, after November 2008. Current Short TAF (FCJP3* RJTD) with the period of validity of 9 hours would be abolished. It was explained that the reason for the selection of period of validity of 27 hours was related to the current capability of the meso-scale model used by JMA to provide numerical guidance for TAF. The meeting was advised in this regard that in the selection of the TAF period of validity due consideration should be given to the user's requirements.

Agenda Item 10: ICAO Advisory & Warning Systems:

1) review implementation of International Airways Volcano Watch (IAVW) including the outcome of IAVWOPSG/3 meeting
2) review implementation of tropical cyclone advisories and warnings
3) SIGMET related issues

Review of the outcome of the IAVWOPSG/3 meeting

10.1 The meeting reviewed relevant items included in the executive summary of the report of the IAVWOPSG/3 meeting held in Bangkok from 19 to 23 March 2007. The full report is available on: http://www.icao.int/anb/iavwopsg/meetings/iavwopsg3/report/. The meeting took note of the proposed amendment to the IAVW-related regional procedures in the FASID.

Information on the operations of VAAC Darwin

10.2 The meeting noted that a total of 452 Volcanic Ash Advisories (VAA) were issued by the Darwin VAAC over the 12 months July 2006 – June 2007. A large eruption from Rabaul volcano was the most problematic for aviation but showed that the volcano observatory was capable of providing an exceptionally good flow of information. A Gulfstream GII aircraft experienced a twin-engine flameout while flying over Papua New Guinea at 39,000ft on the 17 July 2006. The engine manufacturer has provisionally attributed the cause of the flameout to volcanic ash, presumably from an undetected high-level eruption from Manam.

10.3 The following implementation issues have been outlined:

- Monitoring of active volcanoes in the region is still patchy, and was expected to remain so for some years. Efforts were being made to improve the situation. The Australian Bureau of Meteorology and the Indonesian Centre of Volcanology and Geological Hazard Mitigation were conducting an AusAID funded project in Flores and surrounding islands to upgrade monitoring at 15 volcanoes. The United States, Italy, Belgium and other countries were also working with Indonesia, and Geoscience Australia was continuing its long partnership with Rabaul Volcanological Observatory in collaboration with the United States Geological Survey.

- Remote sensing challenges remained, despite the steady progress. It was emphasised that real-time pilot reporting and ground-based observations were fundamentally necessary to the successful operation of the IAVW. Strong efforts have been made to improve the number and timeliness of pilot reports, but to less-than-hoped-for effect.

- The situation with SIGMETs and NOTAMs appeared to be improving slowly, but communications remained a significant problem, particularly with Papua New Guinea.

- Promoting the issuance of SIGMETs was a major effort, with the VAAC undertaking liaison visits to MWOs in Port Moresby, Jakarta and Ujung Pandang.

Implementation of a volcano observatory notice for aviation

10.4 The meeting was informed of the progress in developing a template for the provision of information from the States' selected volcano observatories to the associated Area Control Centers (ACC), Meteorological Watch Offices (MWO) and Volcanic Ash Advisory Centers (VAAC). The form, Volcano Observatory Notice for Aviation – VONA, had been presented at the IAVWOPSG/3 meeting and would be included in Doc 9766, *Handbook on the International Airways Volcano Watch (IAVW) – Operational Procedures and Contact List.* Additional guidance on the use of the form would be developed to facilitate the use of the form by the selected volcano observatories.

Information about the 4th International Workshop on Volcanic Ash (VAWS/4)

10.5 The Fourth International Workshop on Volcanic Ash was held at the Rotorua, New Zealand from 26 to 30 March 2007, and was convened/sponsored by the World Meteorological Organization (WMO), hosted and co-sponsored by the Civil Aviation Authority of NZ (CAA) and co-sponsored by the Australian Bureau of Meteorology (BoM) and Meteorological Service of NZ Ltd (MetService). The objective of the Workshop was to improve the scientific aspects of the ICAO International Airways Volcano Watch (IAVW), including: the understanding and use of ground-based volcanic monitoring; detecting, analysing and tracking eruption clouds; and forecasting ash cloud dispersion. Detailed summary of the results is available on the WMO website: http://www.caem.wmo.int/moodle/course/view.php?id=27

Issues related to the operation of Tropical Cyclone Advisory Centres (TCAC)

10.6 The representative of Maldives raised an issue with the area of responsibility of TCAC New Delhi. Currently the southern boundary of the area of responsibility was 5 degrees North and did not cover the whole Male FIR served by the Meteorological Department of Maldives. This issue has already been raised at the WMO Tropical Cyclone Panel for the Bay of Bengal and Arabian Sea and it was expected that appropriate action would be taken to ensure better coverage of the Male FIR. The meeting was advised that the designation of the TCACs in the Regional Air Navigation Plan had been done in coordination with WMO and the area of responsibility of the TCACs had been determined based on the existing areas of responsibility of the RSMCs.

Regional SIGMET tests

10.7 The meeting was informed of the results of the third series of regional SIGMET tests conducted in January and February 2007 by the Task Force on Implementation of VA/TC advisories and warnings and the OPMET/M TF in coordination with the Regional Office. The tests were conducted as follows:

- test for SIGMET for volcanic ash (WV SIGMET) - 15 January 2007;
- test for SIGMET for tropical cyclone (WC SIGMET) – 22 January 2007;
- test for SIGMET for other weather phenomena (WS SIGMET) – 9 February 2007.

10.8 The meeting reviewed detailed information on the tests results presented by the Rapporteur of the VA/TC/I TF. The overall results were very similar to those of the test conducted in 2006 without significant improvement in terms of availability, which varied from 50 to 60% for the different type of SIGMET. It was recalled in this regard that the CNS/MET SG/10 meeting proposed a regional performance objective of 95% availability of the test SIGMET. Considering that this target level was yet to be achieved, the meeting agreed that the periodic SIGMET tests should continue in accordance with the developed regional procedures in the ASIA/PAC SIGMET Guide. The future tests would continue to be coordinated by the two task forces (VA/TC/I TF and OPMET/M TF) and the Regional Office.

SIGMET monitoring web page

10.9 The meeting was informed of the follow-up action on APANPIRG Conclusion 17/42 on the development of a web page for monitoring SIGMET availability in the ROBEX Scheme. APANPIRG invited Hong Kong, China in coordination with Singapore to develop such a web page to be used for real-time monitoring of the issuance of SIGMET and advisories in the Asia/Pacific Region.

10.10 The web page has been developed by the Hong Kong Observatory (HKO) and Singapore RODB arranged that all SIGMET and advisory bulletins are relayed to HKO for visualization on the web page. An on-line demonstration of the functionality of the webpage was presented. The meeting was advised that the access to the webpage would be through a digital certificate and username/password issued by the HKO on request by the MWOs and ROBEX centres. A State letter had been circulated to the Asia/Pacific States providing information on the webpage and the access procedures.

10.11 The meeting commended Hong Kong, China for developing an excellent tool for monitoring of SIGMET and advisories in the Region. It was expected that the webpage would be a very useful tool and would contribute to improving the issuance of SIGMET by the MWOs.

Regional SIGMET seminar

10.12 The meeting recalled that, as part of the efforts to improve the SIGMET service in the Region, CNS/MET SG/10 proposed that a SIGMET Seminar should be organized in 2007. APANPIRG/17 endorsed this proposal and adopted Conclusion 17/42 inviting ICAO in coordination with the WMO and the TCAC and VAAC provider States to organize the training seminar.

10.13 In February 2007, the Secretary General of ICAO wrote to the WMO and the TCAC and VAAC Provider States requesting their assistance in organizing the Seminar. As a result, the WMO agreed to provide financial support to participants from the developing States in the Region. The Provider States: Australia, Fiji, India, Japan and New Zealand took active part in the coordination and preparations for the seminar and provided key speakers. China and Hong Kong, China also strongly supported the seminar.

10.14 The SIGMET Seminar was held at the ICAO Regional Office from 11 to 13 July 2007. It was attended by 26 participants from 16 Asia/Pacific States and IATA. Representatives of three VAACs (Darwin, Tokyo and Wellington) and four TCACs (Darwin, Nadi, New Delhi and Tokyo) attended the Seminar. The WMO also participated through an on-line presentation from Geneva via Internet.

10.15 The main objective of the Seminar was to assist in improving the availability and quality of SIGMET information in ASIA/PAC Region, through:

- Enhancing the participants' awareness of the ICAO SIGMET provisions;
- Enhancing the knowledge of modern observing and forecasting techniques used in the SIGMET issuance;
- Receiving feed-back from States and discussing common issues identified;
- Strengthening the system of MWO focal points.

10.16 The meeting agreed that the SIGMET Seminar was a very successful training event and commended all presenters for the excellent presentations which would be made available on the ICAO APAC website to allow all States in the Region to benefit from this training event. The participants in the Seminar expressed their strong wish that such training events should be organized regularly to enhance the capacity of the States and assist in implementing the ICAO provisions on aeronautical meteorology.

10.17 The Seminar helped in receiving important feedback from States on common implementation problems which need to be addressed by ICAO. The list of identified issues is in **Appendix A1** to the Report. The meeting agreed that these issues should be brought to the attention of the new Meteorological Warnings Study Group (METWSG) under the Air Navigation Commission and formulated the following draft conclusion:

Draft Conclusion 11/33 – Issues related to Implementation Improvement of the SIGMET Provisions

That, the implementation issues identified by the ASIA/PAC SIGMET Seminar, listed in **Appendix A1** to the Report, be brought to the attention of the Meteorological Warnings Study Group (METWSG) for further study and development of additional guidance to improve the implementation.

Finalization of the SIGMET posters

10.18 The final drafts of the three SIGMET posters, which had been prepared by Hong Kong China, Australia and New Zealand as a follow-up of APANPIRG Conclusion 16/47, were presented. It was informed that further coordination would be carried out between the authors of the posters in order to harmonize the content and the graphic design and after a final review by the ICAO and WMO the posters would be produced and circulated to all States with MWO responsibilities.

New edition of the ASIA/PAC SIGMET Guide

10.19 Following the adoption of Amendment 74 to Annex 3 by the ICAO Council, a new draft edition of the ASIA/PAC SIGMET Guide prepared by the ICAO Regional Office was presented to the meeting. The following changes have been introduced:

- Changes brought up by Amendment 74:
  - Deletion of provisions for transonic and supersonic flights;
  - Period of validity – up to 4 hrs for WS SIGMET, up to 6 hrs for WC and WV SIGMET;
  - Deletion of all procedures related to OUTLOOK part of WC and WV SIGMET;
  - Small changes to the procedures for reporting “Position” of the phenomenon – addition of “LINE, “AT” and “WID”;
  - “RDOACT CLD” added to the list of phenomena for which SIGMET should be issued.

- Updates to Appendices and Tables:
  - New Appendix J containing the ASIA/PAC SIGMET Test Procedures
  - Updated Appendices A, B and C corresponding to FASID Table MET 1B, 3A and 3B.

10.20 The meeting agreed that the new edition ASIA/PAC SIGMET Guide should be published on the ICAO APAC web site as soon as possible after the CNS/MET SG/11 meeting to allow the MWOs in the Region to prepare in time for the implementation of the new and amended provision. The meeting the following the following draft conclusion in this regard:

Draft Conclusion 11/34 – New edition of the ASIA/PAC SIGMET Guide

That, the Fourth edition of the ASIA/PAC SIGMET Guide, as shown in **Appendix A2** to the Report, be published on the ICAO APAC website according to established procedures and the Regional Office urges States to implement the amended SIGMET provisions in time for the applicability date of Amendment 74 to Annex 3 (7 November 2007).

Amendment to MET part of the Asia and Pacific Regional ANP (Doc 9673)

10.21 The meeting noted that the changes to SIGMET and advisory provisions in Amendment 74 to Annex 3 would require changes to related regional procedures in the ASIA/PAC Basic ANP and FASID (Doc 9673). A draft amendment proposal prepared by Secretariat was reviewed in this regard.

10.22 The amendment to Part VI, Meteorology (MET) of the Basic ANP reflected the deletion of the requirement for outlook in the SIGMET for volcanic ash and tropical cyclones. The regional procedure on the period of validity of SIGMET has also become obsolete since Amendment 74 introduced a global standard on the SIGMET period of validity.

10.23 The proposed amendments to FASID Tables MET 1B, MET 3A and MET 3B were related to improving the information provided to States on the requirements for meteorological watch offices and the issuance of SIGMET.

10.24 The participants provided updates to the FASID Tables and agreed that the amendment proposals should be processed by the Regional Office. The following draft conclusion was formulated:

Draft Conclusion 11/35 – Amendment to the MET part of the ASIA/PAC Basic ANP and FASID (Doc 9673)

That, the amendment proposal to Part VI, Meteorology (MET) of the ASIA/PAC Basic ANP and FASID shown in **Appendix A3** to the Report, be processed in accordance with the established procedure.

Agenda Item 11: Other MET issues:

1) MET/ATM coordination
2) MET support for operations at aerodromes and terminal areas

Report of MET/ATM Task Force and preparation of a regional survey on ATM requirements for MET

11.1 As follow-up to the MET/ATM Coordination Seminar (2006) and subsequent Conclusion 17/43 of APANPIRG/17 the Task Force had focused on the development of a regional survey to help establish the requirements for meteorological information and services in support of air traffic management. A survey questionnaire has been developed by the Task Force with input from Air Traffic Management Authorities in Australia. The questionnaire was presented for review at the ATM/AIS/SAR SG/17 meeting, Bangkok, Thailand, 2 – 6 July 2007 and it was expected that the ATM experts would provide some inputs to improve the survey.

11.2 In presenting the draft survey document, the Rapporteur of the MET/ATM TF stressed on the importance of the meteorological information for the ATM which had been outlined in the ICAO Global ATM Operational Concept. It has been well recognized that the performance of many ATM system components were weather dependent and improved meteorological information would bring significant benefits to the ATM.

11.3 The draft survey questionnaire is presented in the **Appendix A4** to the Report. It has been designed to include many open questions in an attempt to get the ATM experts thinking broadly about which meteorological elements were currently used, how they were used and what could be done to improve on them, as well as identifying meteorological information currently not available which would be required for future initiatives. The meeting agreed to the format of the survey subject to the inclusion of further background and guidance to respondents. The survey is planned to be conducted prior to APANPIRG/18 meeting.

11.4 Concerns were expressed regarding the difficulties with obtaining a good response from the ATM experts that would allow defining a comprehensive set of new requirements for MET information in support of ATM. There was a need to develop better communication links with the ATM community. Therefore, it was suggested that the MET/ATM Task Force, which had been working so far only through correspondence, should consider conducting periodic meetings.

11.5 The meeting recognized that many meteorological services were lacking knowledge of the new ATM concepts and related new expectations for improved MET facilities and services. Further guidance and education was considered essential for the MET stakeholders in order to be a vital part of the new developments. It was suggested in this regard, that such guidance should be developed by ICAO and the following draft conclusion was formulated:

Draft Conclusion 11/36 – Developing guidance on the ATM requirements for MET services and facilities

That, ICAO be invited to extend the guidance material in Doc 9377, *Manual on Coordination between Air Traffic Services, Aeronautical Information Services and Aeronautical meteorological Services*, to cover new requirements for MET services and facilities emerging from the *Global ATM Operational Concept*, Doc 9854 and the *Global Air Navigation Plan*, Doc 9750.

Meteorological information and ATM coordination in New Zealand

11.6 The meeting was provided with an overview of the current arrangements between Meteorological Service of New Zealand Ltd (MetService) and Airways New Zealand (Airways), concerning MET/ATM co-ordination in New Zealand. The meeting noted that New Zealand had a well-established network for the collection and distribution of MET information to air traffic controllers, used for air traffic management in the two New Zealand FIRs (NZZC and NZZO). It was emphasized that regular meetings between management and operational staff of MET and ATM service providers would assist in maintaining the network as well as fostering the close co-operation and understanding that existed between the respective organizations and their staff.

Information on QMS for aviation weather services in Australia

11.7 The meeting was informed that in accordance with Annex 3 recommendations on quality assurance, the Australian Bureau of Meteorology has adopted a quality management (QM) approach to the delivery of aviation weather services. The initial scope of the QM initiative embraced the Aviation Weather Services National Policy Office located in the Bureau’s Head Office in Melbourne, the Sydney Airport Meteorological Unit (SAMU) and the Aviation Meteorological Unit in Sydney. The meeting was informed of the approaches used, the challenges and expected benefits of the establishment of QMS. It was anticipated that formal certification to compliance to the ISO 9001:2000 Quality Management Standard would be completed by September 2007.

Aviation forecaster competencies program and restructure of the aviation weather service in Australia

11.8 Information was also provided on the aviation forecaster competencies program recently established by the Bureau of Meteorology. Competencies provide the foundation for service-focused, operationally relevant training and reflect what a professional forecaster would be expected to do while exercising due care on the job. Forecasters, management and industry would benefit from this approach.

11.9 The Bureau has established an aviation weather services restructure project. The objectives of the project were to establish a more flexible, responsive, service focused, cost effective aviation weather service in Australia that would meet the growing needs of the aviation industry and the advances in technology; and to provide a world-class set of aviation weather services within ICAO and WMO guidelines.

LIDAR windshear alerting in Hong Kong, China

11.10 Hong Kong, China presented the latest developments of the LIght Detection and Ranging (LIDAR) Windshear Alerting System (LIWAS) of the Hong Kong Observatory (HKO) for automatic windshear detection at the Hong Kong International Airport (HKIA). The meeting noted the improvement in the performance of LIWAS using a refined algorithm in 2006 and the plan to deploy one LIDAR for each runway for further enhancement of the windshear alerting service for HKIA in late-2007/early-2008.

New forecasting services for mitigation of airport operations disruption

11.11 The meeting was informed that new forecasting services for mitigation of airport disruption and disaster risk reduction in relation to tropical cyclones were introduced at HKIA in 2007. In particular, forecasting of crosswind and turbulence, which were found to be the major weather factors disrupting airport operations in the past, were enhanced. An alert of these weather conditions would be provided to aviation users for planning and decision-making. At the same time, the traveling public would also be advised to check with the airlines before departing for the airport when such weather conditions were expected to cause significant disruption to flight operations. A website would be developed under a pilot project of the WMO Commission for Aeronautical Meteorology (CAeM) to demonstrate the benefits of such forecasts and services to the aviation stakeholders.

Airport thunderstorm and lightning alerts

11.12 Hong Kong, China briefed the meeting on the development of the Airport Thunderstorm and Lightning Alerting System (ATLAS) for HKIA. ATLAS utilizes lightning strikes detected by the Observatory's Lightning Location Information System and storm motion vectors provided by the nowcasting SWIRLS (Short-range Warnings of Intense Rainstorms in Localized System) developed by HKO. Based on ensemble methods, alerts would be generated and provided to airfield personnel whenever lightning strikes are forecast/detected over the airport. ATLAS products will be provided to the Airport Authority Hong Kong for trial use and evaluation starting mid-2007.

New aviation weather products provided by JMA

11.13 The Japan Meteorological Agency (JMA) was providing aviation weather information to Japan Civil Aviation Bureau (JCAB), airlines and the other customers. This year, JMA introduced more aviation weather information for the safety and efficiency of operations of those customers. New products were as follows: briefing information including forecasts of aerodromes where TAF were not issued, sequential forecast for aerodromes, significant weather charts of observation, analysis, and forecast for domestic airspaces and approach control areas.

Proposal for replacing the SI-unit for wind speed

11.14 China and Hong Kong, China presented a proposal on the use of the "metre per second" as a unit of wind speed in aeronautical meteorological service. It was pointed out that while WMO-No. 306 "Manual on Codes" specified three units ("km/h", "m/s" and "kt") for encoding wind speed in METAR/SPECI and TAF, the unit 'm/s' was not included in ICAO Annexes 3 and 5. Enabling the use of 'm/s', which was an SI coherent derived unit, would bring the following benefits: (a) consistency between ICAO and WMO standards; (b) eliminate the need for unit conversion for wind measuring equipment that already provides raw wind speed data in 'm/s'; and (c) precise wind speed thresholds of operational significance given in 'm/s' in ICAO Annex 3 to ensure accurate interpretation of wind speed data already available in 'm/s'.

11.15 The expert from IFALPA however expressed concerns on the adoption of "m/s" as a generally accepted unit of wind speed in addition to "km/h" and "knot" (see **Appendix A5** to the Report for IFALPA's position on the subject). In the ensuing discussion, it was pointed out currently there were several States using "m/s" as a unit of wind speed but none was using "km/h". It was noted that while the WMO codes provide for the use of m/s as may be determined by national decision, the current user requirement reflected in Annex 3 and Annex 5 is for wind speed to be indicated either in km/h or in kt. In this connection, China put forward an alternative proposal to replace "km/h" with "m/s" as the SI unit of measurement of wind speed in ICAO Annexes 3 and 5. Noting that this proposal would not affect the current use of "knot" as the alternative unit of measurement of wind speed, the following draft conclusion was formulated:

Draft Conclusion 11/37 - Replacing "km/h" with "m/s" as the SI unit of measurement of wind speed in ICAO Annexes

That, ICAO, in consultation with users, be invited to consider replacing "km/h" with "m/s" as the SI unit of measurement of wind speed in ICAO Annexes.

Aviation weather services in the Next Generation Air Traffic System

11.16 The delegate from the US informed the meeting about the latest version 2.0 of the Concept of Operations (ConOps), which has been released recently (13 June 2007). The ConOps provides a common vision of how the Next Generation Air Traffic System (NextGen) would operate in the 2025 timeframe and beyond. This included management of air traffic and airports to achieve greater safety and efficiency. The U.S. air transportation system was under significant stress, with demand in aircraft operations expected to increase to a point that the system would not be able to accommodate the growth. Current systems did not have the flexibility to provide flight information in real time. To meet the need for increased capacity and efficiency while maintaining safety, new technologies and processes were being planned for implementation.

11.17 It was well recognized that weather was a key component of this ConOps. NextGen was focusing on a major new direction in aviation weather information capabilities to help stakeholders at all levels make better decisions during all weather related situations. For NextGen, weather information had a core function – identify where and when aircraft can or cannot safely fly. These safe and efficient NextGen operations will be dependent on enhanced aviation weather capabilities based on three major principles:

- A common picture of the weather for all air transportation decision makers and aviation system users;
- Weather directly integrated into sophisticated decision support capabilities to assist decision makers;
- Utilization of Internet-like information dissemination capabilities to realize flexible and cost-efficient access to all necessary weather information.

11.18 Participants were encouraged to review the detailed information on the ConOps at http://www.jpdo.gov .

Agenda Item 12: Review CNS/ATM systems planning and implementation:

1) Key Priorities for CNS/ATM Implementation and Regional Performance Objective (PO)
2) review and update CNS/ATM Implementation Planning Matrix
3) CNS related issues
4) MET related issues

Under this agenda item, the meeting reviewed several working papers and information papers presented by States and the Secretariat.

Review the Report of RASMAG/7 Meeting

RVSM in the Western Pacific/South China Sea (WPAC/SCS) Area

12.1 The meeting noted that based on the collision risk estimates, the estimate of technical risks satisfies the agreed TLS values of not more than 2.5 x 10^{-9} fatal accidents per flight hour. However, the estimate of overall risk for RVSM in the Western Pacific/South China Sea area exceeds the agreed TLS values. The main cause contributing to this infringement is the significant number of operational errors, which are derived from the series of significant large height deviation (LHD) occurrences. RASMAG/7 noted that the latest safety assessment for the WPAC/SCS airspace had shown a dramatic reversal of the adverse trend.

High Number of Errors in ATC Transition Messages

12.2 RASMAG/7 recognized the value of ATS Interfacility Data Communications (AIDC) between ATS facilities in reducing the potential for ground-ground coordination errors by enabling routine coordination to be undertaken directly between the ATS equipment in respective ATC facilities. In this respect, the meeting noted that the RASMAG/7 had developed a draft conclusion to request States to implement compatible AIDC capabilities based on the Asia/Pacific AIDC ICD between ATC units.

The outcome of the ATM/AIS/SAR/SG/17

12.3 The meeting reviewed the relevant outcomes of ATM/AIS/SAR/SG/17 meeting. The meeting took note of the comments form ATM/AIS/SAR Sub-group into considerations when dealing with related issues. With respect to the Draft Conclusion 17/4 – Global AIDC Interface provision formulated by the ATM/AIS/SAR/SG, the Secretariat informed the meeting that ATN/AMHS or AMHS over IP is being implemented in the different ICAO Regions and OPLINK Panel has developed AIDC message sets and Aeronautical panel has also developed consequential amendment to the technical provisions regarding AIDC. Further more AIDC is the application for use purely between two neighboring ATS units for which appropriate AIDC message set will be selected. Therefore the need for global adoption of AFTN based ICD for AIDC at this stage may not be applicable.

Review of CNS/ATM Implementation and Planning Matrix

12.4 Secretariat presented the matrix reflecting implementation status of new CNS/ATM systems in the Asia/Pacific Regions. It was noted that the CNS/ATM Implementation Planning Matrix was developed in accordance with the Conclusion 11/37 of APANPIRG and the Matrix has since been regularly updated. CNS/ATM Implementation Matrix reflects the status of implementation of major CNS/ATM elements in the region and includes ATN, AIDC, CPDLC, GNSS, ADS-C and ADS-B. The meeting noted that some States had taken up implementation of Multilateration systems for terminal or area surveillance. It was therefore felt that the status of implementation of Multilateration in the region should also be reflected in the Matrix. The meeting decided to adopt the option of grouping ADS-B and Multilateration in the seventh column of the Matrix. The meeting reviewed the Matrix. The changes and updates provided by States during the meeting were reflected in the Matrix. The updated Matrix is provided in **Appendix A6** to the Report.

Key Priorities and performance objective

12.5 The meeting reviewed the List of Key Priorities for the CNS/ATM Implementation in the Asia/Pacific Region updated by the Tenth Meeting of CNS/MET Sub-group and adopted by the APANPPIRG/17 meeting. It was also noted that the list of Key Priorities would be integrated into the performance based planning initiatives. It was considered that the Key Priorities would be subsumed into the regional performance objectives and related projects. The List of Key Priorities for the CNS/ATM Implementation in the Asia/Pacific Region is considered as a baseline for transition to the new planning approach. The meeting also reviewed the performance objectives (PO) in the CNS/MET fields developed by the Tenth Meeting of CNS/MET Sub-group.

12.6 APANPIRG/17 meeting referred the developed performance objectives to the Regional Performance Objective Task Force for coordination and prioritization with the other performance objectives to be developed.

12.7 The meeting briefly reviewed the key priorities and identified that item 4 – preparation for WRC-2007 would be replaced with preparation for WRC-2011. The Performance Based Navigation should be placed on top of the Item 1 - RNP/RNAV Implementation. These comments should also be brought attention of the performance objective task force to be convened. The updated List of Key Priorities for the CNS/ATM Implementation is at **Appendix A7**.

Vision of the Next Generation Air Transportation System

12.8 A Presentation was made by United States on Next Gen, the American vision of how the management of air traffic and airports with greater level of safety and efficiency will be achieved in the timeframe 2025 and beyond. At the heart of the Next Gen concept is the information sharing component, known as net centric infrastructure, which will provide to the users, the information (on demand) they require to take a decision and at the same time ensuring that the same information is available to all the users. Concept of Operations or ConOps version 2.0, released on 13 June 2007 identifies eight goals. The system envisaged for 2025, will be net-centric with identical information provided to all the users and it will also be possible to tailor the information for the specific user. The information will be updated automatically making it current at all the times. Presentation suggested that the Next Gen System envisaged for United States, will in fact cut across the boundaries and will be adopted by all the other States.

MET Related Issues

Uplink and downlink of meteorological information

12.9 Hong Kong, China presented the latest development of uplink and downlink of meteorological information. The meeting was informed that the TWIP uplink trials carried out in Hong Kong, China had successfully demonstrated the capability and potential benefits of weather information uplink, especially in windshear applications. While the trial would likely be extended at the request of the participating airline, the current bandwidth limitations of ACARS prevented real-time uplinking of graphical information which would fully realize the benefits to airlines and pilots. In this connection, the meeting noted that the completion of APANPIRG 16/52 "Air-Ground Data Link Supporting Graphical Meteorological Information Uplink" would allow wide implementation of the real-time uplink of weather information benefiting the aviation community. As regards downlink of MET information, the meeting was informed that Hong Kong, China had successfully implemented windshear reporting based on high-resolution ascent data from the Aircraft Meteorological Data Relay (AMDAR) equipped aircraft in 2006. The meeting also noted that the eventual implementation of automatic air-reporting by the Mode S datalink (APANPIRG Conclusion 14/44) and/or ADS-B 1090 MHz extended squitter (APANPIRG Conclusion 17/49) would bring significant enhancements in the provision of automated aircraft reports in support of more frequent updating of high-resolution wind and temperature data in the terminal area.

Agenda Item 13: Review of deficiencies in the CNS and MET fields:

1) Status of CNS deficiencies (APANPIRG Deficiency List)
2) Status of MET deficiencies (APANPIRG Deficiency List)

13.1 The meeting noted that APANPIRG/17 had accorded highest priority to the resolution of safety related deficiencies and adopted four Conclusions and one Decision on the subject. It was stressed that the States listed in the APNPIRG List of deficiencies should make firm commitments and undertake decisive actions to resolve the deficiencies as soon as possible. It was strongly recommended that States should apply cooperative efforts and a sub-regional approach to the resolution of deficiencies. Actions should be taken to address typical deficiencies observed in certain areas.

Progress with development of on-line database on deficiencies

13.2 The meeting recalled that the fifth meeting of the ALLPIRG/Advisory Group (ALLPIRG/5) held at ICAO Headquarters in Montreal from 23 to 24 March 2006, adopted Conclusion 5/14 addressed to PIRGs to consider establishing and maintaining a regional online database of air navigation. APANPIRG/17 followed it up with its Conclusion 17/53, which called for the ICAO Regional Office to establish a regional on-line database of air navigation deficiencies and provide secure access to States' Administrations and other users concerned. The purpose of the on-line database is to ensure transparency and facilitate the resolution of safety related deficiencies.

13.3 The meeting was presented with the prototype of the on-line database based on Microsoft Access that has been developed by the Regional Office. It has been designed to provide more structured information on deficiencies and better understanding of the required corrective action.

13.4 It was expected that the design of the database would be finalized after the third meeting of the Deficiency Review Task Force (DRTF) from 23 to 24 July. The database will be available through the ICAO APAC secure website; States' CAA will be provided username and password to access the database upon its endorsement by the APANPIRG/18 meeting.

13.5 The data base would generate a single data sheet for each deficiency which would be sent to the State concerned for formulation of the corrective action plan. It was expected that this would improve the current practice of receiving only general comments from the States expressing intention to resolve deficiencies without firm commitment with specific target dates. It would also help States to identify the assistance they may need to resolve the identified deficiencies if their own resources were not sufficient.

13.6 Establishing of on-line database would expedite resolving the safety related deficiencies by States concerned. It is fully in line with the principles of transparency and information sharing in the Global Safety Roadmap and the ICAO Global Aviation Safety Plan (GASP).

Deficiencies in the CNS field

13.7 The meeting reviewed the status of the CNS deficiencies in the Deficiency list and identified through ICAO missions. The meeting also noted the follow-up actions taken by the Secretariat for those communication problems identified at ATM/AIS/SAR/SG/16. Following areas of major concern were reviewed.

13.7.1 The deficiency of air ground VHF communication in Yangon FIR was brought to the attention of the higher authority in the government. Action was taken by Myanmar to implement the action plan. VHF system within the entire country was upgraded using 6 RCAG sites supported by VSAT links to Yangon ACC and was put into operation. An ICAO mission was conducted to Myanmar in November 2006 to review the situation as the reliability of the RCAG VHF was not found adequate to meet operational requirement. Recommendations were made to correct problems experienced. Need to improve reliability of HF air ground communication provided in the area outside VHF coverage in Yangon FIR was also noted by the meeting. The HF and VHF equipment were reported to be in place and were in operation however the deficiency has not been completely eliminated as IATA recent reports still indicate communication difficulties experienced by pilots. It was identified by the ATS/AIS/SAR SG/17 that the problem may have been caused by operational issues and has suggested missions to be conducted by ATM experts. The shortage of manpower in the ATS field in Myanmar was identified and highlighted in previous mission reports for urgent attention by the Administration.

13.7.2 A CNS mission was conducted specifically to deal with HF communication deficiency in Ujung Pandang FIR in Indonesia from 19 to 24 November 2006. The HF transmitters and receivers were shifted from Bali to Makassar and installed. During the mission tests were conducted and by the end of December 2006 the new system was put in normal operation at Makassar in accordance with Action Plan developed by the ICAO mission. The HF communication deficiency identified by ATS/AIS/SAR/SG/16 and noted by APANPIRG/17 was corrected by Indonesia through implementing the Action Plan developed by the ICAO mission.

13.7.3 A CNS mission was also conducted to Mumbai and Kolkata, India. The communications issues identified by ATS/AIS/SAR/SG/16 have been addressed by the Airports Authority of India. The air/ground HF communication at Mumbai has been improved. Further recommendations for improvement of air/ground communication and ground/ground communication with neighbouring ACC were provided to India for consideration.

13.8 The ATIS function has not been operational in Dhaka and Kathmandu for a long time due to equipment problem and other reasons. This deficiency has adversely affected the quality of VHF communication. There is heavy density of traffic at peak hours and serious congestions have been caused on the Tower and approach control frequencies by the exchange of MET and other operational information which should have been broadcasted by ATIS. This deficiency identified at both the locations needs to be corrected as soon as possible by implementing ATIS. Nepal expressed that ATIS at Kathmandu will be implemented by the target date specified in the corrective action plan.

13.9 Manila-Hong Kong AFTN circuit has been interrupted since February 2007 and it is urgently required to be restored to meet the requirement for the exchange of safety messages between Manila and Hong Kong within the established transit time of 5 minutes. The problem is unlikely to be solved until Philippines avails the service of some other communication service provider. The prolonged outage of the Manila/Hong Kong AFTN circuit should be rectified immediately by ATO Philippines availing service from a reliable communication service provider. The current diversion routing of AFTN messages established in coordination with all concerned is to be continued until the link is restored.

- Hong Kong China confirmed the deficiency and expressed deep concern about this prolong outage of AFTN circuit. The Philippines was requested to take urgent action to restore the circuit.

- The Philippines indicated that urgent action is being taken. The circuit will be restored by the end of September as specified in the corrective action plan

Deficiencies in the MET field

13.10 The meeting reviewed the status of the MET deficiencies in the Region. The following major areas of concern were outlined:

13.11 Deficiencies in the small island developing States in the South Pacific. The meeting recalled that APANPIRG adopted Conclusion 17/52 on providing special assistance for resolution of MET deficiencies in the South-West Pacific Small Island Developing States (SIDS). It was suggested that this assistance should be provided in the form of a technical cooperation project. WMO was invited to join this effort and support the establishment of such a project, in particular, the training component of the project.

13.12 The meeting noted the progress of the follow up action on this Conclusion as follows:

- Coordination with the WMO has been established.

- ICAO Technical Cooperation Bureau (TCB) has submitted a TC project for approval by the International Financial Facility for Aviation Safety (IFFAS).

- IFFAS approved a grant of US$ 95,000 for this project, which would allow an ICAO recruited expert to work in the SW Pacific sub-region for three months and assist the States' meteorological authority in improving the national regulatory framework and planning for sustainable MET services for aviation, as required by the Regional ANP.

- WMO committed to contribute another grant to support the training programme of the TC project.

- initially it was envisaged that the ICAO expert will be based in Fiji, however, it was later decided that New Zealand will host the project. The Secretariat would like to thank both Fiji and New Zealand for the support to the project.

13.13 MET Deficiency list: The MET Deficiencies as reviewed by APANPIRG 17 included 14 items filed related to 8 States for the following areas of non-compliance:

- MET Reports;
- SIGMET and information for VA;
- SIGMET;
- MWO;
- Service for operators and flight crew members.

13.14 Based on the SIGMET and OPMET monitoring conducted for the Region, the following new deficiencies were proposed for inclusion in the APANPIRG Deficiency Database in accordance with the established procedure:

- Bhutan – no METAR (and no TAF) for the AOP aerodrome Paro (VQPR);
- Lao PDR – no MWO established;
- Nauru – no MET service and MWO established;
- Solomon Islands – no MWO established;
- DPR Korea – no SIGMET service (no information about MWO);
- Indonesia – METAR shortfalls for AOP aerodromes.

13.15 The meeting reviewed and updated the list of deficiencies in the CNS and MET fields. The meeting also discussed some of corrective action plan in the list. The updated list of deficiencies in the CNS and MET fields is shown in the **Appendix A8** to the Report.

Agenda Item 14: Future Work Programme

TOR and Subject/Tasks List of CNS/MET Sub-group

14.1 The Seventeenth Meeting of APANPIRG held in Bangkok from 21 to 25 August 2006 reviewed the Subject/Tasks List of the CNS/MET Sub-Group. The meeting in its Decision 17/46 adopted the updated Subject/Tasks List as the Work Programme for CNS/MET Sub-Group.

14.2 The APANPIRG/17 while adopting the proposed changes to the Subject/Tasks List noted that a column had been added in the Subject/Tasks List Table to reflect the associated Strategic Objectives and the GPIs. APANPIRG/17 also noted the changes towards performance based approach to the air navigation planning (APANPIRG Conclusion 17/23 refers).

14.3 The meeting reviewed and updated the Subject/Tasks List. The new tasks included in the list are: Implementation of Performance Based Navigation and updating of FASID Table CNS-1E. The status of on-going tasks was also updated as necessary.

14.4 The meeting reviewed the Terms of Reference of the CNS/MET Sub-group and agreed that they should be aligned with the proposed discontinuation of the ASIA/PAC Regional Plan for the new CNS/ATM Systems.

14.5 The meeting formulated the following draft decision on the TORs and the Subject/Tasks List:

Draft Decision 11/38 - Updated Terms of Reference and Subject/Tasks List of the CNS/MET Sub-group

That, the Terms of Reference and the Subject/Tasks List of the CNS/MET Sub-group presented in **Appendix A9** and **Appendix A10** to the Report respectively, be adopted.

Next Meeting

14.6 It was agreed that the Twelfth Meeting of the CNS/MET Sub Group should be scheduled tentatively for 21 to 25 July 2008 at the Regional Office, Bangkok. The dates are to be confirmed by the APANPIRG/18 meeting.

ICAO Panels Work Porgramme

14.7 The meeting noted the new work programme of ANC Panels including Aerodromes Panel (AP), Aeronautical Communications Panel (ACP), Aeronautical Surveillance Panel (ASP), Air Traffic Management Requirements and Performance Panel (ATMRPP), Airworthiness Panel (AIRP), Dangerous Goods Panel (DGP), Flight Recorder Panel (FLIRECP), Navigation Systems Panel (NSP), Instrument Flight Procedure Panel (IFPP former OCP), Operations Panel (OPSP), and Separation and Airspace Safety Panel (SASP). Information on the MET study groups was also provided to the meeting.

Agenda Item 15: Any other business

RVSM for Formation Flights

15.1 Under this agenda item, the USA made a presentation on the RVSM Separation for RVSM Compliant Aircraft Operation in Formation Flights. The meeting noted that RVSM separation for a formation flight consisting of all RVSM approved aircraft was started in the USA in May 2005.

Changes in the Secretariat

15.2 The meeting noted that the Mr. Dimitar H. Ivanov, Regional Officer MET and a secretary serving the CNS/MET Sub-group will be moving to ICAO Paris Office. The meeting recorded its appreciation and gratitude to Mr. Dimitar Ivanov for his dedicated service and contributions in the MET field in the Region in the past 6 years.

15.3 The meeting also noted that Mr. Sujan Saraswati, a new member of the Secretariat team joined ICAO recently as a Regional Officer, CNS from the Airports Authority of India.

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Follow-up to APANPIRG/17 Conclusions/Decisions — Action Plan

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
D 10/1	**Study on using AFTN for Transmission of warning messages**	That, the VA/TC/I Task Force undertake a study of the feasibility of using AFTN for the dissemination of warning information for tsunamis and other type of natural disasters in the Region including respective formats and procedures.						**Closed** AFTN already used for dissemination of aviation related warning messages

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
DC 10/2 **(D 17/1)** **A , D**	**Implementation of ALLPIRG/5 conclusions by APANPIRG**	That the following conclusions of ALLPIRG/5 be studied by the concerned subgroups, that action be taken to implement them and that the outcome be presented to ensuing APANPIRG meetings: – Conclusions 5/2, 5/4, 5/5, 5/7, 5/8, 5/9, 5/11, and 5/13: ATS/AIS/SAR/SG; – Conclusions 5/2, 5/4, 5/5, 5/13, 5/16, and 5/17: CNS/MET/SG; – Conclusions 5/14, 5/15: DRTF	ANC noted the Decision	Allocate responsibility to contributory bodies Identify projects for implementation	APANPIRG – ATM/AIS/SAR SG – CNS/MET SG – DRTF	Decision Updated work programmes of sub-groups and other contributory bodies Implementation projects	Aug 2006 July 2007	**Ongoing** Most of the CNS/MET related issues already addressed, remaining issues have been included in the work programme

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
D 17/10 **D**	**Establish APANPIRG Regional Performance Framework Task Force**	That, recognizing the new regional planning methodologies precipitated by the second amendment to the Global Air Navigation Plan and the new ICAO business planning requirements, a Task Force be established to develop a proposal/framework for consideration by APANPIRG/18 for incorporating the performance based approach into the work programme of APANPIRG and its contributory bodies. The Terms of Reference of the Task Force are provided in **Appendix B** to the Report on Agenda Item 2.1.	ANC noted the Decision and recommended to extend the approach of developing the regional performance framework to the remaining PIRGs. Also, review and align the planning methodologies of PIRGs to facilitate integration of regional operational plans into the ANIP in support of the Business Plan.	Creation of TF Teleconference Follow work programme established with TORs	APANPIRG TF TF	TOR TF Report Regional performance framework Report to ATM/AIS/SAR/17 CNS/MET/11 APANPIRG/18	Aug 2006 Dec 2006 May 2007 June 2007 July 2007 Aug 2007	**On-going**

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
DC 10/3 **(D 17/20)** **D**	**Revision to the Terms of Reference and the Subject/Tasks List of ATNICG**	That, the revised Terms of Reference and the Subject/Tasks List of the ATNICG provided in **Appendix A** to the Report on Agenda Item 2.2 be adopted.	ANC noted the Conclusion	Adopt revised TORs	APANPIRG	Revised TORs	Aug 2006	**Completed** Revised Subject/Tasks List adopted by APANPIRG presented in ATNICG/2
DC 10/4 **(C 17/21)** **D**	**Updating of the Strategy for Implementation of ATN**	That, the Strategy for implementation of ATN in the ASIA/PAC Region be amended as shown in the **Appendix B** to the Report on Agenda Item 2.2	ANC noted the Conclusion	Amend Strategy for implementation of ATN in the ASIA/PAC Region Publish on ICAO web	APANPIRG Regional Office	Strategy document Web page	Aug 2006 Sept 2006	**Completed** Strategy for ATN implementation available on ICAO APAC Website

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
DC 10/5 **(C 17/22)** **D**	**Amendment to FASID Table CNS 2**	That, FASID Table CNS 2, *Aeronautical mobile service (AMS) and aeronautical mobile satellite service (AMSS)*, be replaced with an updated Table in accordance with the established procedure.	ANC noted the Conclusion	Process amendment proposal for FASID Table CNS-2	Regional Office	Amendment proposal	Feb 2007	**Completed** The amendment proposal was processed in April 2007. Updated FASID Table CNS-2 approved. (ICAO APAC State Letter dated 4 July 2007)
DC 10/6 **(C 17/23)** **D**	**Performance Based Navigation Seminar/Workshop**	That, ICAO organize appropriate workshop/seminar to facilitate the orderly adoption of the Performance Based Navigation (PBN) concept.	ANC noted the Conclusion	Conduct workshop/seminar	ICAO HQ, Regional Office	Workshop	TBD	**Completed** PBN Seminar being organized at Bangkok from 11 to 14 September and at New Delhi, India from 17 to 21 September 2007

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
DC 10/7 **(C 17/24)** **D**	**Revision of the Strategies for Approach Landing and Departure Guidance Systems**	That, the updated Strategies for the Provision of Approach, Landing and Departure Guidance Systems provided in **Appendix E** to the report on Agenda Item 5 be adopted and provided to States	ANC noted the Conclusion Recognizing that the strategy was a living document. Noted it had updated and aligned in response to recent development	Update Strategy documents Publish on ICAO web	APANPIRG Regional Office	Strategy document Web page	Aug 2006 Sept 2006	**Completed** Updated Strategy for the provision of Approach, Landing and Departure Guidance in the Asia Pacific Region is posted on ICAO APAC Website
DC 10/8 **(C 17/24)** **D**	**Revision of the Strategy for the implementation of GNSS Navigation Capability in the ASIA/PAC Region**	That, the updated Strategy for the Implementation of GNSS Navigation Capability in the ASIA/PAC Region provided in **Appendix F** to the Report on Agenda Item 5 be adopted and provided to States.	Recognizing that the strategy was a living document. Noted it had updated and aligned in response to recent development					**Completed** Strategy for implementation of GNSS Navigation Capability in Asia Pacific Region posted on ICAO APAC Website

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
DC 10/9 (C 17/14) A, D	**Improvement of aeronautical information exchange and management**	That, in order to increase the reliability and integrity of the aeronautical information in support of navigation functions, ICAO, as a matter of urgency, establish a standard model for the electronic exchange of aeronautical information.	The work of defining the global data model for AI interchange was already in progress to be completed in 2007.					The Conclusion was adopted by APANPIRG under agenda item 2.1. Monitoring of follow-up by ATM/AIS/SAR SG
DC 10/10 (C 17/25) D	**The First Amendment to the AIGD**	That, the amended ADS-B Implementation and Operations Guidance Document (AIGD) as provided in the **Appendix E** to the Report on Agenda Item 2.2 be adopted.	ANC noted the Conclusion	Amend AIGD Publish on ICAO web	APANPIRG Regional Office	AIGD document Web page	Aug 2006 Sept 2006	**Completed** Updated ADS-B Implementation and Operations Guidance Document posted on ICAO APAC Website

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
DC 10/11 (C 17/26) D	**Investigation and expedition of way to present ADS-B Data using ACAS hardware**	That, ICAO be requested to: a) take into account the importance and benefit of ADS-B IN applications and the role it will have in the final business case; and b) define and support the use of ACAS hardware and traffic displays to present ADS-B based flight identity and velocity vector.	ANC note the Conclusions and recommended that Secretary General follow-up on relevant developments	Develop relevant provisions	ICAO HQ	Appropriate provisions	TBD	**Closed** Monitoring related activities being initiated by the industry
DC 10/12 (D 17/27) D	**Development of Strategy for the implementation of surveillance systems in the ASIA/PAC Region**	That, the strategy for the implementation of surveillance systems as contained in the in the **Appendix F** to the report on agenda item 2.2 be further refined for consideration by APANPIRG/18.	ANC noted the Decision	Finalize strategy	CNS/MET SG	Strategy document	July 2007	**Completed** Revised Surveillance Strategy being presented in CNS/MET SG/11 WP-23
DC 10/13 (D 17/28) D	**Revised Terms of Reference for ADS-B Study and Implementation Task Force**	That, the Revised Terms of Reference for the ADS-B Study and Implementation Task Force as provided in the **Appendix G** to the report under agenda item 2.2. be adopted.	ANC noted the Decision	Adopt revised TORs	APANPIRG	TORs	Aug 2006	**Completed** Revised Terms of Reference for ADS-B Study and Implementation Task Force presented in the ADS-B TF/6

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
DC 10/14 **(C 17/29)** **D**	**Mode S transponder inspection**	That, recognizing more Mode S Radar ground stations being introduced in the region, States in the Asia/Pacific Region be urged to have aircraft registered having Mode S transponder regularly inspected to ensure correct operation of the Mode S transponders.	ANC noted the Conclusion	Urge States	Regional Office	State letter	Dec 2006	**Completed** State Letter sent to States for conducting inspection. 7 States replied intimating the action taken.
DC 10/15 **(C 17/30)** **A , D**	**Preparation for World Radiocom. Conference – 2007 (WRC-2007)**	That, ICAO consider convening Regional Preparatory Group Meeting for WRC-2007 in Bangkok during early 2007.	ANC noted the Conclusion	Conduct RPG Meeting	ICAO HQ, Regional Office	Meeting and development of Regional Strategy	1Q 2007	**Completed** Convened Regional Preparatory Group (RPG) meeting for WRC-2007 at Bangalore in January 2007

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
DC 10/16 **(C 17/31)** **D**	**RF interference on the protected DME frequency**	That, States' civil aviation administrations be encouraged to work closely with the respective regulatory authorities and undertake all necessary action to ensure that DME and SSR service are not interfered by devices such as wireless CCTV cameras.	ANC noted the Conclusion	Urge States CAAs	Regional Office	State letter	Dec 2006	**Completed** In line with the Conclusion, ICAO APAC Office issued State Letter dated 20 December 2006 advising States to take appropriate action with State Regulatory Authorities
DC 10/17 **(C 17/32)** **D**	**HF Interference**	That, States where aeronautical stations are experiencing HF radio interference, take necessary actions in coordination with respective radio regulators to identify the source of interference and to eliminate problem.	ANC noted the Conclusion	Urge States CAAs	Regional Office	State letter	Dec 2006	**Completed** ICAO APAC Office issued State Letter dated 19 December 2006 advising the States to identify source of interference and eliminate the problem in coordination with the State Radio Regulators

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
DC 10/18 **E**	**SADIS Strategic Assessment Tables**	That, the ASIA/PAC SADIS strategic assessment tables, as given in **Appendix J** to the report, be adopted and forwarded to the SADISOPSG for planning the future SADIS bandwidth requirements						**Completed**
DC 10/19 **(C 17/33)** **D**	**Enhancement of ISCS/2 Operational Efficacy Survey**	That, the ISCS Provider State, in coordination with the SADIS Provider State and the ICAO Secretariat, be invited to enhance the survey questionnaire on the operational efficacy of ISCS/2, for consideration by the WAFSOPSG and SADISOPSG.		Invite ISCS and SADIS Provider States	Regional Office, ICAO HQ, UK, USA	New Survey questionnaire	1Q 2007	**Closed** Agreed to conduct ISCS Survey with the existing questionnaire
DC 10/20 **(C 17/34)** **D**	**Continuation of PNG-formatted SIGWX Charts**	That, the WAFSOPSG be invited to consider continuation of the provision of PNG-formatted SIGWX charts by both WAFCs beyond 30 November 2006.	ANC noted the Conclusion	Inform WAFSOPSG of regional feedback	Regional Office, WAFSOPSG	Decision of WAFGSOPSG	Nov 2006	**Closed** Issues referred to WAFSOPSG – update presented in IP/18

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
DC 10/21 **(C 17/35)** **D**	**Survey on the transition from SADIS 1G to SADIS 2G in ASIA/PAC**	That, a survey to evaluate the States' progress in replacing the existing SADIS 1G receiving systems with SADIS 2G receiving systems in the ASIA/PAC Region be conducted in 2007 by the WAFS Implementation Task Force (WAFS/I TF) with assistance of the ICAO Regional Office.		Conduct regional survey	WAFS/I TF Regional Office SADIS user States	Questionnaire for the survey State letter Survey replies	July 2007 1Q 2007 2Q 2007	**Completed** Survey result presented to CNS/MET SG/11
DC 10/22 **D**	**ASIA/PAC WAFS Implementation Plan**	That, the ASIA/PAC WAFS Implementation Plan and Procedures amended as shown in **Appendix K** to the report.						**Completed**

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
DC 10/23 **(C 17/36)** **D**	**Further development of WAFS Output Performance Indicators**	That, the WAFSOPSG be invited to: a) include performance indicators for wind and temperature for the WMO defined verification area covering Australia and New Zealand, in their suite of existing output performance indicators; b) investigate the feasibility of producing wind and temperature performance indicators for all standard forecast levels; c) investigate the feasibility of providing wind and temperature performance indicators in a global gridded and chart format; and d) consider evaluating the SIGWX forecasts, in particular TC and VA symbols, in order to measure the harmonization of these forecasts issued by the two WAFCs.	ANC noted the Conclusion	Develop specified Output Performance Indicators	WAFSOPSG	Appropriate PIs	TBD	**Closed** Issues referred to WAFSOPSG – update presented in IP/18

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
DC 10/24 (C 17/37) D	**Update of ROBEX Handbook**	That, the ROBEX Handbook be updated with the additional material on the quality control (QC) and regional bulletin update procedure, as shown in **Appendix H** to the Report on Agenda Item 2.2.		Update ROBEX Handbook Publish on ICAO website	Regional Office Regional Office	Updated chapters Web document	Sept 2006 Sept 2006	**Completed** The updated ROBEX Handbook (version Jan 2007) posted on the website
DC 10/25 (C 17/38) A , D	**Amendment to ASIA/PAC FASID Table MET 1A, Meteorological services required at aerodromes**	That, the ASIA/PAC FASID Table MET 1A be amended as shown in **Appendix I** to the Report on Agenda Item 2.2.		Process amendment proposal for FASID Table MET 1A	Regional Office	Amendment proposal	Jan 2007	**On-going** Included in a consolidated amendment proposal for the MET part of BANP and FASID to be processed in July 2007

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
DC 10/26 **(C 17/39)** **D**	**Coordination of plan for transition to BUFR-coded OPMET information**	That, in order to expedite the finalization of the regional plan for transition to BUFR-coded OPMET information and related planning for AMHS, the appropriate WMO bodies be invited to confirm, as a matter of urgency, their plan for the use of BUFR code for OPMET information.	ANC noted the Conclusion and recommended that Secretary General seek confirmation from the WMO concerning their plans to migrate to the use of BUFR code form for OPMET information	Notify WMO	ICAO HQ	Letter to WMO	Oct 2006	**Completed** Letter to WMO issued; expert team established to pursue the matter
DC 10/27 **D**	**Terms of reference and work programme of OPMET/M TF**	That, the terms of reference, work programme and composition of the OPMET Management Task Force be amended as shown in **Appendix P** to the Report						**Completed**
DC 10/28 **(C 17/40)** **A**	**Standard message format for volcano observatories participating in IAVW**	That, IAVWOPSG be invited to develop a standard message format to be used by the States' volcano observatories designated in the Regional ANP to provide information to the associated ACC, MWO and VAAC.		Develop standard message format	IAVWOPSG	Appropriate provision	TBD	**Closed** Included in the work programme of IAVWOPSG

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
DC 10/29 **(C 17/41)** **A , D**	**Development of web page for monitoring SIGMET availability in the ROBEX scheme**	That, Hong Kong, China be invited to develop, in coordination with Singapore, a web page on the Hong Kong Observatory web site, providing real-time information on the valid SIGMETs and advisories issued by the MWOs and advisory centres in the ASIA/PAC Region for monitoring purposes within the ROBEX scheme. *Note: Authorized access to the web application to be provided to the RODBs, ROBEX centres, MWOs and the ICAO Regional Office.*	ANC noted the Conclusion	Develop and maintain web page	Hong Kong, China, Singapore, Regional Office	Web page	Nov 2006	**Completed** Webpage developed by HKO. States invited to apply for authorized access

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
DC 10/30 (C 17/42) **A , D**	**ASIA/PAC SIGMET Seminar**	That, a) ICAO, in coordination with WMO and the VAAC and TCAC Provider States in the ASIA/PAC Region, be invited to organize in 2007 a regional training seminar for the States' SIGMET Focal Points; and b) States' CAAs and meteorological authorities be strongly encouraged to ensure participation of the designated SIGMET Focal Points or other appropriate personnel in the above Seminar.	ANC noted the Conclusion and supported the proposal to organize a training seminar for SIGMET Focal Points in 2007. Commission recommended that Secretary General should invite WMO, Volcanic Ash and Tropical Cyclone Advisory Center (TCAC) Provider States, in coordination with ICAO to organize training in 2007	Organize SIGMET seminar Ensure participation of appropriate personnel	Regional Office, ICAO HQ, WMO, VAAC Provider States, TCAC Provider States ASIA/PAC States	SIGMET Training Seminar Participation in the training	2007	**Completed** Seminar held at the Regional Office, 11-13 July 07

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
D 10/31	**TOR and work programme of the Task Force on the Implementation of VA and TC advisory & warning services (AV/TC/TF)**	That, the Terms of Reference and the Work Programme of the VA/TC/I Task Force be amended as shown in Appendix Q to the Report						**Completed**
DC 10/32 (C 17/43) D	**Development of provisions on MET/ATM coordination**	That, in recognizing the importance of the meteorological support for the air traffic management, a) ICAO Regional Office conduct a survey of the evolving requirements for meteorological information and services in support of air traffic management; and b) the results of the survey above, be referred to the appropriate ICAO body in view of potential extension of the existing provisions on the meteorological services for ATS, to cover the other ATM fields.	ANC noted the Conclusion	Conduct survey Develop SARPs	MET/ATM TF, Regional Office ICAO HQ	Questionnaire for the survey Survey Report to be presented to ATM/AIS/SAR/17 CNS/MET/11 Appropriate provisions	1Q 2007 Jun 2007 TBD	**On-going** Draft questionnaire presented to ATM/AIS/SAR/17 CNS/MET/11 Comments expected to be completed by the end of 2007

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
DC 10/33 **(C 17/44)** **A , D**	**Development of new windshear posters**	That, ICAO be invited to consider updating the windshear posters for training and educational purposes, based on the posters being developed by Hong Kong, China in collaboration with WMO and IFALPA.	ANC noted the Conclusion	Develop windshear posters	Hong Kong, China, ICAO HQ, WMO, IFALPA	Posters	2007	
DC 10/34 **(C 17/45)** **D**	**Applicability of the turbulence metric based on EDR for approach/take-off**	That, ICAO be invited to consider: a) the applicability of the EDR metric for reporting of turbulence for approach/take-off; and b) developing guidance to States for implementation of automatic aircraft turbulence reporting for all phases of flight.	ANC noted the Conclusion and recommended that Secretary General should address the related issues with the assistance of the METLINSG and develop required guidance	Develop guidance	ICAO HQ	Appropriate provisions	TBD	**Closed** Included in the work programme of METLINKSG

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
DC 10/35 **(C 17/49)** **D**	**Use of ADS-B 1 090 MHz Extended Squitter for automatic air-reporting**	That, ICAO be invited to develop the necessary SARPs and guidance material to facilitate the implementation of ADS-B 1 090 MHz extended squitter for automatic air-reporting.	ANC noted the Conclusion and recommended to the Secretary General to consider the subject after the report of the ongoing investigation of the RF pollution problem associated with the use of 1030/1090 MHz frequencies by the ASP becomes available	Develop SARPs guidance material	ICAO HQ	Appropriate provisions	TBD	**Closed**

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
DC 10/36 (C 17/50) A, D	**New ICAO abbreviations for windshear warning**	That, in order to facilitate inclusion in the windshear warnings of the windshear intensity in terms of headwind changes, ICAO be invited to include new abbreviations for “headwind gain” and “headwind loss” in the ICAO Abbreviations and Codes (Doc 8400) and to amend the windshear warning template (Table A6-3) in Annex 3 accordingly.	ANC noted the Conclusion and recommended to Secretary General to consider developing with the assistance of the WISTSG the necessary provisions that would enable the detection of low-level windshear affecting aircraft operations along approach and take-off paths. Also include new abbreviations for “headwind gain” and “headwind loss” in the ICAO *Abbreviations and Codes* (Doc 8400) and to amend the windshear warning template (Table A6-3) in Annex 3 accordingly.	Amend provisions	ICAO HQ	Appropriate provisions	TBD	**Closed** Included in the work programme of the new study group on advisories and warnings

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
DC 10/37 **(C 17/52)** **A, D**	**Special assistance or resolution of MET deficiencies in the South-West Pacific Small Island Developing States (SIDS)**	That, in recognizing the safety implications of the long standing MET deficiencies in the South-West Pacific SIDS, ICAO, in coordination with WMO, be invited to consider providing further assistance to these States in order to build their capacity to provide the required services in a sustainable cost-efficient manner. *Note: It is suggested that the appropriate form of providing assistance to the South Pacific SIDS would include assignment of ICAO expert to the sub-region and provision of training through technical cooperation project and/or extended SIP*	Invite WMO to consider providing further assistance to these South-West Pacific Small Island Developing States in order to build their capacity to provide the required services in a sustainable and cost-efficient manner.	Express support Assist in establishment of TC	ICAO HQ WMO	Letter to WMO TC Project	Oct 2006 2007	**Completed** Letter by Sec-Gen sent to WMO; WMO committed to support the project. TC project proposal developed and submitted for IFFAS grant. IFFAS approved a grant. TC project expected to be initiated sep/Oct 2007
DC 10/38 **(D 17/46)** **A , D**	**Updated Subject/ Tasks List of the CNS/MET Sub-group**	That, the Subject/Tasks List of the CNS/MET Sub-group presented in **Appendix J** to the report of on Agenda Item 2.2 be adopted.		Adopt Subject/Task List	APANPIRG	Subject/Task List	Aug 2006	**Completed** Subject/Tasks List being presented in CNS/MET SG/11

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
DC 10/39 **(2.2.82)**	**Establishing Regional Performance Objectives in CNS and MET Fields**	That, in support of the ICAO Strategic Objectives and the evolution towards performance based navigation planning and implementation: a) the following regional performance objectives (PO) in the CNS and MET fields related to the ICAO Strategic Objectives and the Global Planning Initiatives (GPI) be established: **CNS** PO-CNS-1 Establishment of ground-to-ground Aeronautical Telecommunication Network (ATN) Infrastructure PO-CNS 2 Implementation of ATS Inter-facility Data Communication (AIDC) PO-CNS 3 Implementation of DATA Link Flight Information Services (DFIS) applications						This draft Conclusion was not adopted by APANPIRG/17. The proposed performance objectives were referred to the Regional Performance Framework Task Force for coordination and prioritization with other objectives to be developed. The meeting of the Task Force has yet to be conducted.

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
		PO-CNS 4 Protection of Aeronautical Spectrum **MET** PO-MET 1 Improvement of the availability of OPMET data from the ASIA/PAC States PO-MET 2 Improvement of the availability and reliability of ASIA/PAC advisory and warning services b) The CNS/MET Sub-group be tasked to develop, in coordination with the Regional Offfice, regional projects in support of the above performance objectives including appropriate performance indicators and specific target dates, in time for the APANPIRG/19 meeting 2007						

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
(C 17/51) A	**Special Implementation Project to assist rectification of Deficiencies**	That in order to facilitate mitigating action in relation to identified operational safety deficiencies in a group of States in the Asia/Pacific Region, ICAO undertake a special implementation project during 2007. The SIP would address difficulties with air/ground and ground/ground communications, poor ATC practices and non compliances with Annexes 14 and 15.	ANC noted the Conclusion and recommended to Secretary General to consider establishing an SIP during 2007 to assist in the rectification of identified operational safety deficiencies in a group of States of the Asia Pacific Region, subject to formal approval process.	Establish and conduct SIP	Regional Office ICAO HQ	SIP proposal SIP establishment	Jan 2007 March 2007	SIP missions were carried out by expert and Regional Officer to Bangladesh and Nepal. Regular Missions were conducted to Indonesia and India. Recommendations and/or remedial actions were developed and provided to States for consideration. Follow-up action also taken by the RO with States concerned. Some deficiencies were identified.

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
(C 17/53) A	**A regional on-line database of air navigation deficiencies in ASIA/PAC Region**	That, in order to ensure transparency and facilitate resolution of deficiencies, ICAO Regional Office be invited to establish a regional on-line database of air navigation deficiencies and provide secure access to States' Administrations and other users concerned.	ANC noted the Conclusion	Establish on-line database	Regional Office, DRTF, ICAO HQ	On-line database	Aug 2007	**On-going** Online database of air navigation deficiencies has been created and is on trial
(C 17/54) A	**Deficiency resolution objective for ASIA/PAC States**	That, a) all ASIA/PAC States listed in the APANPIRG List of deficiencies be urged to establish action plans with fixed target dates for resolution of all safety related deficiencies and inform ICAO Regional Office by mid 2007 of their plans; and b) the need for urgent action in resolving safety related deficiencies be brought to the attention of DGCA/43 conference in December 2006.	ANC was pleased to note that APANPIRG has accorded highest priority to the urgent elimination of safety related deficiencies in the Region. Stares reflected in the deficiencies list had been urged to establish action plan with fixed target dates by mid-2007	Establish action plans Report to DGCA	States Regional Office	Action plan DP for DGCA	June 2007 Dec 2006	**On-going** Reported to DGCA/43 States urged to submit action plans Very low response from States

TBD = To be determined

CM-No. (AP-No.) SO	Title of Conclusion/ Decision	Text of Conclusion/Decision	ANC/Council Action	Follow-up Action	To be initiated by	Deliverable	Target date	Status
(D 17/55) **A**	**Third meeting of DRTF**	That, the deficiency review task force (DRTF) conduct a meeting in early 2007 with the following tasks: a) develop appropriate follow-up action to ALLPIRG Conclusions 5/14 and 5/15; b) review the implementation aspects of the regional supplement to the Uniform Methodology including an assessment of the current List of Deficiencies; and c) report to APANPIRG/18	ANC noted the Decision	Conduct meeting and act on a), b) and c).	Regional Office, DRTF	DRTF/3 Report Report to sub-groups and APANPIRG/18 Database format document	Mar 2007 Jun, Jul, Aug 2007 Aug 2007	**On-going** Meeting scheduled for 23-24 Jul 07

*** Note:** ICAO has established the following Strategic Objectives for the period 2005-2010:
A: Safety - *Enhance global civil aviation safety*; **B: Security** - *Enhance global civil aviation security*; **C: Environmental Protection** - *Minimize the adverse effect of global civil aviation on the environment*; **D: Efficiency** - *Enhance the efficiency of aviation operations*; **E: Continuity** - *Maintain the continuity of aviation operations;* **F: Rule of Law** - *Strengthen law governing international civil aviation.*

TBD = To be determined

STATUS OF OUTSTANDING CONCLUSIONS/DECISIONS OF APANPIRG IN THE CNS/MET FIELDS

Report Reference ----------- Conc/Dec No.	**Noted by ANC/ Council**	**Decision/Conclusion ANC/Council Action, if any**	**Action by States/ICAO**	**Status**
C 14/24	 *ANC*	**Conclusion 14/24 - Preparation for World Radio Communication Conference 2007 (WRC-2007)** That, States, a) assign high priority to aeronautical spectrum management; b) participate in the development of States' position for WRCs at the national level to ensure support to the ICAO position; c) ensure, to the extent possible that, aviation representatives are included in States delegations to the Asia-Pacific Telecommunity (APT) Conference Preparatory Group) meetings and at WRCs; d) to nominate an ICAO designated focal point or contact person for aviation issues related to the WRC-07; and e) ensure participation of the designated focal point or contact person at the ICAO Regional Preparatory Group Meetings for WRC-07, APT Conference Preparatory Group Meetings for WRC-07, and at WRC-2007. *Noted the Conclusion and requested the Secretary General to continue encouraging the States to participate at various levels in different fora to provide support for the ICAO position at the forthcoming WRC-2007 so as to protect aeronautical frequency spectrum.*	As a follow up action this Conclusion was presented to the 41st DGCA Conference. States have been urged to nominate focal point of contact. 30 States have designated focal point of contact and replies from 5 States awaited. 42nd DGCA Conference further endorsed the Action Item 41/3. 31 States have designated focal point of contact and replies from 4 States awaited. ~~The Second RPG is tentatively planned during early 2007. Action on this item is expected to be completed by the third quarter of 2007.~~ Second RPG meeting was held in Bangkok from 15 to 17 January 2007 RPG/2 recommendations were circulated through ICAO APAC State Letter dated 29 March 2007 ICAO Final Position on WRC-2007 agenda points was circulated through ICAO State Letter dated 3 July 2007	On going

Report Reference ----------- Conc/Dec No.	Noted by ANC/ Council	Decision/Conclusion ANC/Council Action, if any	Action by States/ICAO	Status
C 15/15		**Conclusion 15/15 – Asia/Pacific Regional ATN Implementation System Management Operational Procedures** That, the Asia/Pacific regional ATN Implementation System Management Operational Procedures be published to assist States in implementation of the ATN ground infrastructure in the Asia/Pacific region.	Considered premature due to lack of experience in operational aspect to develop a manual procedure. This task can be addressed only after gaining sufficient operational experience of AMHS. Asia/Pacific Regional ATN Implementation System Management Operational Procedures containing initial direction and guidance was published in August 2004. It is expected that sufficient operational experience would be gained by end of 2007.	On-going
D 15/40		**Decision 15/40 – Planning for migration to BUFR-coded aeronautical meteorological messages** That, a) the ATN Transition Task Force and the OPMET Management Task Force be tasked to address the issues related to the transition to BUFR-coded aeronautical meteorological messages by conducting studies, as necessary; b) the two Task Forces develop in coordination a regional plan for migration to BUFR-coded aeronautical meteorological information by the end of 2005.	The matter has been addressed by the OPMET/M TF/3 meeting, March 2005 and the ATN Transition TF meeting in April 2005; joint meeting of the two groups planned for 2006. OPMET/M TF/4 and ATN IC Group addressed the matter. A joint Project Team was formed; the first meeting of the PT planned as a side meeting during CNS.MET SG/10. OPMET/M TF/5 has been advised that WMO and ICAO will study the possibility of using XML in place of BUFR. The regional planning for the transition is suspended until the results of the study are made available.	~~On-going~~ Closed
Conclusions/Decisions of APANPIRG/16				

Report Reference ----------- Conc/Dec No.	Noted by ANC/ Council	Decision/Conclusion ANC/Council Action, if any	Action by States/ICAO	Status
C 16/47		**Conclusion 16/47 – Production of SIGMET posters** That, in order to enhance the availability and quality of the SIGMET information, Australia and Hong Kong China be invited to produce in 2006, in coordination with the VA/TC Implementation TF, and in consultation with ICAO, WMO and the TCAC and VAAC Provider States in Asia/Pacific Region, SIGMET posters describing the SIGMET procedures for volcanic ash clouds, tropical cyclones and other hazardous meteorological phenomena, to be used as training material and quick reference tools by the MWOs.	Draft posters for WS and tropical cyclone SIGMET have been prepared by Hong Kong, China; draft poster for volcanic ash SIGMET has been prepared by Australia and New Zealand in coordination with the ICAO, WMO and Japan. Drafts have been reviewed during the SIGMET Seminar. The production of posters and their dissemination to States is planned to be done by the end of 2007.	On-going
~~C 16/53~~		~~**Conclusion 16/53 – Regional Contingency Arrangements in support to continuity of aviation operations in the event of natural disasters or other crisis situations**~~ ~~That,~~ ~~Asia/Pacific States be invited to provide data to the ICAO Regional Office regarding availability of resources and services which could be readily made available in the event of natural disaster and other crisis situations to the States in need and to support international humanitarian relief operations involving aviation;~~ ~~Based on the data received from the States, ICAO Regional Office develop a catalogue and act as facilitator and coordinator of the international aviation operations in response to disaster and other crisis. The catalogue would provide details regarding contact points, general description of facilities and services available and~~	~~State letter issued to ASIA/PAC States~~ ~~Information based on the received responses from States is available and could be used in emergency events.~~	~~Closed~~

Report Reference ----------- Conc/Dec No.	**Noted by ANC/ Council**	**Decision/Conclusion ANC/Council Action, if any**	**Action by States/ICAO**	**Status**
		~~arrangements under which services would be provided (i.e. government to government, commercial, humanitarian etc.) and~~ ~~States consider implementing RNAV (GNSS) approaches procedures as an alternate to ground-based radio navaids in particular for areas prone to natural disasters, such as tsunami, tropical cyclones, volcanic eruptions etc.~~		

ATTACHMENT

FOLLOW-UP BY APANPIRG ON CONCLUSIONS OF ALLPIRG/5

ALLPIRG/5 Conclusions	Relationship with Strategic Objective & Global Plan Initiatives (GPIs)	Follow-up task	Follow-up to be initiated by
Conclusion 5.2 — Implementation of Global Plan Initiatives (GPIs) (for CNS/MET SG and International Organizations)			
That, recognizing that the evolution continues from a systems-based to a performance-based approach to planning and implementation of the air navigation infrastructure, the regional planning groups:	Increases efficiency (Strategic objective D) Relates to all GPIs	*The subject/task list and work program of the Task Forces and Sub-group have been associated with GPIs.*	
a) note that the Global Plan is a significant component in the development of regional and national plans and that, together with the global ATM operational concept, provide an effective architecture for achieving a harmonized and seamless Global ATM system;		Note that the Global Plan is a significant component in the development of regional and national plans *Noted. Follow-up draft Conclusions on actions to the Global Air Navigation Plan has been developed by CNS/MET/SG/11.*	APANPIRG, States and international organizations
b) identify GPIs that most closely align with the well established implementation plans of their respective regions;		Identify GPIs that most closely align with the implementation plans of their respective regions	APANPIRG, States and international organizations
c) select GPIs that would be most effective in achieving the objectives of the region while ensuring continuation of the work already accomplished;		Select GPIs that would be most effective in achieving the objectives of the region	APANPIRG, States and international organizations
d) implement GPIs that take into account the Initiatives across regions, to align work programmes and to develop national and regional plans that facilitate achieving a Global ATM system;		Implement GPIs in the development of national and regional plans.	APANPIRG, States and international organizations
e) utilize the planning tools as the common planning and implementation mechanism, thereby ensuring proper coordination and global integration; and		Utilize the planning tools as the common planning and implementation mechanism *Being developed*	APANPIRG, States and international organizations
f) review, at each PIRG meeting as a part of its regular agenda, the progress achieved and challenges identified in the implementation of GPIs using a common template.		Review, at each PIRG meeting as a part of its regular agenda, the progress achieved and challenges identified in the implementation of GPIs. *(Working papers on AIDC, ADS-B, ATNICG etc.)*	APANPIRG.

ALLPIRG/5 Conclusions	Relationship with Strategic Objective & Global Plan Initiatives (GPIs)	Follow-up task	Follow-up to be initiated by
Conclusion 5/4 — Application of the business case model for CNS/ATM systems implementation (for CNS/MET SG, States and International Organizations)			
That PIRGs, States and airspace users:	Increases efficiency (Strategic objective D) Relates to all GPIs	*SIP Workshop on Development of Business Case for the Implementation of CNS/ATM systems scheduled from 23 to 27 July, 2007 at Bangkok*	
a) note that business cases for the implementation of CNS/ATM systems leading to a global ATM system is a key element in the development of regional, subregional and national plans;		Note that business cases for the implementation of CNS/ATM systems is a key element in the development of regional, subregional and national plans	APANPIRG, States and international organizations
b) consider the application of the model for the development of business cases in the formulation of national and subregional plans with a view to facilitating the achievement of a global ATM system; and		Apply the model for the development of business cases in the formulation of national and subregional plans	APANPIRG, States and international organizations
c) establish, with ICAO's assistance and within the limits of the programme budget, a network of experts on cost-effectiveness, cost-benefit analyses and business cases for the implementation of CNS/ATM systems in order to share expertise and to provide assistance to the Regional Offices.		Establish a network of experts on cost-effectiveness, cost-benefit analyses and business cases for the implementation of CNS/ATM systems	

ALLPIRG/5 Conclusions	Relationship with Strategic Objective & Global Plan Initiatives (GPIs)	Follow-up task	Follow-up to be initiated by
Conclusion 5/5 — ICAO Global air navigation plan (ANP) database and geographic information system (GIS) portal (for CNS/MET SG, States and International Organizations)			
Recognizing that access to an ICAO Global ANP database and associated planning services through an web-based ICAO GIS portal would constitute an invaluable tool in supporting, integrating and monitoring the planning and implementation of harmonized regional, interregional and global air navigation infrastructures, the regional planning groups: a) note the progress made by the Secretariat in accordance with Recommendation 1/14 of AN-Conf/11 and the ICAO Global ANP database;	Increases efficiency (Strategic objective D) Relates to all GPIs	Note the progress made in the development of ICAO Global ANP database	*ICAO Global ANP database being developed. Web-based implementation database is also being developed. ATN/AMHS related information is available on APAC website and Deficiency Management tool is also being made available.* APANPIRG, States and international organizations Portal address http://192.206.28.84/eganp
b) note the ongoing efforts by the Secretariat in harmonizing formats of all the ANP tables together with the inclusion of temporal information in the tables that would assist the regional planning groups in monitoring and analysing the implementation progress;		Harmonize formats of all the ANP tables	ICAO Headquarters
c) note the intent to expand the ANP tables to include Global Plan Initiatives (GPIs), as appropriate; and		Include GPIs in the ANP tables	ICAO Headquarters
d) utilize, through the ICAO GIS portal, the ICAO Global ANP database and associated planning services so as to ensure the currency, coordination and implementation of regional air navigation planning and to contribute to the further development of air navigation plans as the framework for the efficient implementation of new air navigation systems and services at the national, regional, interregional and global levels.		Utilize the ICAO Global ANP database and associated planning service	APANPIRG, States and international organizations

ALLPIRG/5 Conclusions	Relationship with Strategic Objective & Global Plan Initiatives (GPIs)	Follow-up task	Follow-up to be initiated by
Conclusion 5/13 — Implementation of performance-based navigation concept (for CNS/MET SG, States and International Organizations)			
That, to increase awareness and understanding of the performance-based navigation concept and its elements:	Increases efficiency (Strategic Objective D) Relates to GPI 5		
a) ICAO organize workshops and training activities; and		Organize workshops and training activities through the SIP mechanism	ICAO Headquarters. PBN PBN Seminar is being organized at Bangkok from 11 to 14 September and at New Delhi from 17 to 21 September 2007
b) where area navigation (RNAV) or required navigation performance (RNP) implementations are required, these will be implemented by PIRGs and States according to the performance-based navigation concept.		Implement performance-based navigation concept	APANPIRG, States and international organizations *Plans or roadmap to be developed.*
Conclusion 5/16 — Implementation of very small aperture terminals (VSATs) (for CNS/MET SG, States and International Organizations)			
That PIRGs:	Increases efficiency (Strategic Objective D) Relates to GPI 22	*States followed up relevant APANPIRG's Conclusion on using VSAT to establish sub-regional network to overcome last mile communication problems.*	*It had been addressed by ATNTTF and CNS/MET Sub-group*
a) discourage the proliferation of VSAT networks where one/some of the existing ones can be expanded to serve the new areas of interest;		Discourage the proliferation of VSAT networks	APANPIRG, States and international organizations
b) work towards integrated regional/interregional digital communication networks with a single (centralized) operational control and preferably based on the Internet Protocol (IP); and		Work towards integrated regional/interregional digital communication networks. *Digital circuit being employed to replace analogue circuit some of which meet the requirements for both the voice and data communications*	APANPIRG, States and international organizations
c) give due consideration to managed network services (e.g. a virtual private network (VPN)), subject to availability and cost-effectiveness.		Give due consideration to managed network services *Managed network service being used for ATN/AMHS trials between States. Such kind of service is also considered by ADS-B SITF for the managed ADS-B Service.*	APANPIRG, States and international organizations

ALLPIRG/5 Conclusions	Relationship with Strategic Objective & Global Plan Initiatives (GPIs)	Follow-up task	Follow-up to be initiated by
Conclusion 5/17 — Provisions for digital communication networks (for CNS/MET SG)			
That ICAO:	Increases efficiency (Strategic Objective D) Relates to GPI 22	*SARPs and Technical provisions for ground/ground communication using IPS has been finalized by ACP/1 in May 07. Regional Strategy for allowing dual stack protocol was developed in 2006. End to end performance being addressed through RCP. Some procedures have been developed for monitoring end-end communication performance. .*	
a) expedite the development of provisions relating to the use of the Internet Protocol Suite (IPS) in the aeronautical telecommunication infrastructure; and		Expedite the development of provisions relating to the IPS in the aeronautical telecommunication infrastructure	ICAO Headquarters
b) initiate the development of provisions governing the end-to-end performance of digital communication networks, irrespective of the technologies and protocols utilized therein.		Develop provisions governing the end-to-end performance of digital communication networks	ICAO Headquarters

TITLE AND TERMS OF REFERENCE

Title:	**AERONAUTICAL TELECOMMUNICATION NETWORK IMPLEMENTATION CO- ORDINATION GROUP (ATNICG)**
Terms of Reference:	Coordinate implementation of ATN in the Asia and Pacific Regions to satisfy performance requirements and address relevant implementation issues.
Composition:	The Group will be composed of experts nominated by: Australia, China, Hong Kong-China, Fiji, India, Indonesia, Japan, New Zealand, Republic of Korea, Singapore, Thailand and United States
Reporting:	The Group will present its report to APANPIRG through the CNS/MET Sub-group.
Remarks:	The ATNICG, while undertaking the tasks, should take into account the work being undertaken by Aeronautical Communication Panel and other related regional groups in other ICAO regions with a view to avoid duplication.

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No.	PERFORMANCE OBJECTIVE	ICAO Srategic Objective	Associated GPI	Tasks/Strategy	Benefits	Deliverables	Target Date	Leader	Supporting Members	ATNICG/2 Update
1	ATN Implementation Coordination	D. Efficiency	GPI-17, GPI-19, GPI-22	(1) Review of implementation problems and develop co-ordinated solutions	Expedite implementation activities, ensure system campatibility through out the region	Co-ordination Report	Ongoing/Semi-anually until (2010)	Ken Morris (Australia)	All members	Updated the FASID CNS 1D. Coordinate the intra regional interface. Planning and Implemenation Status are updated at ICAO APAC website.
2	ATN Operational Procedures	D. Efficiency	GPI-17, GPI-19, GPI-22	(1) Development of Interim Database for Directory Services (2) Develop the operational database management procedures	Make available real time and quality assurance addresses for ATN message delivery	(1) Interim Database (2) Operational Procedures	(1) (2007) (2) (2007)	Robert Hallman (USA)	Thailand, Hong Kong China, Japan	The database was demonstrated. Aerothai will maintain the database on behalf of the regional ICAO. Aerothai is designated as focal point for accessing AMC at short term. Intiated by Aerothai
3	ATN Certification & Validation Process	D. Efficiency	GPI-17, GPI-19, GPI-22	(1) Develop conformance procedures and checklist for AMHS and ATN routers (2) Develop validation process document	Expedite implementation activities, ensure global system compatibility	(1) Checklist (2) Conformance Document	(1) (2007) (2) 2007	Victor, Lee (Singapore)	China, Hong Kong China, Indonesia,ROK, USA,	Update distributed to member States for comment Deadline by CNS/MET in July by Victor same as above
4	ATN Documentation	D. Efficiency	GPI-17, GPI-19, GPI-22	(1) Study DIR objects/attributes proposed in ACP and follow development within other groups	Expedite implementation activities, ensure global system compatibility	(1) Directory Report	(1) Annually until (2010)	Chonlawit B.	Thailand	Develop the database and review proposal from Eurocontrol. Will present the procedure for coordination. Further consequential changes needs to be made and additional annex needs to be added.

No.	PERFORMANCE OBJECTIVE	ICAO Srategic Objective	Associated GPI	Tasks/Strategy	Benefits	Deliverables	Target Date	Leader	Supporting Members	ATNICG/2 Update
				(2) Development AIDC documentation (including ICD) and follow development within other groups		(2) AIDC ICD	(2) 2007 (ACP-dependent)	(Thailand)	Thailand	Status reported to ATNICG/2 indicating the operation of AFTN based AIDC; Postpone development of ATN based AIDC ICD as experience gained by the implementors.
				(3) Update of AMHS ICD to comply with SARPs 3rd Edtion		(3) Updated AMHS ICD	(3) (2007)		Japan	Completed. Provided to ATNICG/2 for endorsement
5	ATN Performance	D. Efficiency	GPI-17, GPI-19, GPI-22	(1) Develop/establish/adapt/monitor/identify/analyse performance indicators	Assure QOS, service continuity, timely delivery of services	(1) AMHS performance report	(1) Annually until (2010)	Japan	Republic of Korea, India	On-going and challenging. Proposed to further study how to measure the erformance
6	ATN Service Enhancements	D. Efficiency	GPI-17, GPI-19, GPI-22	(1) Review the impact of the implementation of Directory Services in the Region	Enhancing the service	(1) Report on directory	(1) Annually until (2010)	Fiji	USA, Thailand, New Zealand, Japan, Australia	Review the database developed by Aerothai for the Regional ICAO office.
				(2) Development of profiles for the directory access and exchange protocols (Ref. Decision 7/9)	Enhancing the operation	(2) Report on profiles	(2) (2008)	Fiji		
				(3) Study the use of IP	Lowering the operating cost	(3) Report on the use of IP	(3) (2008)	Singapore	China	Will develop a Working Paper to ATNICG/3
				(4) Study for transition to BUFR code	Enhancing the service	(4) Report on the impact of BUFR code to ATN	(4) (2007)	Japan	New Zeland, USA,	Analysis was presented by Hong Kong, China. No progress subject to discussion at CNS/MET/11
				(5) Study for transition of AFTN-based AIDC to ATN environment	Improving the service and lowering the operating cost	(5) Report on the impact of transition of AFTN-AIDC to ATN-AIDC	(5) (2008)	Thailand	India,Indonesia, New Zealand, USA,	A report will be presented by Aerothai to indicate the operation of AFTN based AIDC version 2.0

No.	PERFORMANCE OBJECTIVE	ICAO Srategic Objective	Associated GPI	Tasks/Strategy	Benefits	Deliverables	Target Date	Leader	Supporting Members	ATNICG/2 Update
7	Security	B. Security	GPI-17, GPI-19, GPI-22	(1) Develop Information Security policy	Safe and Secure Inter and Intra Regional Communication and service infrastructure	(1) Policy Document	(1) Annually until (2010)	Vidyut Patel (USA)	Australia, Hong Kong China	USA made a presentation at ATNICG/2. High level guidance document needs to be presented to WG/2
				(2) Develop Information Security Guidance		(2) Guidance Document	(2) (2008)			
				(3) Develop Information Security Solution for Initial and Enhanced Services		(3) Security, Technical, Management and Operational Control	(3) (2008)			
				(4) Co-ordinate and monitor ACP working group and other regions		(4) Report	(4) Semi-Annually until (2010)		Thailand	
8	ATN Service Enhancements	D. Efficiency	GPI-17, GPI-19, GPI-22	Analyze Common Address Prefix Proposal	Improving the service and routing efficiency	Report on common prefix based analysis conduced	End of 2007	Mark Brown [Japan]	Australia, Fiji, HongKong China, New Zealand and USA	Action Items developed at ATNICG/2 for follow-up at WG/2 meeting

No.	PERFORMANCE OBJECTIVE	ICAO Srategic Objective	Associated GPI	Tasks/Strategy	Benefits	Deliverables	Target Date	Leader	Supporting Members	ATNICG/2 Update

The ATN PERFORMANCE OBJECTIVE

The APAC ATN ground-to-ground infrastructure will be fully operational 53 percent at 23 locations by December 2007.

(GPI-22) COMMUNICATION NETWORK INFRASTRUCTURE

Related ATM objectives: AMSS; HF data; VHF data; SSR Mode S; ATN

Scope: To evolve the aeronautical mobile and fixed communication infrastructure, supporting both voice and data communications, accommodating new functions as well as providing the adequate capacity and quality of service to support ATM requirements.

(GPI-19) METEOROLOGICAL SYSTEMS

Objective: To improve the availability of meteorological information in support of a seamless global ATM system.

(GPI-17) IMPLEMENTATION OF DATA LINK APPLICATIONS

Scope: Increase the use of data link applications

Related ATM objectives: Application of data link; Functional integration of ground systems; with airborne systems; ATS inter-facility data communication (AIDC)

International Civil Aviation Organization
Asia and Pacific Office

Draft

1st Edition
of
the Guidance Document for
AMHS Conformance Testing
(AMHS Manual)

Scope of the Document

This document has been developed by ATN ICG in order to present a comprehensive collection of test and checklist required to ensure conformance and compatibility pertaining to the implementation of AMHS facilities in the Asia and the Pacific Region.

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Document Control Log

Edition	Date	Comments	section/pages affected
0.11	30/03/2007	Creation of the document.	all

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1. Structure of the Asia and the Pacific AMHS Conformance Manual

1.1. The Asia and the Pacific AMHS Manual consists of 2 parts. The “Main Part” and the Appendices.

The main part will introduce and provide general guidance and detailed information on requirements concerning AMHS implementation in the Asia and the Pacific Region. They consist of:

1. Structure of the Asia and the Pacific AMHS Conformance Manual
2. Introduction
3. Asia and the Pacific AMHS Requirements
4. System implementation - Guidelines for system requirements
5. Tests and validation of systems
6. Miscellaneous

For better presentation and management, detailed documents, which have been produced on particular subjects initially addressed in the main body of the Manual, have been included as Appendices to the Manual.

1.2. The following Annexes to the Asia and the Pacific AMHS Manual have been produced:

- Annex A: Guidelines on Quality of Service (QOS)
- Annex B: AMHS Conformance Tests
- Annex C: ATN Router

2. Introduction

2.1 Background Information

2.1.1 AFS

The Aeronautical Fixed Service provides, among other things, for the exchange of messages pertaining to the safety of air navigation and the regular, efficient and economical operation of air services.

The following categories of message are handled by the AFS:

- distress and urgency messages
- flight safety messages
- meteorological messages
- flight regularity messages
- aeronautical information services messages
- administrative messages
- service messages

The principal users of messages in the above categories are ATS and the AIS, ATFM, MET and SAR Services which support and complement the ATS.

2.1.2 AFTN/X.25

Initially, the operational requirements for such an information exchange were met by the development of the Aeronautical Fixed Telecommunications Network. The AFTN provides astore-and-forward messaging service for the conveyance of text messages in ITA-2 or IA-5 format, using character-oriented procedures. Although AFTN served its purpose well for many years, AFTN technology has become outdated due to the fact that is remains bound to its telex/telegraphic origins.

The X.25 network provides a common transport service for the conveyance of binary or text application messages in an expeditious and reliable manner.

In the Asia and the Pacific Region, the X.25 provides the reliable backbone data communications infrastructure for the AFTN and a general data communications service to non-AFTN applications such as OPMET.

2.1.3 AMHS

The most recent development with regard to messaging in the ATS environment is the AMHS. The AMHS is a natural evolution from AFTN/X.25, replacing the telegraphic style of working with a modern Message Handling System based on international Standards.

It is presumed that the ATSMHS, being an ATN application, utilises the infrastructure of the ATN internetwork. However this is not a prerequisite for the initial deployment of the ATSMHS.

There are several advantages of AMHS over AFTN/X.25 including:

- increased speed, capacity and throughput
- enhanced reliability
- extended functionality
- interoperability with other global messaging services
- security capabilities
- use of COTS equipment and services

The provisions pertaining to ATSMHS, such as SARPs and general guidance material, are contained in the following ICAO documents, which constitute the main references for this Manual.

- Annex 10, Volume II, Chapter 4 [1]
- Annex 10, Volume III, Part I, Chapter 3 [1]
- Doc 9705 Sub-Volume III [3]
- Doc 9739 Part III, Chapter 6 [4]
- ICAO Asia and Pacific Regions BASIC ANP
- ICAO Asia and Pacific Regions ANP (FASID)

2.1. ATSMHS Overview

2.2.1 General

The ATN SARPs for the Air Traffic Services Message-Handling Service (ATSMHS) define the ICAO store and forward messaging service used to exchange ATS messages between users over the ATN internet.

The set of computing and communication resources implemented by ATS organisations to provide the ATS Message Handling Service is commonly referred to as AMHS (ATS Message Handling System). The ATS Message Handling System SARPs are compliant with mature message handling systems standards such as ISO/IEC 10021 [20] and ITU-T X.400.

2.2.2 Functional Components

In terms of functionality, the ATSMHS comprises the following components:

(a) the Message Transfer Agent (MTA) which performs the function of the Message switch,

(b) the User Agent (UA) which performs the user access to the MTA and provides an appropriate user interface,

(c) the Message Store (MS) which provides the intermediary storage between MTA and UA and is usually co-located with the MTA, and

(d) the Access Unit (AU) which provides for intercommunication with other Messaging Systems.

(e) the ATN router (Optional)

2.2.3 End systems

Three categories of ATN end systems are defined for the support of the ATS Message Handling Service:

- the ATS message server
- the ATS message user agent
- the AFTN/AMHS gateway

Together, these systems provide connectivity between users at ATN end systems and users at AFTN Stations in three different end-to-end configurations:

a) from an AFTN/X.25 Station to another AFTN Station over the ATN

b) from an AFTN/X.25 Station to an ATN End System, and vice versa

c) from an ATN End System to another ATN End System with ATN routers

2.2.4 Levels of service

Two levels of service are defined within the ATS Message Handling Service:

a) The Basic ATS Message Handling Service

b) The Extended ATS Message Handling Service

The Basic ATS Message Handling Service meets the basic requirements of the MHS Profiles published by ISO as International Standardized Profiles (ISPs), and it incorporates additional features to support the service offered by the AFTN.

Compared to the service of the AFTN, the Basic ATS Message Handling Service offers some significant improvements such as:

- practically unlimited message length
- virtually no limit on the number of addressees of a message
- provision of non-delivery reports
- indication of the subject of a message

The Extended ATS Message Handling Service provides functionality in addition to those of the Basic ATS Message Handling Service such as the introduction of directory services and security mechanisms. Furthermore, in addition to IA-5 text, the extended service allows for the transfer of binary coded data, files etc.

The Extended ATS Message Handling Service is backwards compatible with the Basic ATS Message Handling Service.

2.2.5 Inter-operability

During the transition phase from the AFTN or the X.25 network to the AMHS the interoperability between systems is achieved by the use of the AFTN/AMHS and X.25/AMHS gateways respectively.

The SARPs for the AFTN/AMHS gateways have been defined by ICAO.

3. AMHS Requirements

3.1. Quality of Service Requirements

The purpose of this section is to define quality of service (QoS) requirements and set target performance objectives for the AMHS. The performance requirements dealt with in this section are the common understanding on what the applications will get in terms of performance and what level of performance the network has to provide. The performance parameters are therefore necessary for designing applications as well as the network itself.

It is also a very subjective matter. So the detail of this section is only include in the appendix for reference. It is not a requirement but just a guideline for those who interests.

3.2. AMHS Addressing

3.2.1. Introduction

This section aims at the production of the AMHS Addressing Plan for all the Potential AMHS users in the Asia and the Pacific Region. This Plan should define the AMHS users addressing in an intuitive way and it should be comprehensible and meaningful to the human user and independent of the use (or not) of any type of Directory service such as X.500.

The Addressing Plan should also provide the rules to extend the addressing defined to other ATSOs (or not yet identified users).

3.2.2. Requirements

The AMHS addressing scheme should meet all of the following requirements:

- The addressing scheme should be as uniform as possible across all AMHS implementations in different Regions (as it is currently the case for AFTN addresses);
- The same addressing scheme should be maintained when indirect AMHS users (i.e. AFTN users or X.25 network users) migrate to AMHS. This implies that the AMHS addressing scheme is pre-defined and published before actual operation of the newly implemented AMHS;
- The addressing scheme should be independent of any constraints that may be imposed by Management Domains (MDs) in the Global MHS (i.e. the non-AMHS services operating globally as commercial services) or by national regulations that may vary from Region to Region; and
- The addressing scheme should allow for the interchange messages with MDs in the Global MHS.

3.2.3. MHS Addressing structure

Each MHS address consists of a set of MHS standard components referred to as address attributes.

3.2.3.1. High level MHS address attributes

The high level MHS attributes identify an MHS Management Domain as specified in ISO/IEC 10021-2, Section 18.3 [19]. They are determined by the structuring of Management Domains of the MHS Region / organisation to which the address belongs. Each attribute must be registered with an appropriate registration authority to ensure that all addresses remain unambiguous. They are as follows:

- **Country (C) Name:**
  This is mandatory, and the possible range of values of the attribute is drawn from the ISO 3166 register of country names. The register contains a special value 'XX', allocated for the purposes of international organisations (i.e. those that are established by international treaty) which do not ‘reside’ within any particular country;

- **Administrative Management Domain (ADMD) Name:**
  This is mandatory, and its value is the name of an MHS Service provider in the context of a particular country. ADMD Names must be registered by a national registration authority. ADMDs registered under the 'XX' country must obtain that registration from the Telecommunication Standardisation Sector of the International Telecommunication Union (ITU-T).

- **Private Management Domain (PRMD) Name:**
  This is optional, and its value is the name of an MHS service usually operated by a private organisation. PRMD names must be registered either with their respective ADMDs, or with a national register of PRMDs.

3.2.3.2. Low level MHS address attributes

They are as follows:

- **Organisation name:**
  The organisation name is the most significant naming ttribute of the O/R address. Many organisations will operate as sub-naming authorities, allocating name space below their organisation name attribute. The function of the domain names, both Administrative and Private, is to provide a relaying mechanism for delivery of the message to the intended destination. Relaying to the intended destination is made easier by the combination of a unique Organisation Name within a unique PRMD

- **Organisational unit name:**
  The organisational unit (OU) names are used within the context of a hierarchical addressing structure as identified by the organisation name attribute, and should be used to identify meaningful subdivisions of that namespace. The X.400 O/R address allows for up to 4 specified, each up to 32 characters in length, in descending order of significance within the organisational hierarchy.

  The other *OU name* (*OU2-4*) attributes can be used to further subdivide the namespace represented by the *OU1* attribute if necessary. Subordinate OU names should only be used if all superior OU names are in use.

- **Common Name:**
  The common name attribute is the preferred way of Identifying distribution lists and computer applications, avoiding the (mis)use of the personal name attribute. The common name attribute can be up to 64 characters in length.

3.2.3.3. List of Attributes

A complete list of attributes with different information concerning on the Maximum length and type of allowed characters for each attribute type is provided in the following Table:

MNEMONIC FORM ADDRESS ATTRIBUTE	CHARACTERISTICS
Country name	2 alpha or 3 numeric
ADMD name	24 Printable String
PRMD name	24 Printable String
Organisation name	64 Printable String
Organisational unit name	32 Printable String
Common name	64 Printable String

Table 2: Mnemonic O/R address attributes maximum length and types

3.2.4. AMHS Addressing Schemes

3.2.4.1. XF-Addressing Scheme

The AMHS SARPs describe a potential AMHS addressing scheme, the XF- Address (translated), composed of the following:

a) an AMHS Management Domain identifier;

b) an organisation-name attribute:

   (1) as specified in ISO/IEC 10021-2, Section 18.3,

   (2) taking the 4-character value “AFTN”, and

   (3) encoded as a Printable String;

c) an organisational-unit-names attribute:

   (1) as specified in ISO/IEC 10021-2, Section 18.3,

   (2) comprising a sequence of one single element, which takes the 8-character Alphabetical value of the AF-Address (AFTN-form address) of the user; and

   (3) encoded as a Printable String.

Note 1. – An XF-Address is a particular MF-Address whose attributes identifying the User within an AMHS Management Domain (i.e. those attributes other than country-name, administration-domain-name and private-domain-name) may be converted by an algorithmic method to and from an AF-Address. The algorithmic method requires the additional use of look-up tables which are limited, i.e. which include only a list of AMHS Management Domains rather than a list of individual users, to determine the full MF-address of the user.

Note 2. – An MF-Address (MHS-form address) is the address of an AMHS user.

A summary of XF-Addressing Scheme can be found in the following table:

Attribute	Attribute value	Remarks
Country-name ©	C = “XX”, as already obtained by ICAO from ITU-T	
ADMD-name (A)	A = “ICAO”, as already registered by ICAO at ITU-T	
PRMD-name (P)	P = private-domain-name, taking the value of the one or two-letter ICAO Nationality Letters as specified in Document 7910.	Default value will be used to ensure that the attribute value is always defined (see [10]).
Organization name (O)	O = “AFTN”, taking the 4-character value “AFTN” encoded as a Printable String	
Organizational unit-Name (OU1)	OU1 = the 8-letter AF-address (or AFTN indicator) of the considered user	

Table 3: XF-Addressing Scheme

3.2.4.2. CAAS Addressing Scheme

(a) High-level attributes

The following preferred high-level MD and address structure that meets all of the requirements outlined in paragraph 3.2.1 above:

• Country Name = 'XX';

• ADMD Name = ‘ICAO’;

• PRMD Name = preferred operating name assigned by each ATSO or group of ATSOs.

In this way, ICAO creates an international ADMD without addressing constraints Imposed from outside ICAO and its members.

This scheme has placed two requirements on ICAO:

- To obtain from the ITU-T the registration of the name ‘ICAO’ (or some other suitable acronym agreed between ICAO/ANC and ITU-T); and
- To establish and maintain a register of PRMDs established by ATSOs that operate using the 'XX' + ‘ICAO’ address structure, in a way similar to Doc. 7910 [5]and Doc 8585 [6].

  Note. – This scheme does ***not*** *require ICAO itself to operate the ADMD systems since this should be delegated to the participating ATSOs.*

This registration will enable the establishment of regional AMHS services and their later interconnection, and it will provide ATSOs with a good deal of stability within which they can develop their AMHS plans.

(b) Low level attributes

The CAAS addressing scheme includes the following attributes:

- Organisation name (O) = Region,
- Organisational unit 1 (OU1) = Location,
- Common name (CN) = User

Consequences:

- Each ATSO will define the values for the Organization-Name attribute (O) in its Management Domain. The character set to be used for this attribute will be the set of characters allowed by the ASN.1 type "Printable String".
- Organisational Unit 1 (OU1) will be the 4-character ICAO location indicator (as specified in ICAO Doc 7910 [5]) of the user.
- Common Name (CN) will either include the 8-character AFTN address for AFTN users, or the X.25 users (OPMET, AFTN Operator messages). It should be noted that this is partly redundant with the definition of OU1, however it is considered as unavoidable due to the evolutionary nature of the move from AFTN to AMHS.

3.2.5. Asia and the Pacific AMHS Addressing Plan

3.2.5.1. Asia and the Pacific AMHS Addressing Scheme

Major concepts of this AMHS Addressing Plan are shown as follows:

Attribute	Attribute value	Remarks
Country-name (C)	C = “XX”, as already obtained by ICAO from ITU-T	
ADMD-name (A)	A = “ICAO”, as already registered by ICAO at ITU-T	
PRMD-name (P)	P = a name to be defined by each ATSO and registered by ICAO. Such a name will identify a State, an Organization, or an organization within a State. .	In the absence of such a name being registered by the ATSO at ICAO, a default value will be used to ensure that the attribute value is always defined. This default value is the ICAO two letter State/territory identifier, as may be foundin Doc 7910.
Organization name (O)	O = a value corresponding to local/national geographical information, e.g. a region or a geographical area within a State where the user is located.	The syntax and value are to be defined by the considered ATSO. The table associating such an organization-name to each ICAO location indicator (4 characters) needs to be registered and published by ICAO.
Organizational unit-name (OU1)	OU1 = the ICAO location indicator (4 characters) of the considered user;	

Table 4: AMHS Addressing Plan

Example: MF AMHS Address of Singapore Com center:
/C=XX/A=ICAO/P=Singapore/O=CAASG/OU=WSSS/CN=WSSSYFYX

3.2.5.2. Distribution lists.

The scheme to be used for the identification of AMHS Distribution Lists is the same as for potential AMHS users. The O and OU attributes would then represent the expansion point of the Distribution list.

3.2.6. Guidelines on PRMD Name assignment

3.2.6.1. Purpose

A PRMD-name attribute shall be formulated and assigned by each ATSO in order to uniquely identify the AMHS Management Domain of which the considered ATSO is in charge. Practically, the PRMD-name attribute identifies that part of the AMHS for which an ATSO is responsible.

3.2.6.2. Assignment rules

When assigning a value to the PRMD-name attribute the following rules should be considered:

1) It should be representative of the whole AMHS Management Domain for which the ATSO is responsible;

2) It should be as short as possible, an acronym would be sufficient;

Note. – The use of the two-letter ISO 3166 country codes (e.g. SG for Singapore, AU for Australia, US for the United States, etc.) is not advisable, as these codes are used as values of the Country-name attribute and not the PRMD-name attribute. This may confuse the operators.

3) It should be stable and not subject to changes unless there are duly justified Technical and/or operational reasons;

4) It should be unique and unambiguous;

Note. – Care should be taken not to use a name or an acronym such as "civil aviation", "ATSO", "DGAC".

5) A default value has been reserved in order to ensure that this attribute value is always defined. This default value is the ICAO two letter State/territory identifier, as may be found in Doc 7910 [5].

6) It should only comprise standard characters, e.g. no accented letters or letters that are only used in specific geographical areas;

7) The use of figures is not advisable.

3.2.6.3. Registration

Once assigned by the concerned ATSO, the PRMD-name value(s) shall be registered and published by ICAO after checking its uniqueness, as described in paragraph 3.2.6.2.

Note. – ICAO being the naming authority for AMHS addresses, there is no requirement to register the PRMD-name value(s) with a national authority.

3.2.7. Guidelines on Organization Name assignment

3.2.7.1. Purpose

The purpose of the Organization-name attribute is to allow each ATSO to split, if needed, the AMHS Management Domain (MD) for which it is responsible in distinct geographical areas.

Within a given AMHS Management Domain (identified by the "C", "A" and "P" attributes) two potential AMHS network architectures are possible:

a) Centralised architecture, with one single ATS message server; and

b) Geographically distributed architecture, with several regional ATS message servers.

It is to be noted that architectural aspects and addressing aspects are not completely linked together; in effect the agreed addressing scheme does not place any constraints on the AMHS network deployment plan.

3.2.7.2. Assignment rules

Before assigning a value to the Organisation-name attribute, each ATSO
Should follow the following 3-step process:

1) Develop the general architecture of the AMHS to be implemented;

2) Define the location and the number of sites at which ATS Message Server could be installed within a foreseeable time frame (e.g. 5, 10 or 15 years); and

3) Chose and assign a name to each one of these sites.

A specific case is the situation where a single ATS Message Server is implemented in an AMHS MD, providing services to AMHS users that are all directly attached to this server (centralized architecture). For simplification, it was suggested that a single organization name (O) value be allocated to all location indicators in the AMHS MD.

Potential criteria for the selection of sites include:

- Geographic divisions, such as: North, South, East, West, etc.;

- Administrative divisions of the concerned ATSO, such as ATS, Meteorological, etc.;

- Operational divisions centred around the ACCs (if more than one ACCs exist);

- Operational divisions centred around the main airports;
- Mapping of the AMHS architecture on the existing AFTN / architecture;
- A mixture of the above criteria; and
- Other.

Note. – Care should be taken not to define too many geographical areas within a given AMHS MD as this may lead to less efficient message routing.

When assigning a value to the Organisation-name attribute, the following rules should be considered:

1. It should be as short as possible;
2. It should only comprise standard characters, i.e. no accented letters or letters only used in specific geographical areas;
3. The use of figures is not advisable.

Note. – An ATSO should define different values for the Organization-name attribute only if it plans to implement a distributed AMHS architecture in the short, medium or long term future. ATSOs not planning to implement a distributed AMHS architecture should allocate a single value for this attribute.

3.2.7.3. Registration

Once assigned by the concerned ATSO, the Organization-name values shall be registered and published by ICAO, as described in paragraph 3.2.8.3.

Note. – ICAO being the registration authority for AMHS addresses, there is no requirement to register the Organization-name value(s) with a national authority.

3.2.8. Address conversion

3.2.8.1. Addressing Plans requirements

The selected address conversion strategy must take into account the following principles:

- The selected address conversion solution shall be able to support any X.400 addressing plan making use of any address form.
- The AFTN address of an AFTN or AMHS user is unambiguous, internationally recognized and shall not be replaced by another value.

The addresses to be considered are: AFTN, XF-form, CAAS and MF (non- CAAS). It can be concluded that:

- All Asia and the Pacific AFTN/AMHS gateways shall implement the conversions AFTN<=>XF;
- All Asia and the Pacific AFTN/AMHS gateways shall implement the conversions AFTN<=>ATSOs;

- All Asia and the Pacific ATSOs gateways should implement the conversions AFTN<=>ATSOs, together with an ATSOs address space within their remit (SARPs recommendation);

- To deal with the arrival of spurious XF addresses at Asia and the Pacific ATSOs MDs from the global AMHS, the redirection XF=> ATSOs could be supported by all ATSOs;

- If an ATSO defined an MF (non-ATSO) address space, then all gateways would have to support the conversion AFTN<=> MF (non-ATSO). This is an undesirable alternative since a global and common CAAS has been recommended by ICAO.

3.2.8.2. Address Conversion Scenarios and Criteria

The identified scenarios are the following: single conversion, AMHS transit conversion, AFTN transit conversion and multiple transit conversion.

Once the scenarios have been established, the following considerations for the address conversion have to be performed:

- The result of the address conversion performed in an AFTN/AMHS gateway shall depend only on the pre-defined pair of unambiguously associated AFTN and AMHS addresses, and not on the gateway itself, according to the form published by ICAO and defined by the delivering MD.

- It is recommended that each gateway performing address conversion should have access to the minimal necessary information to perform mappings between AFTN addresses and AMHS addresses and vice-versa. The complete mappings between AFTN addresses and their AMHS equivalents should be published (in electronic form) and made available to all gateways that support address translations.

- The conversion process shall be easy to use and manage, and efficient.

As a conclusion, a compromise solution combining the use of algorithmic tables and X.500 directory is preferred for the address conversion.

3.2.8.3. General model for address distribution and gateway address conversion

A model of address distribution and gateway address conversion is depicted in Figure 1 below. The figure represents information exchanges between ICAO and three ATSOs implementing AMHS Gateways, concerning address conversion. ATSO1 and ATSO2 implement a distributed address publishing service (APS), e.g. by means of ATN X.500 Directory Services. This allows electronic distribution. ATSO3 provides this information to ICAO for manual collation and distribution (e.g. on paper, electronic database), and does not support a directory.

The dotted arrows represent exchanges that are performed in a non-electronic way, e.g. through "paper" procedural exchanges. The full arrows represent exchanges that are performed electronically using appropriate communication protocols.

The model identifies a number of components that are necessary for address conversion:

(1) Collection and distribution of the basic addressing information that establishes equivalence between the different addresses identifying each MHS/AFTN/X.25

user; the content of this information **must** be standardised and made available to all AMHS/AFTN/X.25 Gateways;

(2) Access to, and/or import of the basic addressing information into AFTN/AMHS gateways. This depends on the particular gateway implementation;

(3) Re-structuring the basic addressing information into a format suitable for use by each gateway's internal address conversion procedures (AMI). This is again Gateway implementation specific;

(4) The internal procedures and data structures of the gateway (AMP and AMT) that make use of the re-structured addressing information. This is gateway implementation specific.

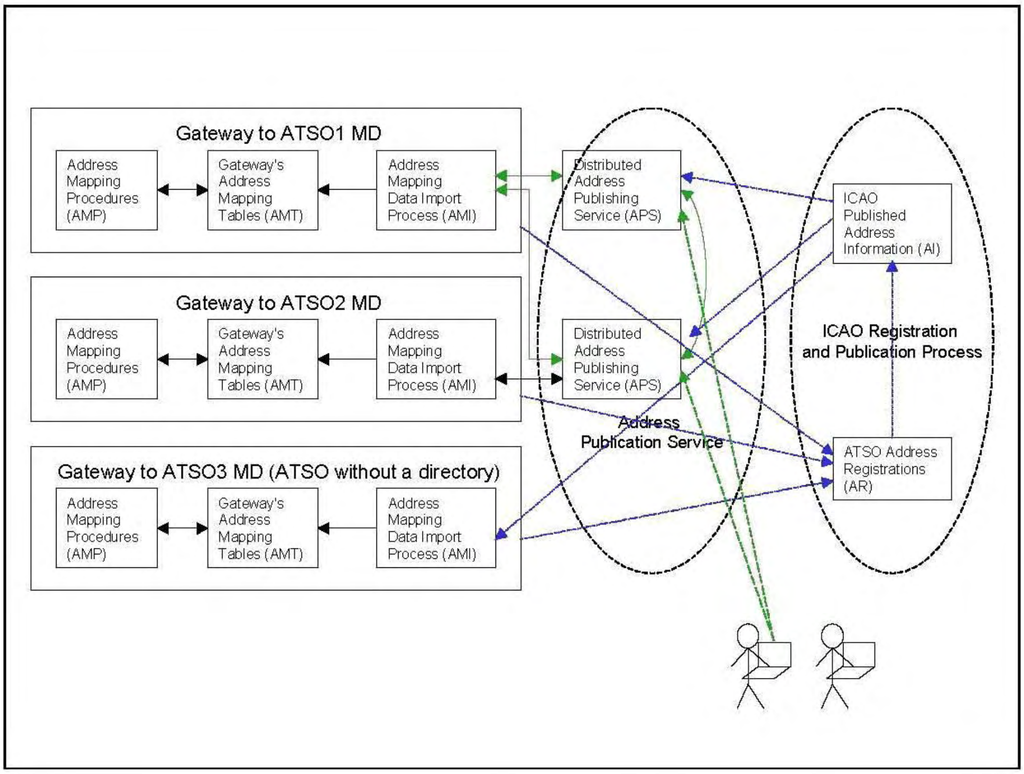


Figure 1: General model for gateway address conversion

The address mapping information content held in AMT and distributed through APS is identical in nature.

The structure of APS must be compatible with many different systems (e.g Different ATSO's Gateways), and must therefore be standardised. There are a number of possibilities for structuring APS:

- As an X.500 Directory Information Tree, thereby enabling implementation of a Distributed APS;

- By some other electronic means (e.g. CSV files);

- On paper.

3.2.8.4. The impact of different paths through the AFTN and AMHS

There is also a potential need for messages to undergo multiple address conversions. In order to minimise message rejection and to regulate the responsibilities for conversions, the following rules should apply:

- Originating MDs (for originator's addresses) shall generate addresses according to the form published by ICAO and defined by the delivering MD (for recipient addresses);

- Delivering MDs shall be authorized to reject messages received with recipient addresses which do not comply with the address form published by ICAO and defined by the delivering MD.

- Delivering MDs should have the capability of redirecting potential internal XF addresses to the corresponding MF(S) form addresses for use within their delivering MD, for a transition period of at least 6 months after publication of the appropriate ICAO documentation.

- Transit domains should not attempt to perform any AMHS <-> AMHS Mapping unless a specific bilateral agreement has been established with the delivering MD (for recipient's addresses) or the originating MD (for originator addresses). Transit MD should only use the attributes C, A, P (which are invariant and predetermined for all AMHS address forms in the ATS) in selecting a message route.

3.2.8.5. Recommended AMHS Address Conversion Strategy

The recommended AMHS address conversion strategy is the means by which the general model represented in Figure 2 should be realized by States in the Asia and the Pacific Region. It is also applicable on a worldwide basis and has been presented and adopted by the ICAO ATNP as the general AMHS address conversion strategy[1]. This strategy is made of the following elements:

a) the establishment, by an appropriate ICAO body or entity, of an ICAO Registration and Publication process as a set of procedures for collecting and publishing AMHS address conversion information on a periodic basis (e.g. twice yearly). This will include:

    i) the MD information included in the ICAO Registry of AMHS Management Domains, i.e. the MD identifier and the corresponding ICAO State/territory two letter identifier, together with the specification of the type of implemented addressing scheme.

    ii) for those MDs having implemented the ATSOs, the mapping information providing the organization-name address attribute for each ICAO location indicator;

b) A Distributed Address Publishing Service (APS), based on ATN Directory Services, that allows publication of real-time AMHS address conversion information. This is to

[1] This will result in the corresponding guidance material being included in Edition 2 of ICAO Document 9739 (Comprehensive ATN Manual).

be implemented at the earliest opportunity upon ATSOs initiative, with the following principles:

i) use of the directory scheme;

ii) initial population of the Directory Information Base with the information distributed through the ICAO Registration and Publication process;

iii) implementation of a single Directory System Agent (DSA) per ATSO to hold the MD Registry sub-tree, the world-wide ATSO information distributed through the ICAO Registration and Publication process, and the local AMHS MD address conversion information sub-tree; and

c) in co-existence with the use of Address Mapping Tables (AMT) directly derived from the information published through the ICAO Registration and Publication process, for ATSOs that choose to defer the implementation of ATN Directory Services.

As a local implementation matter, ATSOs that envisage implementation of Directory Services for the purpose of the Distributed address publication service (APS) at the same time as they implement AMHS, should also consider the use of directory solutions as a technical option for the gateway's Address Mapping Tables (AMT).

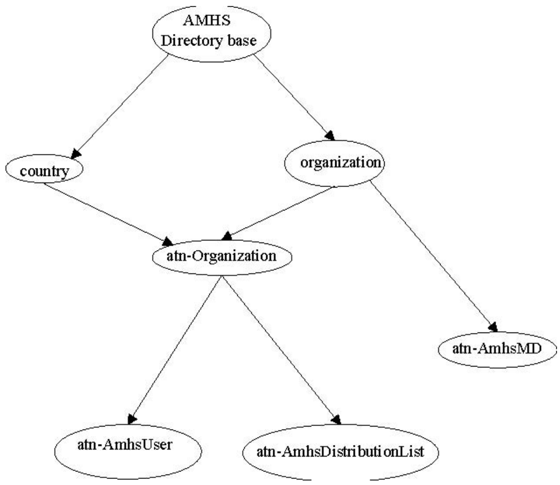


Figure 2: DIT structure for AMHS address conversion

3.2.8.6. Regional provisions

The strategy above is complemented by the following transitional provisions which may apply regionally.

In case the first element in the above strategy is not implemented by ICAO in a timeframe compatible with early AMHS implementations, an equivalent process may be set up on an ad-hoc basis among ATSOs forming an AMHS island. This is particularly applicable to any countries ATSOs being early AMHS implementers.

In case of ATSOs implementing the second element in the above strategy that initially prefer to group together for the implementation of a single ICAO Regional DSA, the following should apply:

- the MD Registry sub-tree,

- a local AMHS MD ATSOs information sub-tree for each of the ATSOs in the group; and

- the world-wide ATSOs information distributed through the ICAO Registration and Publication process.

The Regional DSA thereby becomes an aggregation of the local DSAs envisaged in the principle strategy.

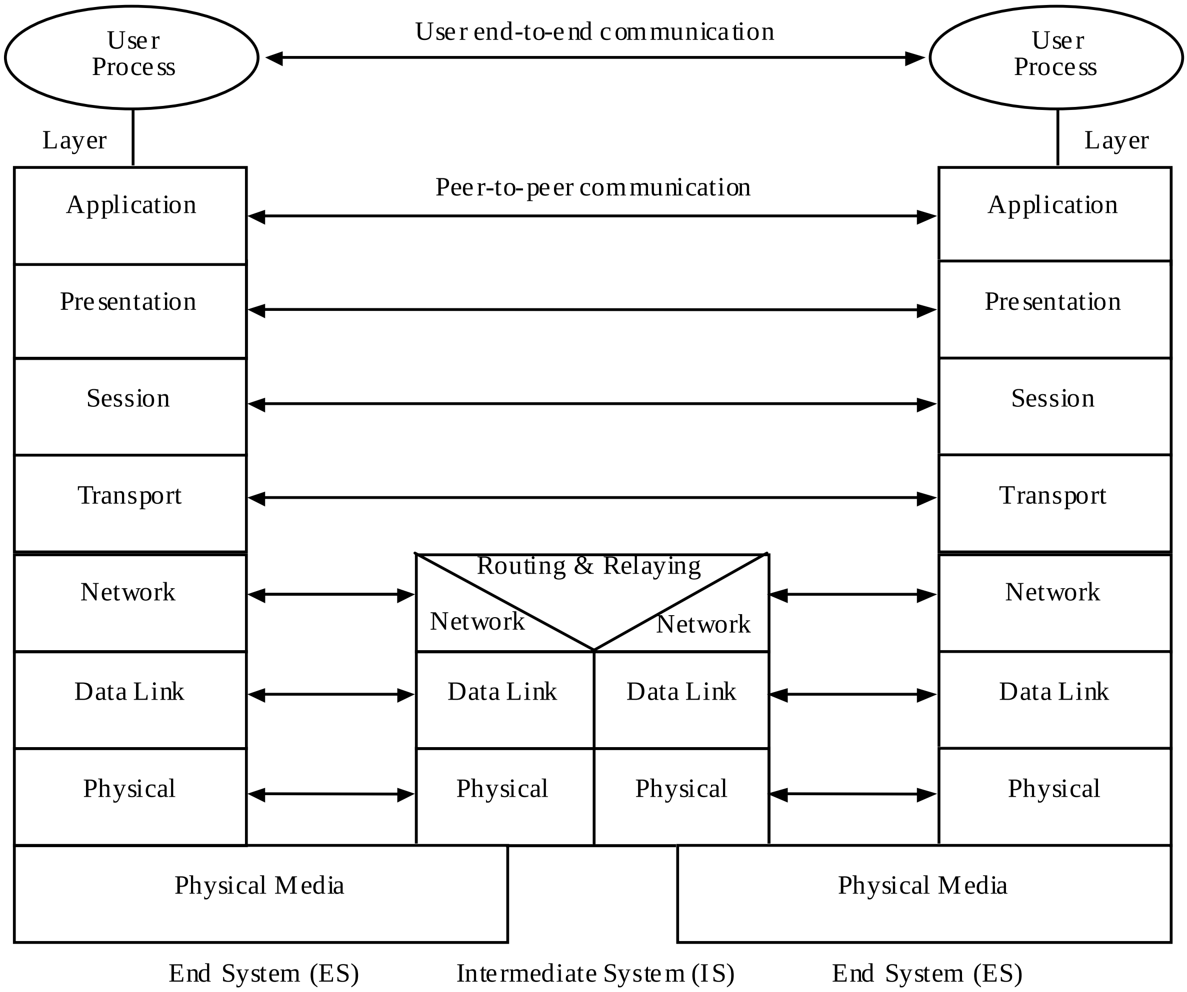
In the Asia and the Pacific Region, the creation of an Offline Management Centre is recommended to consolidate, co-ordinate and distribute AMHS user address changes across the Region. This Offline Management Centre should implement such a Regional DSA in support of its address management activities.

3.3. AMHS router topology

3.3.1. OSI Model for ATN Router

This section addresses the lower three layers of the OSI seven-layer model for the ATN Ground-Ground (G/G) routers in the Asia/Pacific regional ATN network. The three layers are Network, Data Link and Physical layer.

The ATN uses the ISO/IEC8473 Connectionless Network Protocol (CLNP) as the network protocol. Data are transferred in the CLNP Protocol Data Units (PDUs) over sub-networks such as ISO/IEC 8802 Local Area Network (LAN) and ISO/IEC 8208 ("X.25") point-to-point connections or packet switched networks. ATN routers bridge these sun-networks together to form an integrated ATN network, relaying data packets between LAN and WAN, and WAN and WAN.



Open System Interconnection reference model

a. Network Layer

The network layer includes three sub-layers:

Sub-network Independent Function (SNICF)

The SNICF **shall** include the following routing and routed protocol:

1. ISO/IEC 10747 — the Inter-Domain Routing Protocol (IDRP); and
2. ISO/IEC 8473-1 — the Connectionless Network Protocol (CLNP).

The SNICF may support the following two optional routing protocols:

1. ISO/IEC 9542 — the End-System to Intermediate-System (ES-IS) protocol; and
2. ISO/IEC 10589 — the Intermediate-System to Intermediate-System (IS-IS) Intra-domain routing information exchange protocol.

Sub-network Dependent Convergence Function (SNDCF)

The proper SNDCF **shall** be implemented for underlying sub-network(s). The most commonly implemented SNDCFs are the following:

1. ISO/IEC 8473-2 — Sub-network Dependent Convergence Function (SNDCF) for Local Area Network (LAN); and
2. ISO/IEC 8473-3 — Sub-network Dependent Convergence Function (SNDCF) for X.25 network.

Sub-network Sub-layer

The sub-network sub-layer is determined by the underlying sub-network. When the data are communicated over X.25 sub-network, the sub-network **shall** include X.25 Packet Layer Protocol (PLP) as specified in ISO/IEC 8208.

b. Data Link Layer

The ATN G/G router Data Link Layer for use within States is a local matter and could be X.25, LAN, etc.

The Data Link Layer used between States is subject to bilateral agreement. To ensure regional interoperability, however, the data link layer requirements for ATN routers that connect to the Asia/Pacific ATN regional network are specified in the Asia/Pacific regional ATN router ICD.

c. Physical Layer

The ATN G/G router Physical Layer is a local or bilateral matter and could use the Physical Layer of X.25, LAN, etc.

3.3.2. Routing and Routed Protocols

Class 4 routers support dynamic routing using the following routing protocols:

1) End system to Intermediate System (ES-IS) routing protocol;

According to ICAO Doc 9705, the ES-IS routing protocol is an optional protocol for ATN G/G routers. However, if ES-IS is supported, it is recommended that to ensure interoperability with End Systems, ATN G/G routers **should** comply with the requirements of ISO/IEC 9542 (ES-IS).

2) Intermediate System to Intermediate System (IS-IS) routing protocol; and

According to ICAO Doc 9705, the IS-IS routing protocol is an optional protocol for ATN G/G routers. However, if IS-IS is supported, it is recommended that to ensure interoperability with IS routers. ATN G/G routers **should** comply with the requirements of ISO/IEC 10589 (IS-IS).

3) Inter-domain Routing Protocol (IDRP).

The ATN G/G router **shall** comply with the requirements in ISO/IEC 10747 (IDRP), section 5.8.3 of ICAO Doc 9705, and the IDRP APRLs specified in the Asia/Pacific regional Ground/Ground router ICD.

4) Connectionless Network Protocol (CLNP)

The ATN G/G router **shall** comply with the requirements in ISO/IEC 8374-1, sections 5.6.2 and 5.6.3 of ICAO Doc 9705, and the CLNP APRLs specified in the Asia/Pacific regional Ground/Ground router ICD.

4. AMHS Protocol Scenarios

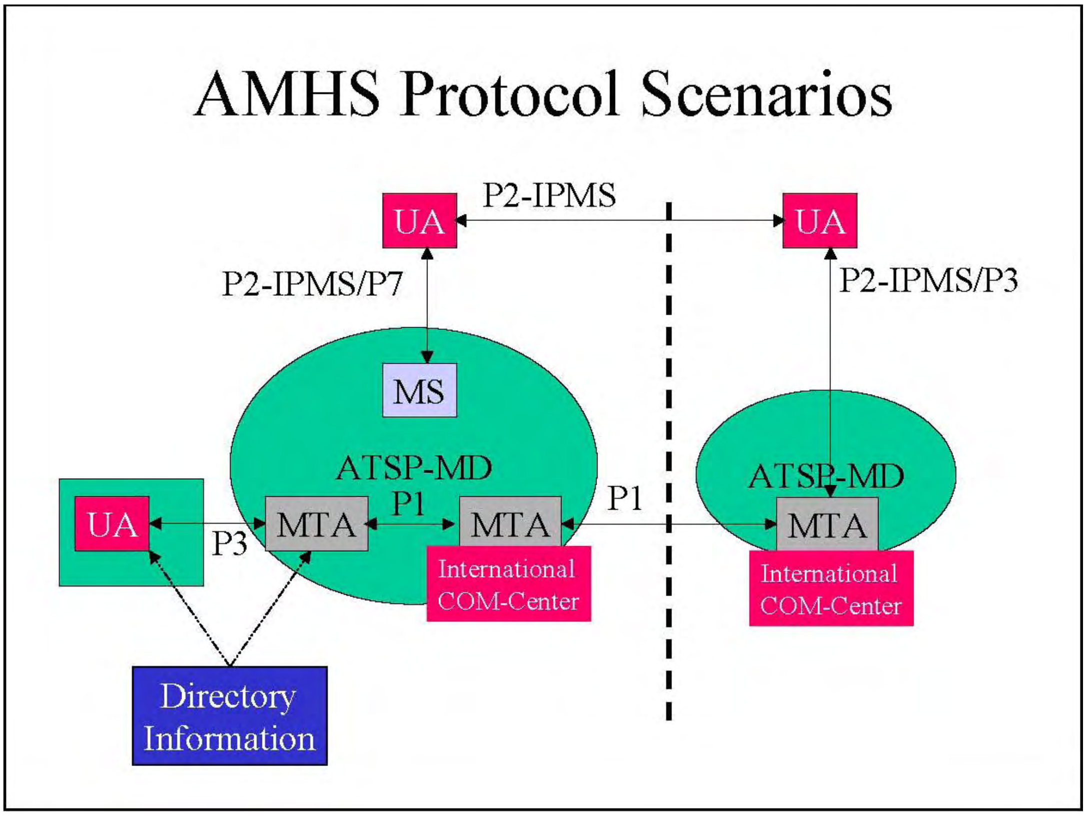


Figure 3: AMHS Systems and interconnecting Protocols

4.1 Applicable Profile

The Profile applies to the following AMHS system components:

a) UA - User Agents

b) MTA - Message Transfer Agents

c) MS - Message Stores

The Profile applies to the following AMHS protocols:

a) P1 - Message Transfer

b) P2 - IPM Content

c) P3 - Message Submission/Delivery

d) P7 - Message Retrieval

The Profile specifies a profile of ATS Message Handling Service conformance called the Asia and the Pacific-AMHS Profile. It is based on the requirements of following:

a) The Basic ATS Message Handling Service (Bas), introduced in the Doc. 9705 Ed. 3, para. 3.1.1 Note 2;

b) A number of further Functional Groups and options selected from the Extended ATS Message Handling Service (Ext), introduced in the Doc. 9705 Ed.3, para 3.1.1 Note 2;

The resulting scope is sufficient to ensure inter-State message interchange using AMHS according to the Basic AMHS requirements stated in Doc. 9705, which covers Basic Message Transfer Capabilities, Distribution Lists, appropriate message size capability and Legal Recording.

Security requirements are not a mandatory part of the Asia and the Pacific-ATSMHS Profile. However, the Profile mandates IP address validation and the protocol includes system identification following transport connection establishment. It must be pointed out that certain Messaging Application Security functions are also mandated in the MHS.

6.1 Use of the Directory

Use of Directory is not mandated in the Profile due to the following reasons:

- There are other ways to implement the distribution of the necessary directory information which are viable at least in the early phases of AMHS implementation;

- Some States will not implement the directory (nor access it) in the first Implementation of AMHS. Some of the reasons for this are that they want to implement AMHS first before taking the next step to the Directory. Also, some currently available AMHS products do not support access to the Directory;

- Some States foresee that Directory Access as specified in Doc. 9705 using X.500 DAP is too costly in terms of software purchase, and they would like to be able to use LDAP (a more cost effective RFC-based equivalent). However, there are no currently available LDAP schema standards covering some of the ATN Directory-specific requirements (and some aspects of X.400 support). There are also no suitable standard LDAP products available;

- In some cases, it is not quite clear what elements of the ATN-Directory Schema are required to support different AMHS functions (e.g. in terms of directory information). These issues need to be resolved by further guidance material on the use of the ATN/AMHS Directory by the ACP. Currently, work is ongoing to fulfill this requirement.

5 System implementation -Guidelines for system requirements

5.1. Introduction

5.1.1. This section is intended to deal with technical and operational requirements for a COM system replacing the AFTN/X.25 system by an AMHS or adding the ATSMHS capability. As indicated by its title, this section covers guidelines for requirements not specified in the AMHS SARPs, but considered by the Group important enough for being included in a Call For Tender for the procurement of an AMHS system.

5.1.2. The main input of this section was a subset of the specifications of an actual Call For Tender issued by one of the Group members, adapted and modified in order to have a 'template' able to be used by any ATSO who intends to procure an AMHS system.

5.1.3. The section covers technical and operational requirements like:

- General facilities
- Addressing - mapping table facilities
- Queue management facilities
- Message repetition facilities
- Tracing facilities
- Sizing
- Availability and reliability

5.1.4. For such a COM system in the following paragraphs the term "**AMHS System**" will be used.

5.1.5. Due to the character of this section (as guidelines for system requirements) the Term "**should**" is used. In a specific Call For Tender this term can be replaced by shall.

5.2. General requirements

5.2.1. The AMHS System should implement the ATSMHS and AFTN/AMHS Gateway facilities in accordance to the specifications defined in the latest approved ATN SARPs for Basic Services, but supporting AFTN messages with a message length up to 64 Kbytes.

Note. – This requirement is not covered by the SARPs, which mandate support of Standard AFTN message length only.

5.2.2. The AMHS System should support several simultaneous associations with an MTA partner (at least, up to 5).

5.2.3. The AMHS System should support simultaneous associations with several MTA partners (one or several associations with each MTA partner) with the same or different “transport” protocols (e.g. TCP/IP to be used within EUR, ATN between ICAO Regions).

5.2.4. The AMHS System should support the total number of simultaneous Associations (sum of all associations) without any restrictions caused by inherent limitations of the system (memory, interfaces, etc).

5.2.5. The AMHS System should allow control of establishment of associations with MTA partners via on-line operator commands; i.e., it should be able to:

- Prevent/allow the establishment of associations with a given MTA partner by AMHS System (local MTA), by MTA partner only or by both partners.
- Prevent/allow the establishment of associations with all configured MTA partners by AMHS System (local MTA), by all MTA partners only or by all partners.
- Force the termination of associations already established with a given MTA partner.
- Force the termination of associations already established with all configured MTA partners.

Note. – The number of actual simultaneous associations to be supported will depend on:

- *the target 'logical' AMHS network topology: for example each centre establishes direct associations with all the other centres or each centres establishes associations with adjacent centres only (as in AFTN);*
- *whether permanent or dynamic connections will be established. Such distinction is only applicable in case there is no requirement for continuous traffic exchange.*

5.2.6. The AMHS System should implement MTA queues. These queues will keep the AMHS messages that:

a) either are pending to be sent; or

b) have been transmitted but for which a delivery report is expected.

Note 1. – The queue referred to in " item a" should be implemented in the MTA.

Note 2. – The queue of messages for which a DR is expected should be implemented in the User Agents and MTCUs of the AFTN/AMHS gateways. The reaction of an AMHS System in case of loss of a DR should be fixed (implementation matter): E.g., would it have to resend the message after timeout? How many attempts to resend the message should be made? A DR or NDR is addressed to the originator of the message, therefore it should be left to the originator to react upon non-arrival of a DR as it is his task to react upon reception of a NDR. If the originator is an indirect (AFTN) user, the AFTN/AMHS gateway has to perform this task on his behalf. Furthermore, a report may take another route than the message it refers to, that means it does not necessarily pass through the same MTAs as the original message.

5.2.7. There should be a logical MTA queue per configured MTA partner. Management of these queues is specified in section 5.4).

5.2.8. The configuration of an MTA partner (via on-line commands) should provide flexibility for each of its parameters. For example:

a) It should be possible to configure the “transport” protocol (e.g. ATN, TCP/IP, TP0/X.25, TP4/X.25) to be used per each MTA partner.

b) In case of selection of TP4/X.25, it should be allowed to configure at least two local X.25 attachments to be used for the connections, several calling – called addresses to be used for initiating a call or acceptance of an incoming call, etc.

c) It should be possible to configure the maximum number of simultaneous associations with each MTA partner.

d) It should be possible to configure whether the associations have to be left permanently established or whether they have to be established and closed depending on traffic.

5.2.9. The AMHS System should allow configuration of all profile items if possible.

5.2.10. The AMHS System should allow configuration of the following profile items, at least:

a) Mapping between AFTN priorities and AMHS Message Transfer Envelope priorities.

b) Values of “rn” and “rnr” in the notification-requests element in the recipient fields in the IPM heading. These values should depend on the value of the AFTN priority.

Note 1. – Both functions should be implemented in the UAs and MTCUs of the AFTN/AMHS gateway since the MTA does not deal with the ATS Message Priority (or AFTN priority) which is contained in the ATS Message Header as part of the IPM body.

Note 2. – The SARPs specify the values of these profile items. It is considered that the implementation should allow the possibility to change them just by configuration in case operational experience recommended other settings. The processing is implementation matter.

5.3. Addressing – mapping tables requirements

5.3.1. The AMHS System should support the CAAS (see section 3.2)

5.3.2. The AMHS System should process and manage AMHS messages received with the O/R name in the XF Addressing Scheme also, even if the ATSO has chosen the CAAS for its internal users.

5.3.3. The AMHS System should provide mechanisms to import mapping tables needed in the AFTN/AMHS Gateway. The tables to be imported will be downloadable from the AMC system.

5.3.4. The implemented facilities in the AFTN/AMHS Gateway which map an AFTN address to an O/R name should be flexible enough to accommodate different O/R structures (Addressing Schemes) and use the minimum number of configuration / lookup tables with the minimum number of entries. As an example for the implementation of the mapping of an AFTN address to an O/R name, the following information should be entered in configuration tables:

i) Attributes and associated values that are fixed for each State. E.g. in the case of States using the address scheme described in section 3.2 the attributes and associated values to be entered should be Country, ADMD and PRMD. Each entry will be indexed by the ICAO routing area or State/territory identifying letters (1 or 2 first characters of the AFTN address).

ii) Attributes whose values can be determined directly from the AFTN address. e.g. in the case of States using the CAAS described in section 3.2, the Organization Unit 1 attribute (first to fourth characters in the AFTN address) and the Common Name (all characters in the AFTN address) should be declared here for them.

iii) Attributes whose values depend on a mapping table. For each such attribute for each State, the following should be specified: the name of the mapping table and the subset of the AFTN address (e.g. one to four first characters, the complete AFTN address, wild characters could be used to define the subset...) that gives the index to the mapping table. The mapping table itself should also be provided. E.g. in the case of countries using the CAAS address scheme described in section 3.2.4.2, the value for the Organization attribute should be defined this way.

5.3.5. The possibility to use a directory should also be contemplated, even if this is not part of the Basic Services.

5.4. Queue management requirements

5.4.1. The AMHS System should provide, in addition to a pure diversion facility of outgoing queues, a reprocessing of messages in X.400 (outgoing) queues in case of longer outages of adjacent MTAs (non-reachability).

Note. – Such reprocessing facilities will be very important during the time period when both AMHS and AFTN/X.25 centres coexist in the Asia Region.

5.4.2. Two types of reprocessing should be envisaged at:

a) the pure X.400 level

b) the AFTN level (in the case of AFTN/AMHS Gateways)

5.4.3. Reprocessing at the pure X.400 level

5.4.3.1. The reprocessing at pure X.400 level should allow :

a) To extract messages waiting in an X.400 queue from this queue,

b) To process these messages again by the X.400 routing software and

c) To route according to possible new or temporarily modified X.400 routing tables.

5.4.3.2. Such a mechanism would allow to extract the messages from the queue associated to a non reachable MTA. The messages could be routed through another centre (MTA) and forwarded through the alternate route only for those recipient addresses for which alternate routes have been activated. For all other recipients addresses the messages remain in the queue. This prevents a general forwarding of messages to an other centre (MTA) with recipient addresses not intended to reroute.

5.4.3.3. The reprocessing at the pure X.400 level should be present in the ATS Message Servers, in AFTN/AMHS Gateways and (in the future) in X.25/AMHS Gateways.

5.4.4. Reprocessing at the AFTN level

5.4.4.1. The reprocessing at AFTN level should allow:

a) To extract messages waiting in an X.400 queue,

b) To re-process them by the AFTN layer, and

c) To route them according to the current AFTN, X.25 and X.400 routing tables respecting the updated route availability information (predefined alternate routing).

This reprocessing would solve the problem of non-reachability due to outages, in a heterogeneous AFTN/ X.25/AMHS environment.

5.4.4.2. An X.400 queue can contain messages, reports and probes. The AFTN Reprocessing function should only concern the messages. These messages can be of different ‘types,
e.g. i) messages from AFTN/AMHS gateways,
ii) messages from X.25-OPMET/AMHS gateways,
iii) ‘pure’ UA to UA exchanges, etc.

All these messages will be IPM messages, so there is no way to distinguish them at the X.400 (envelope) protocol level.

5.4.4.3. The reprocessing should be restricted to messages generated by an AFTN/AMHS gateway.

5.5. Message repetition requirements

5.5.1. The AMHS System should provide powerful message repetition facilities in the AFTN, X.25 and AMHS subsystems implementation.

5.5.2. The repetition facilities should be able to repeat messages as they were originally transmitted i.e. sent to all recipients following the same transmission paths.

5.5.3. Additionally, the repetition facilities should be able to specify (with the use of wildcards) ‘detailed’ or ‘generic’ destinations. Such destinations can be an AFTN address, an O/R name, all AFTN addresses mapped to a given Ax, all O/R names of a given PRMD, etc.

5.5.4. The AMHS System should find all the messages that were transmitted to such specified 'generic' destinations within a specified time interval and retransmit them only to pending destinations and following the current routing. To avoid a transmission to other destinations originally contained in the message the addresses not matched by the 'generic' destination should be suppressed (address stripping).

5.6 Tracing facilities requirements

5.6.1 The AMHS System should provide a facility to allow generation of X.400 probes.

5.6.2 The user interface of the facility should allow entering of the priority, the O/R name of the originator / destinations and the message length.

5.6.3 The AMHS System should send the reports regarding the probes (delivery, non-delivery) to a configurable instance (e.g. the rejection queue).

Note. – This requirement relates to a user interface requirement. The user should get some notification when the delivery report related to the probe has been received. It is an implementation matter to decide whether this is performed just by allocating a fixed originator O/R name to one of the queues of the system or by another way.

The contents of such reports should be decoded and presented in a 'human' readable and understandable format.

5.6.4 The AMHS System should provide association-tracing facilities to monitor in real time the establishment, interruption and finalization of associations related to adjacent MTAs.

5.7 Sizing requirements

The sizing of the AMHS System operational platform should support the traffic during peak hour situations with:

a) Average peak hour total CPU usage at 30% maximum.

b) Communication adapters loaded at a maximum 30% of their real bandwidth capacity (not the theoretical one) and excluding the redundancy needs.

Note. – The previous values have to be reconsidered by each ATSO depending on the expected lifetime of the AMHS System. As e.g., if the lifetime is expected to be 10 years and the traffic estimates for the peak hour relate to the end of the lifetime, the usage requirements for the CPU and the communication adapters should be greater than 30% (if not, the purchased system will be oversized during quite a number of years)

c) Processing time of a message (High QoS flow type class, see section 3.1) at least less than 1.5 seconds. The processing time is defined as the difference between the moment the latest character of the message enters into the AMHS System and the moment the first character of the message is sent out. This applies for all implemented in / out protocol combinations. For messages of other flow types, the processing time should be less than 3 seconds.

Note. – This value, especially for AMHS, has significant implications in the platform sizing and total network transit time if the value is too low, a very powerful platform isrequired; If the value is too high, it could introduce a significant delay in the overall message transmission (specially if the other centres also have high values).

d) Response time to configuration / management on-line commands less than 3 seconds. This response time is related to requests from a management position for actions which do not require a query / browsing of a log (e.g. closing a PVC, create an Ax, etc).

e) At least sufficient disk space remaining available after:

1. all the standard and specific developed software versions (including the possibility of more than one software versions and two configurations per version) are present on disk,

2. all logs and archive folders corresponding to the number of days to be kept on-line in the system are present on disk.

Note.1 – The precise number of days will depend on the particular policy of each ATSO to comply with the ICAO Legal Requirements

If its policy indicates that all the data has to be kept on the AMHS System, the system should support at least 30 days. If the policy indicates that the data are saved for such purpose somewhere else (e.g. in another system, in an external media like CD-ROM, DAT, cartridge, etc), data concerning fewer days needs to be kept on-line (e.g. three days, one week, etc.).

Note.2 – As for the CPU and communication adapter usage, the value for disk Space shall be reconsidered by each ATSO depending on the expected lifetime of the AMHS System and the traffic estimates related to.

5.8 Availability and reliability requirements

5.8.1 The AMHS System should operate 24 hours per day and 365 days per year.

Note. – The values provided below should be considered as 'minimum' requirements. Each ATSO should reconsider them according to its own policy and internal SLAs with its internal users.

5.8.2 Interruptions for system maintenance and installation should be limited to the Strict minimum and should be less than 60 minutes.

5.8.3 After power is switched on, the AMHS System should be fully operational after a maximum of 15 minutes.

5.8.4 The AMHS System should auto monitor:

- the state of its application processes.
- the state of its system processes.
- the state of its system components (hardware).

5.8.5 The AMHS System should generate an SNMP MIB of the states monitored (see above).

5.8.6 The AMHS System should automatically try to recover from failure conditions in its application processes. If it is not possible to recover without impacting the service, the AMHS System should terminate all its application processes in an orderly manner and restart them afterwards automatically.

5.8.7 The AMHS System should allow an operator to:

a) Stop the AMHS application gracefully (with automatic restart).

b) Stop the AMHS application gracefully (with no automatic restart).

c) Force the AMHS application to stop (with no automatic restart).

d) Start the AMHS application with message recovery (messages that were in queue when the system was stopped are processed and forwarded).

e) Start the AMHS application without message recovery (messages that were in queue when the system was stopped are discarded).

5.8.8 The AMHS System should lose no message that has been acknowledged by it (according to the respective messaging protocol), unless an operator explicitly requests to drop the messages.

5.8.9 The AMHS System should lose no message because of its load.

5.8.10 In case of a switchover (cluster, master/standby) configuration the following requirements apply:

a) After detection of failure of the primary system unit or after an operator command, the switchover process should last less than five minutes. The duration of the switchover is counted as the time from the failure detection (or operator command) until the time the AMHS restarts forwarding messages again (assuming there are messages in queue or there are new incoming messages).

b) The time needed for the standby unit to detect failure of the primary one should be less than three minutes.

c) The switchover process should be completely automatically without requiring any plugging / unplugging of any type of cables (communications, disks ...). A matrix switch action (if a matrix switch is proposed) is not considered as a cable plug / unplug.

5.8.11 Any period of time longer than one minute, during which the AMHS System does not perform message switching (in a total or partial manner) due to software or hardware problems, should be considered as an interruption of service.

5.8.12 An interruption of service of a AMHS System should be less than 10 minutes when the recovery is automatic. The duration of an interruption is calculated as the time from the moment the last received message was forwarded until the moment the AMHS System starts forwarding messages again (assuming there are messages in queue or there are new incoming messages).

5.8.13 There should be no more than one interruption of service without automatic recovery in a sliding window of six months.

5.8.14 There should be no more than one interruption of service with automatic recovery per day.

5.8.15 There should be no more than two interruptions of service with automatic recovery per month.

5.8.16 There should be no more than three interruptions of service with automatic recovery in a sliding window of three months.

5.8.17 The MTBF of the AMHS System hardware should be higher than 52 weeks.

6 Requirements for statistics

The AMHS System should monitor and produce statistics per direct MTA partner as follows:

a) Number of data messages transmitted
b) Average size of the data messages transmitted
c) Maximum size of the data messages transmitted
d) Average number of destination addresses per message transmitted
e) Number of data messages received
f) Average size of the data messages received
g) Maximum size of the data messages received
h) Average transfer time
i) Number of delivery reports transmitted
j) Number of non-delivery reports transmitted
k) Number of delivery reports received
l) Number of non-delivery reports received
m) Minimum size of data messages received
n) Minimum size of data messages transmitted
o) Maximum, mean and minimum response time
p) Number of recipients processed
q) Number of messages deferred (the criterion for a deferred message should be specified by a configurable system parameter)
r) Number of messages redirected
s) Number of messages rejected
t) Number of loops detected

Additionally the AMHS System should produce the information specified in

The AMHS System should be able to generate the above statistics in at least the following intervals: 1 day interval, 1 hour interval, 30 minutes interval or better.

The AMHS System should be flexible in configuring other intervals for application statistics generation.

The AMHS System should be flexible in generating statistics at a more detailed level, as e.g., MTA route entries, particular O/R attributes, individual O/R names (to be discussed).

Note. – Each ATSO shall consider what requirements on statistics are put on the AMHS System in accordance with its requirements (national and international) and its policy for statistics production. E.g., there can be ATSOs which transfer the traffic logs to another system which will produce all required statistics; in such a case, the AMHS System should be the Asia and the Pacific AMHS Manual ICAO AFSG PG relieved of too many statistics requirements. If an ATSO does not have such other system, the AMHS System shall produce all statistics needed

The AMHS System should be able to export a specific monthly statistic file. Such a statistic file should contain daily as well as peak hour statistical data in a standard format. Detailed specifications are provided in the ATS Messaging Management Manual.

7 Tests and validation of AMHS systems

7.1 Objective

Experience has shown that, although it is claimed that systems have been implemented according to the one set of protocol specifications, they are often not capable of inter-working. This is due to errors in implementation or to different interpretations of the specifications (SARPs). Testing and validation of systems according to the same set of principles, aims at the detection of such errors and the prevention of incompatibility instances.

The primary objective of this chapter is to formulate recommendations for testing the ability of a given AMHS implementation to function as required at the level of an International Communication Centre within the AFTN/ X.25/AMHS network environment.

This chapter provides general information on the AMHS testing concept. The actual testing methodologies, configurations and procedures are defined in Annex B and Annex C. In these Annexes, tests are described in sufficient detail to give an appreciation of the variety of functions that are covered, the facilities required and the expected results.

7.2 General Principles

The creation of standards for testing is subject to consideration by a number of standardization bodies concerned with open systems (e.g. ISO, ITU-T).

In these standards, *conformance testing* is prescribed for testing a protocol implementation (IUT) with respect to its specification.

If conformance testing could be done in a complete and correct manner then two different implementations that passed the conformance test would be interoperable. In practice, conformance testing does not necessarily reach the intended point of completeness and correctness. Consequently, conformance testing may be followed by *interoperability testing* to determine whether two or more implementations will produce the expected behaviour under actual operating conditions.

In a more detailed analysis of the objectives of conformance and interoperability testing the following distinctions can be made:

a) The primary objective of interoperability testing is to confirm the end-to-end interoperability of two systems, which have both been developed to a common specification. Performance and load testing are possible, at least in principle.

b) Conformance testing can be defined as the exhaustive testing of an IUT against the functions and procedures defined in an agreed standard. Performance and load testing are not usually part of conformance testing which is restricted to the "logic" of the protocol implementation.

Furthermore, two essential practical differences between conformance and interoperability testing should be pointed out:

a) Incorrect protocol behavior. – Conformance testing allows "provoking"of the IUT, through incorrect protocol behavior, in order to study its stability. Interoperability testing provides only limited possibilities due to (normally) correct protocol implementations in real systems.

b) Distribution of test locations. – Conformance testing can be performed locally between IUT and a conformance testing equipment. Interoperability testing is normally distributed over at least two remote locations, therefore requiring more coordination effort.

Figure 4, below depicts the principal differences in test arrangements for interoperability and conformance testing.

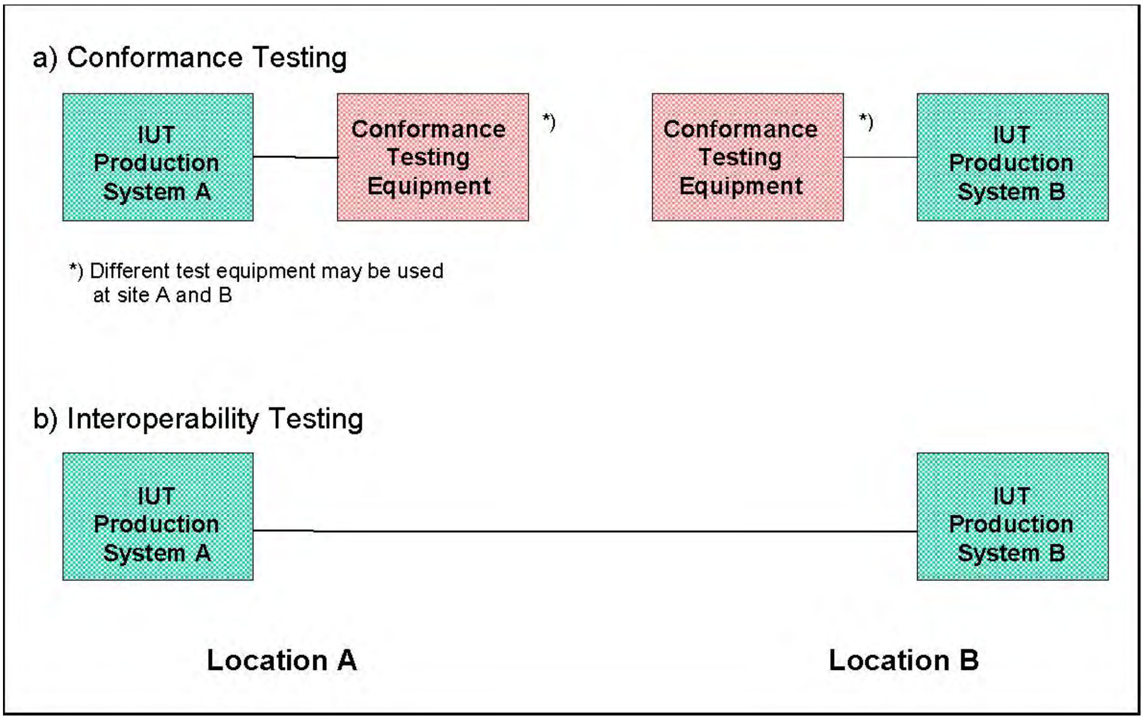


Figure 4: Principal test arrangements for conformance and interoperability testing

7.3 AMHS testing concept

7.3.1 Testing strategy

AMHS system implementations consist of protocol layers according to the principles of the Reference Model for Open Systems Interconnection. The AMHS functions to be tested reside in the application layer of the ISO/OSI reference model. The underlying layers provide supporting communication services, however they are not primarily subject to testing.

Figure 6 provides a generic functional presentation of an AMHS implementation under test.

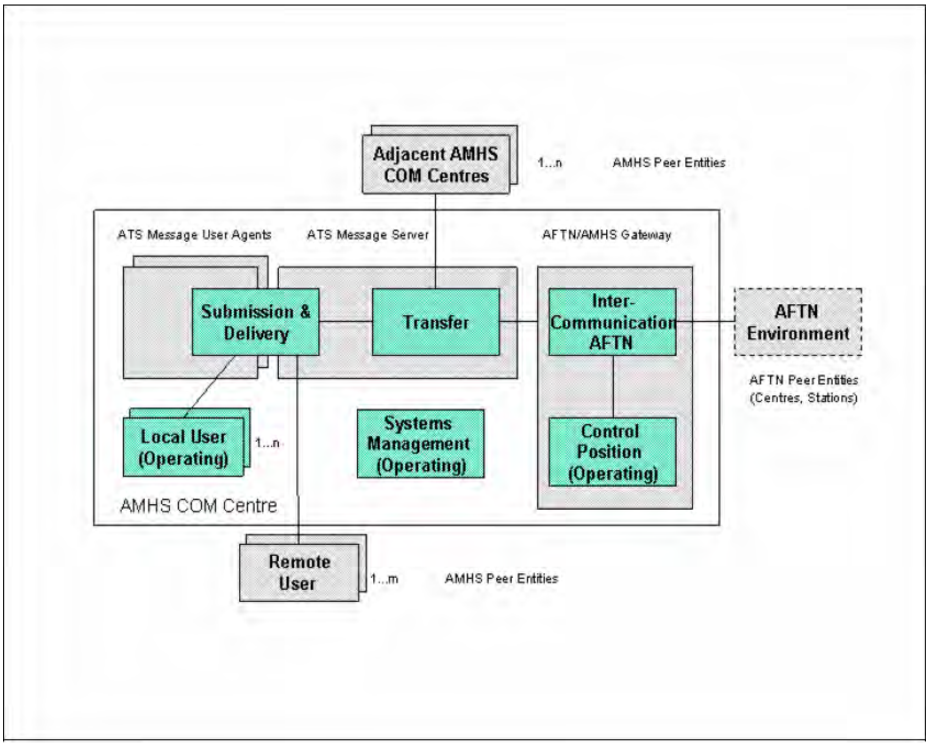


Figure 6: Functional view of an AMHS IUT

7.3.2 AMHS testing phases

7.3.2.1 AMHS Conformance testing

For the purposes of AMHS, *conformance testing* is considered mandatory and shall be performed in parallel with or after the acceptance testing of a new system.

The new system is tested as a *black box*, meaning that that required features are verified by observation of the external *behavior* of the IUT upon stimulation with well defined input events.

A *conformance testing equipment*, called the *AMHS test tool*, is used typically for the production of such input events and the monitoring of the resulting outputs from the IUT. In case such an AMHS test tool or reference implementation is *not* available, a test environment could be configured by using functional components of the IUT itself. Testing in such an environment may be seen as consistency testing rather than conformance testing.

The main AMHS functional areas covered by conformance testing are:

- Transfer of messages probes and reports
- Submission of messages and probes / delivery of messages and reports
- Intercommunication with AFTN
- Naming and addressing
- Parameters
- System management functions.

7.3.2.2 AMHS Interoperability testing

After successful completion of conformance testing, *interoperability testing* is recommended, particularly between AMHS implementations of different manufacturers.

As a first step to interoperability testing the interconnection between pairs of systems should be established and checked.

Then, at the bilateral level, the following functional areas should be covered:

- SUBMISSION, TRANSFER AND DELIVERY OPERATION (AMHS TO AMHS)
- GATEWAY OPERATIONS (AFTN TO AMHS)
- GATEWAY OPERATIONS (AMHS TO AFTN)
- GATEWAY OPERATIONS (AFTN TO AMHS TO AFTN)
- GATEWAY OPERATIONS – SPECIAL CASE SCENARIOS
- STRESS TRAFFIC SITUATIONS
- SUBMISSION/TRANSFER/DELIVERY AND RELAY OPERATIONS
- TEST OF SPECIAL SITUATIONS

At the multilateral level, interoperability testing involves more than two organizations, interchanging normal and exception messages and generating specific reactions of their systems.

7.3.2.3 AMHS Pre-operational testing

Before going into operation, pre-operational testing should be carried out between the AMHS systems concerned, within the operational network environment and using duplicated operational traffic.

The configuration details and the actual sub-sets of traffic to be used, have to be co-ordinated between the test partners. In any case, the operational traffic selected for this purpose should be traffic under the responsibility of the Communication Centres under test.

The AMHS relation between the two systems is considered operational, if the exchange of the total of operational traffic between them (or a subset of that), is performed by means of AMHS only. For this operational traffic no other transmission means (AFTN or X.25) is used.

8 References

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[12] ISO/IEC 10021-10 International Standard, Information technology – Message Handling Systems (MHS): MHS routing (1998)

Annex A

Guidelines to QOS (Quality of Service)

Annex A

of

AMHS Manual

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1 Scope

The purpose of this section is to define quality of service (QoS) requirements and set target performance objectives for the ASIAPAC AMHS. To this end, the properties of the AMHS are considered from the outside of the network, i.e. at its boundary, without taking into account the way in which the service, as defined on its boundary, is provided from within the network.

The performance requirements dealt with in this section are the common understanding on what the applications will get in terms of performance and what level of performance the network has to provide. The performance parameters are therefore necessary for designing applications as well as the network itself.

Numerical values for performance parameters are defined using the following input:

- anticipated location of message servers and gateways;
- analysis of existing and projected message flows in the ASIAPAC area based on presently available information;
- general design principles;
- user expertise.

As in most cases, in order to arrive at concrete values for the performance parameters, a number of assumptions and restrictions are made:

- QoS is not dependent on traffic volumes;
- QoS is measured between originator-recipient pairs;
- QoS is not geographically dependent;
- QoS is not dependent on time;
- QoS represents worst case performance;
- the underlying network should be sized to accommodate QoS;
- degree of corruption is not relevant to the Corruption QoS parameter;
- corruption is not dependent on message size;
- non reachability due to network causes is typically of the order of a few minutes (60per year);
- the bit error rate of an HDLC link is of the order 10^{-11}.

In dimensioning the AMHS only complete messages should be considered for the Following reasons:

- the message is the basic unit of data at the user interface;
- whole messages are stored and forwarded by MTAs in the network;

- in formulating performance requirements, transport or sub-network performance is not taken into account.

Of course, in dimensioning the network, it will be necessary to consider performance aspects of lower level infrastructure as well, but as a result of the user requirements formulated in this document and their impact on MTA performance.

`Further, it is important to note that the specification of performance requirements is based on individual messages, independently of all other messages.

When considering message size, only the volume of user information is relevant since the user has no control (or only very limited control) over the data overhead involved in message handling.

Formulating performance requirements of a given user, taking into account the simultaneous use of the network by other users, does not appear to be feasible. However, it has to be recognised that, in a real world situation, the performance of the network for a given message certainly does depend on the presence of other messages currently being processed. The performance requirements specified here represent minimum or worst-case performance under the load conditions (Traffic Volume Requirements).

<u>Types of performance parameters</u>

There are two distinct groups of performance parameters to be considered in connection with the AMHS. Parameters not dependent on message volumes: These parameters describe the quality of service (QoS), which is available to each individual message considered by itself, e.g. transit time. They can be measured, i.e. they are the quantitative results of the way in which messages are handled by the network.

Message volumes: These parameters describe the volumes of messages, message sizes and their distribution geographically, as they could be generated by users of the network. The parameters could be measured in the user end systems but it is not realistic to measure them in the network.

<u>QoS per individual message</u>

QoS requirements have to be satisfied under worst possible/allowable traffic volumes and most unfavourable originator/recipient pairs within a specific network configuration. Consequently, QoS is formulated for each individual message, independently of other messages being handled by the network.

This choice has been made for the following reasons:

- it is difficult to imagine that users would accept a QoS which is dependent on the demands which other users place on the network at the same time;

- the network has to be dimensioned to handle the maximum message volumes, while performing sufficiently well;

- the QoS requirements represent "worst case" performance when maximum degradation through interaction with other traffic occurs.

It must be pointed out, that AMHS provides the facilities to send messages many orders of magnitude greater than AFTN, with attachments measured in Mb. Clearly transfer times for such messages will be considerably longer than for the short text messages exchanged in AFTN. It is, thus, necessary to qualify the statement that QoS is independent of message size by adding 'for messages containing similar information to that carried over the AFTN'. If a quantitative limit is required, this will be between 4Kb and 6Kb, being the equivalent size of an AFTN message including the AMHS header.

Independence of QoS on location and time

QoS for an originator/recipient pair is most likely dependent on the relative locations of the two end systems, i.e. whether messages are transmitted with more or less hops through MHS systems (MTAs etc.). However, for simplicity reasons and since QoS requirements are "worst case" requirements, they are stated independently of the location of a message server.

Furthermore, QoS requirements remain constant at all times and are not dependent on date and time of day.

The AMHS performance requirements for the AFTN/AMHS Gateways, could, by agreement, be deemed to apply to interfaces between AMHS functions and AFTN functions in Gateways, e.g. a boundary point consisting of an interface between an internal Message Store and an AFTN handler within a Gateway.

Dependence of QoS on the AMHS service used

It may be necessary to specify different QoS levels for the AMHS corresponding to different sets of services used, i.e. there may be different classes of messages with respect to QoS. The number of QoS levels should be kept small for simplicity and the way in which service parameters map a message to a QoS level must be simple.

The values of QoS provided by the AMHS are useful to the application designer in deciding which services to use and how they are used. For example, the degree of certainty that a message will reach its destination will determine whether AMHS acknowledgement services are used and in what way. Furthermore, the values of QoS are useful in designing higher-level protocols.

2 Specification of performance requirements

The specification and meaningful application of performance requirements is not a simple task. This sub-section outlines some of the difficulties involved and principles to be adopted.

Statistical significance

The way in which performance parameters are formulated is necessarily statistical in nature. This is due to the large number of factors, which affect the performance of the network, such as:

- the current network configuration;
- the current overall load of the network, i.e. the behaviour of all users considered as a whole; and
- the dynamic properties of network nodes and transmission systems.

The need for measurement

For the specification and application of performance requirements to be meaningful, there has to be a framework for measuring performance with respect to the performance parameters. Aspects of a measurement framework which have to be considered are:

- because of the non-deterministic nature of network performance, measurements need to involve large samples of messages, as described in the previous section;

- measurements must be made at different locations simultaneously;

- consistent decisions have to be made as to where measurements are performed, e.g. at service interfaces in MTAs, UAs etc.

Network aspects relevant to performance

The following list contains factors which can affect message handling performance:

- processing speed, limits the capacity due to the store and forward nature of message handling;

- the finite transmission capacity (line speed) of links between nodes, limits the network throughput;

- the transmission times across links, affects the message transit time since complete messages are stored and forwarded a number of times between originator and recipient;

- the efficiency of message queues;

- transmission line failures and errors are obvious sources of degraded performance;

- table configuration errors can have major negative effects on network performance;

- software failures, which are difficult to treat quantitatively.

In designing the network, the performance requirements (amongst other things) have to be translated into properties of individual network components such that overall requirements are satisfied. Of course other considerations such as policy, expandability, ease of maintenance etc. enter into the network design as well.

AMHS Quality of Service Requirements

For reasons of completeness, simplicity and relevance, a minimal set of parameters was selected out of the large range of possibilities for expressing performance properties, to form a suitable "frame of reference" for discussing the dynamic properties of the AISAPAC AMHS:

These parameters defined and described in the following sub-sections in more detail, are:

- Destination Non-Reachability;

- Maximum Transit Time;

- Message Corruption**.**

The selection of these three parameters has been made for the sake of:

- Completeness: all relevant performance aspects of AMHS are covered;
- Simplicity: the formulation of requirements is intentionally kept simple; and
- Relevance: no aspects are included which are not considered to be relevant.

If the performance of the AMHS is such that these parameters are exceeded, then the service is deemed to be of poor quality.

Destination Non-Reachability

Destination Non-Reachability is expressed with respect to pairs of addresses (originator / recipient). It is the probability that a message sent by the originator will not reach the recipient within the Maximum Transit Delay (as defined below).

The above definition shows that the parameters Destination Non-Reachability and maximum Transit Time (see below) are not independent of each other: their definitions are coupled. This is intentional. The philosophy behind this definition is that the value of a message to a person or an application receiving it is dependent on its timely receipt. It is assumed, for a given flow type, that all messages belonging to it have the same value of this parameter.

The definition of Destination Non-Reachability is independent of whether the long (or infinite) transit time for a message is reported to its originator or not. It is also independent of whether acknowledgement procedures within the AMHS or on an application level detect the long (or infinite) transit time or not.

Destination Non-Reachability includes the cases in which messages are “lost”, i.e. do not reach their destination in finite time. The probability of message loss must be negligible and this probability is included in the total probability of Destination Non-Reachability. However, there remains a need (for procurement purposes) to place a separate figure on this probability.

In keeping with the above rationale, it is required that the probability of message loss is, at most, one tenth of the probability of Destination Non-Reachability. Maximum Transit Delay

The Maximum Transit Delay is the time within which a single message has to be transmitted through the network end-to-end so that its transmission is of value to the applications (users).

If this time is exceeded, the receipt of the message is, in principle, of no value to the application. If the non-receipt within this time is known to the application, then, presumably, error procedures, such as message retransmission, will be initiated.

The transit delay is the time taken by the network to make the message available to the Message Store associated with the message recipient (UA). Therefore the boundary points of the network may, in this context, be considered to be the MTAs connected to the UAs serving the originators/recipients. The boundary points can also be the MTA functionality within AFTN/AMHS Gateways.

It must be borne in mind, that the parameters Maximum Transit Delay and destination Non-Reachability only have significance when they are taken together.

Message Corruption

The third Quality of Service Parameter concerns message integrity and is called "Message Corruption". It is the probability that each 1,000 octet content block of a message which arrives at its destination, has been corrupted in any way. The definition of Message Corruption applies only to messages which reach their recipients within the Maximum Transit Delay.

"Corruption" means a deviation, end-to-end, of the content of the received message from the content of the original message. The "content" is also deemed to include parameters, such as originator address, which are delivered together with the message. Corruption can also result from unauthorised changes to a message.

Since the volume unit for defining Message Corruption is large (1,000 octets), the requirement is almost independent of the size of (current) messages. This simplification is based on the assumption that corruption is due to unforeseen system malfunctioning, e.g. faulty software.

The corruption of messages due to such causes is not likely to be dependent on the size of messages. (This is true today, but the upcoming use of ADEXP messages-with message lengths up to 10koctets-has to be mentioned, as well as the potential forthcoming applications interchanging messages with binary body parts).

The probability of corruption due to other parameters such as system load, queue sizes, transmission errors etc. is almost negligible.

It is estimated, that the volume dependent non-detected bit error probability for a 1000 octet message traversing the AMHS and involving 5 links and 5 different systems (MTAs, UAs, MSs) is of the order of one bit in 10^5 or less. This justifies the (almost) volume-independent character of the Message Corruption parameter.

QoS Flow Type Classes

Different types of information exchange, called Flow Types here, place different QoS requirements on the AMHS.

In principle, each Flow Type might need to be associated with its own specific values of the three QoS parameters. However, taking into account the large number of possible Flow Types, this would result in a very complex analysis. A suitable approach to reducing this complexity is the introduction of “QoS Flow Type Classes” as follows:

Define a number of "QoS Flow Type Classes" and associate a set of fixed values of the three QoS parameters with each class. Depending on the properties and needs of applications using specific Flow Types, assign these to the QoS Flow Type Classes.

When engineering the network, message traffic volumes of each class need to be taken into account rather than individual Message Flow Types.

Three QoS Flow Type Classes

The approach outlined above is simple and practical provided the number of classes is small. In addition, there is a requirement that the QoS Flow Type Class to which a message belongs, can be coded in some way in the message itself. This requirement comes from the fact that all AMHS components, e.g. MTAs, must be able, at least in principle, to adapt their processing to the QoS Flow Type Class. The means for this coding must come from standard MHS protocol elements, since development specific to AMHS has to be avoided and the possibility of using third-party-service must be kept open. This rules out, for example, the representation of QoS Flow Type Classes by specific User Parts.

The use of the MHS message priority parameter with three values, "urgent", "normal" and "non urgent", belonging to the P1 protocol handled by MTAs, is currently also not suitable for this purpose. The association of values to messages originating from and destined for the AFTN is fixed by SARPs, since such messages traverse an AFTN/AMHS Gateway. This means that values of the MHS priority parameter cannot be freely assigned to message types which are currently handled by the AFTN.

There is no short-term solution to this problem. However, in the long-term, when the majority of messages handled by the AMHS are originated by and destined for native users, the priority parameter may become available for this purpose, keeping in mind, nevertheless, that various practical issues may need to be resolved. In keeping with the three possible values of the MHS message priority parameter, three corresponding QoS Flow Type Classes are defined:

(a) The "High QoS" Flow Type Class
Properties of this QoS Flow Type Class are:

- message transmissions are part of procedures, i.e. the sending and receipt of messages necessarily lead to actions or processing. Without receipt of the message, these actions or processing would not take place, or

- any corrupt information in messages could have serious consequences. This possibility has to be negligible.

(b) The "Medium QoS" Flow Type Class

This class has similar properties to the High QoS Flow Type Class, however the maximum Transit Time requirement can be somewhat less stringent. This distinction is important, because it can be expected that the Maximum Transit Time requirement will have a sensitive effect on network dimensioning.

Properties of this QoS Flow Type Class are:

- message transmissions tend to be of the nature of "information distribution" or "broadcast", possibly based on distribution lists rather than being parts of operational procedures. They are normally not acknowledged. Transit time and reachability constraints are not critical. In the case of non-delivery of messages, this may be noticed by users, in which case backup activities could be initiated; or

- message corruption could have serious consequences and needs to be as low as for the previous class.

(c) The "Low QoS" Flow Type Class

This class has similar properties to the Medium QoS Flow Type Class, however the Destination Non-Reachability and Message Corruption requirements can be somewhat less stringent. This is due to a certain amount of redundancy in the message contents and/or the regular updating and transmission of messages with similar content.

3 Numerical requirements

Guidelines for system requirements.

	High QoS Flow Type Class	Medium QoS Flow Type Class	Low QoS Flow Type Class
Destination Non-Reachability (probability)	$< 10^{-4}$	$< 10^{-4}$	$< 10^{-3}$
Maximum Transit Delay	< 10 seconds	< 5 minutes	< 5 minutes
Message Corruption (probability)	$< 10^{-6}$	$< 10^{-6}$	$< 10^{-5}$

Table 1: Numerical values of SPACE QoS performance requirements

It must be noted that the above numerical values:

- could be adopted as possible quantitative and qualitative characteristics for setting up the ASIAPAC AMHS network;
- will be reviewed on the basis of compiled AMHS operational experience.

4 Application of performance requirements

The QoS parameters are obviously of importance to the network operators, users and application designers.

The QoS requirements along with the volume requirements for each of the Flow Type Classes at the boundary of the network (servers and gateways) are used, in conjunction with a set of well defined design principles (see 3.3 AMHS topology), in order to:

- determine the local performance of servers and gateways, thus dimensioning their configuration,
- determine the throughput of MTAs and capacity of links,
- draft possible network configurations and select the “optimum” network design, and measure actual network performance.

5 Measurement

The specification of numerical values for Performance Requirements is meaningless unless provision is foreseen for measurement of network performance. Such measurement is needed:

- when implementing and enforcing Service Level Agreements between AMHS service providers and users;
- for acceptance testing of network components;
- to determine network capacity;
- to gain experience in network operation (e.g. testing of various routing strategies, etc.).
- to manage the network efficiently.

Technically, network performance measurement involves, among other things:

- generation of large message/data volumes;
- automation of measurement;
- time-stamping of messages;
- use of statistical analysis.

- End-

Annex B

AMHS Conformance and Compatibility Test

Annex B

Of

AMHS Manual

Document Control Log

Edition	Date	Comments	Section/pages affected
1.0	11/04/2007	Creation of the document.	all

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1. Introduction

1.1 Purpose of the Document

The purpose of the document is to define the functional tests for an AMHS Conformance Test, which allows checking an AMHS implementation against the AMHS SARPs as a first step to ensure the interoperability between compliant systems.

1.2 Document Structure

Chapter 2 presents the test environment used for AMHS conformance testing.

Chapter 3 defines the addressing plan implemented in the test environment.

Chapter 4 contains the test procedures with subsections for each AMHS functional area.

Each test procedure is presented in a structured way consisting of

- defined test criteria,
- a (brief) scenario description,
- reference to the relevant part of the standard specification (SARPS section),
- reference to test classes (N, E)

1.3 Test Identification Scheme

Each test procedure has an identifier in the form

CT*xnn*

where CT is an acronym for Conformance Test, *x* is a number identifying the test group [1] and *nn* is a consecutive number identifying the individual test procedure.

Test procedures are presented in six groups:

- test of submission operations (x=1),
- test of delivery operations (x=2),
- test of transfer operations (x=3),
- test of gateway operations converting a user message from AMHS to AFTN (x=4),

2. AMHS Conformance Test Environment

The AMHS Implementation Under Test (IUT) is embedded in a simulated operational environment formed by the AMHS test tool with three MTA instances (representing three adjacent ATS Message Servers or three neighbour PRMDs) and one AFTN/X.25 source/sink (representing an adjacent AFTN/X.25 environment).

The IUT has an AMHS user agent (UA) attached, which is used in submission and delivery tests. Gateway tests involve either the AFTN/X.25 test application or the AFTN user terminal. It is also possible to make use of the IUT's associated Monitor & Control Position – if available - to observe outcomes of the conversion process, especially in error situations.

The AMHS test tool implements three MTA test applications (MTA-1, -2 and -3) to send and receive AMHS messages (IPM, IPN), reports and probes to and from three directions. The test tool generates AMHS data at the X.400/P1 level. It uses the AFTN/X.25 test application or the AFTN user terminal to send and receive AFTN user messages and AFTN service messages.

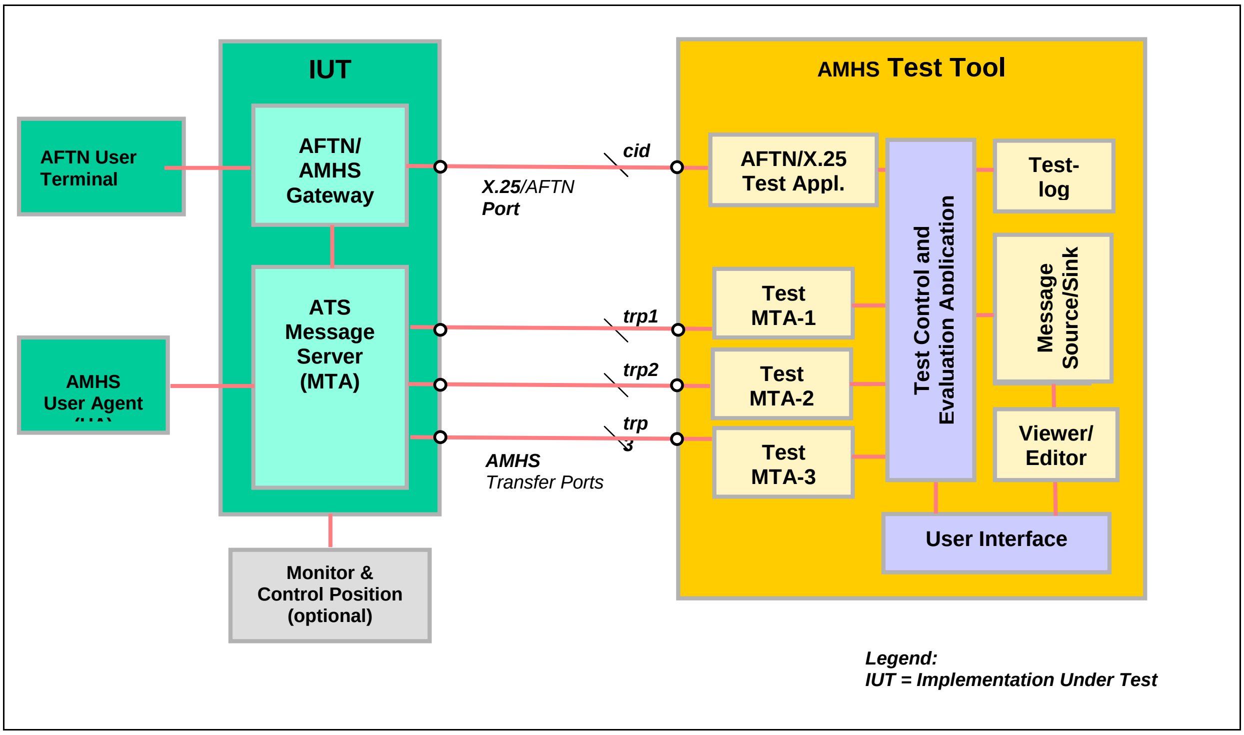


Figure 1: AMHS Conformance Test Environment

Figure 1 shows the test environment used for AMHS conformance tests (setup for the tests CTxxx in Part 3, where xxx refers to the test case number) and the components of the AMHS Test Tool. The AMHS Test Tool will be interconnected with the IUT's (standardized) external interfaces, i.e.

- three AMHS transfer ports (trp1, trp2, trp3) supporting the X.400/P1 protocol over a TCP/IP/LAN[1], and
- a AFTN/X.25 port (cid).

All test applications can be controlled independently via user interface through the Test Control and Evaluation Application. The Test Control and Evaluation Application:

[1] Optionally, an ATN stack can be supported instead of the TCP/IP interface to support the AMHS X.400/P1 protocol.

- maintains test samples in a repository (message source)
- executes test scripts,
- verifies the received messages (message sink),
- evaluates each performed test step,
- stores every test step result in a test log, and
- keeps record of all sent and received messages during a test run.

Test scenarios involve the test components as depicted in Figure 1 in the following way:

Submission operation tests:					
	AMHS User Agent	=>	IUT (ATS Message Server)	=>	MTA-1
Transfer operation tests:					
	MTA-1	=>	IUT (ATS Message Server)	=>	MTA-2 (and for distribution tests also MTA-3)
Delivery operation tests:					
	MTA-1	=>	IUT (ATS Message Server)	=>	AMHS User Agent
AMHS to AFTN gateway tests:					
	MTA-1	=>	IUT (ATS Message Server and Gateway)	=>	AFTN/X.25 Test Application or AFTN User Terminal
AFTN to AMHS gateway tests:					
	AFTN/X.25 Test Application or AFTN User Terminal	=>	IUT (Gateway and ATS Message Server)	=>	MTA-1

3. Addressing Plan for AMHS Conformance Testing

To meet the scope of testing, the test-address space used by AMHS Conformance Testing should include AMHS addresses placed in different AMHS PRMDs and AFTN addresses located in different countries.

As a minimum, there is a need of three generic PRMDs and three generic AFTN countries which may be called: AMHSLAND-1, AMHSLAND-2, AMHSLAND-3, AFTNLAND-1, AFTNLAND-2 and AFTNLAND-3. If required, an extension of the address space should follow the same principles.

This allows covering of all cases of selected addressing schemes, including:

- CAAS with one single organisation-name value for all location indicators within the PRMD,
- CAAS with multiple organisation-name values for different sets of location indicators within the PRMD,
- XF.

The Nationality Letters AA, AB, AC, BA, BB and BC have been reserved for the purpose of AMHS testing. The PRMD names and addressing schemes used for AMHS Conformance testing are indicated in Table 1:

Nationality Letter	C	ADMD	PRMD	Addressing Scheme
AA	XX	ICAO	AMHSLAND-1	CAAS
AB	XX	ICAO	AMHSLAND-2	CAAS
AC	XX	ICAO	AMHSLAND-3	XF
BA	XX	ICAO	AFTNLAND-1	CAAS
BB	XX	ICAO	AFTNLAND-2	CAAS
BC	XX	ICAO	AFTNLAND-3	XF

Table 1: PRMD names and addressing schemes

The user addresses of AMHSLAND-1 (Addressing scheme: CAAS – single "O" value)

C=**XX** *ADMD*=**ICAO** *PRMD*=**AMHSLAND-1**

O=**AA-REGION** *OU1*=**AAAA** **->** *CN*=**AAAAMHAA** till **AAAAMHAZ** and *CN*=**AAAAMHBA** till **AAAAMHBZ**

The user addresses of AMHSLAND-2 (Addressing scheme: CAAS – multiple "O" value)

C=**XX** *ADMD*=**ICAO** *PRMD*=**AMHSLAND-2**

O=**AB-REGION1** *O*=**AB-REGION1**	*OU1*=**ABAA** *OU1*=**ABAB**	**->** *CN*=**ABAAMHAA** till **ABAAMHAZ** **->** *CN*=**ABABMHAA** till **ABABMHAZ**
O=**AB-REGION2** *O*=**AB-REGION2**	*OU1*=**ABBA** *OU1*=**ABBB**	**->** *CN*=**ABBAMHAA** till **ABBAMHAZ** **->** *CN*=**ABBBMHAA** till **ABBBMHAZ**
O=**AB-REGION3** *O*=**AB-REGION3**	*OU1*=**ABCA** *OU1*=**ABCB**	**->** *CN*=**ABCAMHAA** till **ABCAMHAZ** **->** *CN*=**ABCBMHAA** till **ABCBMHAZ**

Table 2: AMHSLAND-2

The user addresses of AMHSLAND-3 (Addressing scheme: XF)

C=**XX** *ADMD*=**ICAO** *PRMD*=**AMHSLAND-3**

O=**AFTN** *OU1*=**ACCCMHAA** till **ACCCMHAZ** and *OU1*=**ACCCMHBA** till **ACCCMHBZ**

The user addresses of AFTNLAND-1 (Addressing scheme: CAAS – single "O" value)

C=**XX** *ADMD*=**ICAO** *PRMD*=**AFTNLAND-1**

O=**BA-REGION** *OU1*=**BAAA** **->** *CN*=**BAAAFTAA** till **BAAAFTZZ**

The user addresses of AFTNLAND-2 (Addressing scheme: CAAS – multiple "O" value)

C=**XX** *ADMD*=**ICAO** *PRMD*=**AFTNLAND-2**

O=**BB-REGION1** *O*=**BB-REGION1**	*OU1*=**BBAA** *OU1*=**BBAB**	**->** *CN*=**BBAAFTAA** till **BBAAFTAZ** **->** *CN*=**BBABFTAA** till **BBABFTAZ**
O=**BB-REGION2** *O*=**BB-REGION2**	*OU1*=**BBBA** *OU1*=**BBBB**	**->** *CN*=**BBBAFTAA** till **BBBAFTAZ** **->** *CN*=**BBBBFTAA** till **BBBBFTAZ**
O=**BB-REGION3** *O*=**BB-REGION3**	*OU1*=**BBCA** *OU1*=**BBCB**	**->** *CN*=**BBCAFTAA** till **BBCAFTAZ** **->** *CN*=**BBCBFTAA** till **BBCBFTZ**

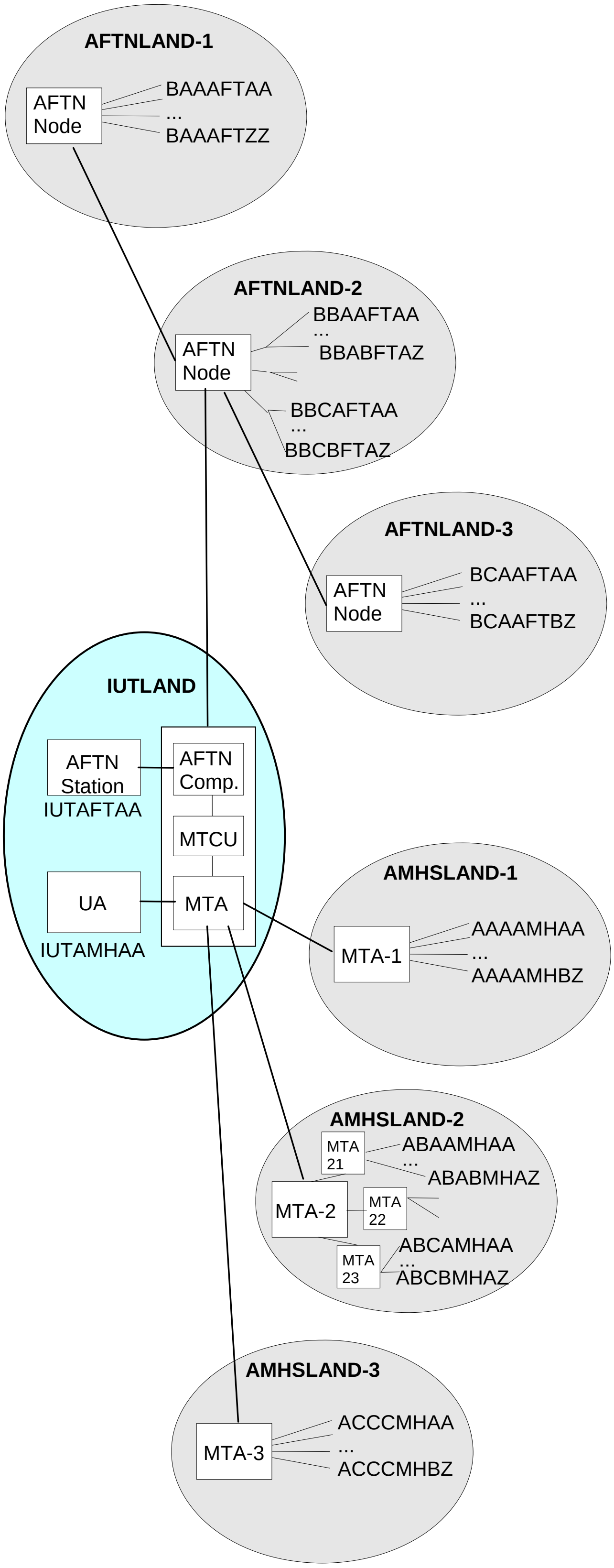
Table 3: AFTNLAND-2

The user addresses of AFTNLAND-3 (Addressing scheme: XF)

C=**XX** *ADMD*=**ICAO** *PRMD*=**AFTNLAND-3**

O=**AFTN** *OU1*=**BCAAFTAA** till **BCAAFTAZ** and
OU1=**BCAAFTBA** till **BCAAFTBZ**

[The portion left empty]



AFTNLAND-1 (Addressing scheme: CAAS)

```
   C = XX
ADMD = ICAO
PRMD = AFTNLAND-1

e.g.  O = BA-REGION
    OU1 = BAAA
     CN = BAAAFTAA
```

AFTNLAND-2 (Addressing scheme: CAAS)

```
   C = XX
ADMD = ICAO
PRMD = AFTNLAND-2

e.g.  O = BB-REGION3
    OU1 = BBCB
     CN = BBCBFTAA
```

AFTNLAND-3 (Addressing scheme: XF)

```
   C = XX
ADMD = ICAO
PRMD = AFTNLAND-3

e.g.  O = AFTN
    OU1 = BCAAFTBZ
```

AMHSLAND-1 (Addressing scheme: CAAS)

```
   C = XX
ADMD = ICAO
PRMD = AMHSLAND-1

e.g.  O = AA-REGION
    OU1 = AAAA
     CN = AAAAMHAA
```

AMHSLAND-2 (Addressing scheme: CAAS)

```
   C = XX
ADMD = ICAO
PRMD = AMHSLAND-2

e.g.  O = AB-REGION3
    OU1 = ABCA
     CN = ABCAMHAA
```

AMHSLAND-3 (Addressing scheme: XF)

```
   C = XX
ADMD = ICAO
PRMD = AMHSLAND-3

e.g.  O = AFTN
    OU1 = ACCCMHBZ
```

Figure 2: Addressing Plan

For the IUT itself as test addresses could be used alternatively:

The original, operational AMHS and AFTN addresses assigned to the COM Centre or a generic address space taken from the fictitious PRMD/AFTN country IUTLAND including the generic user addresses IUTAFTAA and IUTAMHAA (or a more comprehensive set of addresses in case of CAAS with multiple "O" values) which may be mapped either onto the CAAS (preferred) or XF addressing scheme. The following table shows the generic address space assigned to the IUT.

CAAS (preferred) – single "O"	C=XX ADMD=ICAO PRMD=IUTLAND O=IUT-REGION OU1=IUTA CN=IUTAFTAA C=XX ADMD=ICAO PRMD=IUTLAND O=IUT-REGION OU1=IUTA CN=IUTAMHAA
CAAS (preferred) – multiple "O"	C=XX ADMD=ICAO PRMD=IUTLAND O=IUT-REGION1 OU1=IUTA CN=IUTAFTAA ... C=XX ADMD=ICAO PRMD=IUTLAND O=IUT-REGION1 OU1=IUTA CN=IUTAMHAA C=XX ADMD=ICAO PRMD=IUTLAND O=IUT REGION2 OU1=IUTB CN=IUTBFTAA ... C=XX ADMD=ICAO PRMD=IUTLAND O=IUT REGION2 OU1=IUTB CN=IUTBMHAA C=XX ADMD=ICAO PRMD=IUTLAND O=IUT-REGION3 OU1=IUTC CN=IUTCFTAA ... C=XX ADMD=ICAO PRMD=IUTLAND O=IUT-REGION3 OU1=IUTC CN=IUTCMHAA
XF	C=XX ADMD=ICAO PRMD=IUTLAND O=AFTN OU1=IUTAFTAA C=XX ADMD=ICAO PRMD=IUTLAND O=AFTN OU1=IUTAMHAA

Table 4: Generic address spaces of the IUT

3.1 “Unknown” addresses used for “negative testing”

Some conformance tests use addresses, which are “unknown” for the IUT and provoke specific reaction, e.g. return of a NDR. Several cases must be distinguished:

a) The AMHS component (MTA) of the IUT is not able to route the message, neither to an AMHS domain, nor to the AMHS/AFTN gateway (MTCU). For example, this occurs, when the global domain identifier does not match any X.400 routing entry (Table 5).

b) The AMHS/AFTN gateway component (MTCU) of the IUT is not able to find a match in the address mapping table and, therefore, can not translate the originator or recipient address from AMHS to AFTN (Table 6) or AFTN to AMHS (Table 7).

c) The AFTN component of the IUT is not able to route an AFTN message. *Note that AFTN routing is not subject of AMHS conformance tests, and therefore no requirement exists for "unknown" AFTN addresses that do not match a routing indicator in the AFTN routing table.*

The following "unknown" addresses may be used in the conformance tests:

"Unknown" AMHS addresses used to test MTA routing
C=XX ADMD=ICAO PRMD=UNKNOWN O=AA-REGION OU1=AAAA CN=AAAAMHAA ... CN=AAAAMHBZ
C=XX ADMD=ICAO PRMD=UNKNOWN O=AB-REGION1 OU1=ABAA CN=ABAAMHAA ... CN=ABAAMHBZ
C=XX ADMD=ICAO PRMD=UNKNOWN O=AFTN OU1=ACCCMHAA ... OU1=ACCCMHBZ

Table 5: "Unknown" address spaces for MTA routing tests

"Unknown" AMHS addresses used to test MTCU mappings from AMHS to AFTN
C=XX ADMD=ICAO PRMD=AFTNLAND-1 O=UNKNOWN OU1=BAAA CN=BAAAFTAA ... CN=BAAAFTBZ C=XX ADMD=ICAO PRMD=AFTNLAND-1 O=BA-REGION OU1=BAXX CN=BAXXXXXX C=XX ADMD=ICAO PRMD=AFTNLAND-1 O=BA-REGION OU1=BAAX CN=BAAXXXXX
C=XX ADMD=ICAO PRMD=AFTNLAND-2 O=UNKNOWN OU1=BBAA CN=BBAAFTAA ... CN=BBAAFTBZ C=XX ADMD=ICAO PRMD=AFTNLAND-2 O=BB-REGION1 OU1=BBAX CN=BBAXXXXX C=XX ADMD=ICAO PRMD=AFTNLAND-2 O=BB-REGION2 OU1=BBBX CN=BBBXXXXX C=XX ADMD=ICAO PRMD=AFTNLAND-2 O=BB-REGION3 OU1=BBCX CN=BBCXXXXX
C=XX ADMD=ICAO PRMD=AFTNLAND-3 O=UNKNOWN OU1=BCAAFTAA ... OU1=BCAAFTBZ C=XX ADMD=ICAO PRMD=AFTNLAND-3 O=AFTN OU1=BCXXXXXX C=XX ADMD=ICAO PRMD=AFTNLAND-3 O=AFTN OU1=BCAXXXXX

Table 6: "Unknown" AMHS addresses for MTCU mapping tests

"Unknown" AFTN addresses used to test MTCU mappings from AFTN to AMHS
AAXXXXXX, AAAXXXXX, AAABXXXX, **ABXXXXXX, ABAXXXXX, ABBXXXXX, ABCXXXXX, ABACXXXX, ABABXXXX** **ACXXXXXX, ACCXXXXX, ACAAXXXX, ACBAXXXX** **BAXXXXXX, BBXXXXXX, BCXXXXXX**

Remark: These addresses match a routing indicator in the AFTN routing table, but not in the AFTN/AMHS address mapping table.

Table 7: "Unknown" AFTN addresses for MTCU mapping tests

AMHS/AFTN gateway settings

To fulfil the requirements of the "unknown" addresses following setting of the MD Lookup Tables of the AMHS/AFTN gateway is requested:

Nationality Letters, Location Indicator	**Mapped to**	**Used addressing scheme**
AAAA	*C*=**XX** *ADMD*=**ICAO** *PRMD*=**AMHSLAND-1** *O*=**AA-REGION**	CAAS
ABAA	*C*=**XX** *ADMD*=**ICAO** *PRMD*=**AMHSLAND-2** *O*=**AB-REGION1**	CAAS
ABBA	*C*=**XX** *ADMD*=**ICAO** *PRMD*=**AMHSLAND-2** *O*=**AB-REGION2**	CAAS
ABCA	*C*=**XX** *ADMD*=**ICAO** *PRMD*=**AMHSLAND-2** *O*=**AB-REGION3**	CAAS
ACCC	*C*=**XX** *ADMD*=**ICAO** *PRMD*=**AMHSLAND-3** *O*=**AFTN**	XF
BAAA	*C*=**XX** *ADMD*=**ICAO** *PRMD*=**AFTNLAND-1** *O*=**BA-REGION**	CAAS
BBAA	*C*=**XX** *ADMD*=**ICAO** *PRMD*=**AFTNLAND-2** *O*=**BB-REGION1**	CAAS
BBBA	*C*=**XX** *ADMD*=**ICAO** *PRMD*=**AFTNLAND-2** *O*=**BB-REGION2**	CAAS
BBCA	*C*=**XX** *ADMD*=**ICAO** *PRMD*=**AFTNLAND-2** *O*=**BB-REGION3**	CAAS
BCAA	*C*=**XX** *ADMD*=**ICAO** *PRMD*=**AFTNLAND-3** *O*=**AFTN**	XF
IUTA	*C*=**XX** *ADMD*=**ICAO** *PRMD*=**IUTLAND** *O*=**IUT-REGION**	CAAS

Table 8: MD Lookup Table settings of AMHS/AFTN gateway

4 Test Procedures

4.1 Submission Operations

CT101 - Forward a submitted IPM

CT101	**Forward a submitted IPM**
Test criteria	This test is successful, if the IUT forwards a submitted ATS message (IPM) to a peer MTA correctly.
Scenario description	From the UA send a sequence of five ATS messages (IPMs) to the IUT addressing a remote AMHS user reachable via AMHS transfer port *trp1*. • Message 1 (CT101M01) shall have ATS-message-priority KK. • Message 2 (CT101M02) shall have ATS-message-priority GG. • Message 3 (CT101M03) shall have ATS-message-priority FF. • Message 4 (CT101M04) shall have ATS-message-priority DD. • Message 5 (CT101M05) shall have ATS-message-priority SS. Each message shall have different ATS-filing-time and ATS-message-text. The *optional-heading-information* element shall be empty. Verify the messages received by the test tool at the AMHS interface. Check the format and contents of MTE, IPM heading and body. In particular, verify the priority value contained in the MTE and the following elements contained in the IPM body: • ATS-message-priority, • ATS-message-filing-time, • ATS-message-text.
AMHS SARPs reference	3.1.2.2.1 (ATS Message User Agent), 3.1.2.2.2 (ATS Message Server), 3.1.2.2.3.2.3.1 (ATS-Message-Header)
Test class	Normal AMHS communications

4.2 Delivery Operations

CT201 – Deliver an IPM to a local AMHS user

CT201	**Deliver an IPM to a local AMHS user**
Test criteria	This test is successful, if the IUT correctly delivers an ATS message (IPM) received from a peer MTA to its local AMHS user.
Scenario description	From the AMHS Test Tool send a sequence of five ATS messages (IPMs) to the IUT addressing a local UA. • The first ATS message shall have ATS-message-priority KK. • The second ATS message shall have ATS-message-priority GG. • The third ATS message shall have ATS-message-priority FF. • The fourth ATS message shall have ATS-message-priority DD. • The fifth ATS message shall have ATS-message-priority SS. Each message shall have different ATS-filing-time and ATS-message-text. The optional-heading-information element shall be empty. Verify the messages received at the AMHS user agent. In particular, verify the following elements displayed at the AMHS user agent: • ATS-message-priority, • ATS-message-filing-time, • ATS-message-text.
AMHS SARPs reference	3.1.2.1.6 (AMHS routing)
Test class	Normal AMHS communications

CT202 – Deliver an IPM containing erroneous ATS-message-header or ATS-message-text format

CT202	**Deliver an IPM containing erroneous ATS-message-header or ATS-message-text format**
Test criteria	This test is successful, if the IUT, when receiving an IPM containing erroneous ATS-message-header or ATS-message-text from a peer MTA: • delivers this message to its local AMHS user regardless of the contained error, or • indicates the error situation, or • returns a non-receipt notification or NDR.
Scenario description	From the AMHS Test Tool send a sequence of six messages (IPMs) to the IUT addressed to a local UA. • The first message (IPM) shall contain an empty ATS-message-priority. • The second message (IPM) shall contain an invalid ATS-message-priority • The third message (IPM) shall contain an empty ATS-message-filing-time. • The fourth message (IPM) shall contain an invalid ATS-message-filing-time. • The fifth message (IPM) shall contain an OHI text longer than 53 characters. • The sixth message (IPM) shall contain an empty ATS-message-header. • The seventh message (IPM) shall contain an empty ATS-message-text. Verify that the messages are delivered to the UA. Analyse the IUT's log files with respect to delivered messages and reported errors, if any. Check the contents of the received ATS message and verify the ATS-message-priority, ATS-message-filing-time and ATS-message-text displayed at the UA[3].
AMHS SARPs reference	3.1.2.2.3.2 (IPM text)
Test class	Erroneous AMHS parameters

[3] The displayed message depends on the UA capabilities

CT203 – Deliver an IPM containing empty or invalid IPM heading fields

CT203	**Deliver an IPM containing empty or invalid IPM heading fields**
Test criteria	This test is successful, if the IUT when receiving an ATS message (IPM) from a peer MTA containing empty or invalid IPM heading fields: • delivers this message to its local AMHS user regardless of the empty or invalid IPM heading fields, or • indicates the error situation, or • returns a non-receipt notification or NDR.
Scenario description	From the AMHS Test Tool send a sequence of messages (IPMs) to the IUT addressing a local UA. The MTE shall be correctly formatted while the IPM heading contains empty or invalid values. • The first message shall contain an empty originator field in the IPM heading. • The second message shall contain neither primary nor copy nor blind copy recipient addresses in the IPM heading. • The third message shall contain a primary recipient with an invalid combination of the notification-request flag (rn bit = true and nrn bit = false). Check the IUT's log files with respect to delivered messages and reported errors, if any. Check any messages received and displayed at the UA[4].
AMHS SARPs reference	3.1.2.2.1 (ATS Message User Agent – AMH21)
Test class	Erroneous IPMS information objects

[4] The displayed message depends on the UA capabilities.

4.3 Transfer Operations

CT301 – Transfer messages (IPMs and IPNs)

CT301	**Transfer messages (IPMs and IPNs)**
Test criteria	This test is successful, if the IUT transfers (forwards) messages (IPMs, IPNs) correctly.
Scenario description	From the AMHS Test Tool send a sequence of messages to the IUT's transfer port *trp1*. All envelopes shall contain a remote recipient address reachable via transfer port *trp2*. All messages shall have the *originator-report-request* flag and the *originating-MTA-report-request* flag set to "non-delivery-report". The sequence of messages shall consist of: • an IPM with ia-5-text body part, • an IPM with general-text body part, • an IPN containing a RN, • an IPN containing a NRN. Monitor the outcome of IUT transfer ports *trp1*, *trp2* and *trp3*. Verify that: • all messages are routed correctly via transfer port *trp2*, and there is no message misrouted, i.e. no output from the IUT at transfer port *trp1* or *trp3*, • there is no NDR returned via *trp1*, • the content of the forwarded message has not changed, but is identical to the original content, • trace information is added in the message transfer envelope (MTE).
AMHS SARPs reference	3.1.2.2.2 (ATS message server), 3.1.2.1.2.2 (AMHS information model)
Test class	Normal AMHS communications

CT302 – Transfer a report

CT302	**Transfer a report**
Test criteria	This test is successful, if the IUT transfers (forwards) reports correctly.
Scenario description	From the AMHS Test Tool send two manually prepared reports (a DR and a NDR) to the IUT's transfer port *trp1*. The report transfer envelope shall contain a remote recipient address reachable via transfer port *trp2*. The reports shall contain fictitious values for those fields, which are normally automatically generated from the related subject message, for example, the subject-MTS-identifier and originally intended recipients. Monitor the outcome of IUT transfer ports *trp1*, *trp2* and *trp3*. Verify that: • all reports are routed correctly via transfer port *trp2*, and there is no report misrouted, i.e. no output from the IUT at transfer port *trp1* or *trp3*, • the content of the forwarded report has not changed, but is identical to the original report content, • trace information is added in the report transfer envelope (RTE).
AMHS SARPs reference	3.1.2.2.2 (ATS message server), 3.1.2.1.2.2 (AMHS information model)
Test class	Normal AMHS communications

CT303 – Transfer a probe

CT303	Transfer a probe
Test criteria	This test is successful, if the IUT transfers (forwards) a probe testing the reachability of a remote AMHS user correctly and returns a NDR, if the probe contains a content-length value which exceeds the length supported by the IUT's MTA component.
Scenario description	From the AMHS Test Tool send two probes to the IUT's transfer port *trp1*. The probe (envelope) shall contain an intended recipient address reachable via transfer port *trp2*. • The first probe shall contain a content length value of 1.048.576 (octets), which is a length, which must be supported by the IUT's MTA component. • The second probe shall contain a content length value of 2.147.483.647 (octets), which is the maximum length in octets specified in X.411:06/1999. It equals the largest integer in 32 bits. Monitor the outcome of IUT transfer ports *trp1*, *trp2* and *trp3*. Verify that: • the first probe is routed correctly via transfer port *trp2*, and there is not any NDR returned from the IUT, • the second probe is either routed correctly via transfer port *trp2* or rejected, if such a length is not supported by the IUT's transfer capabilities. Check, if either a forwarded probe or a NDR is received from the IUT. *Note. – The AMHS Test Tool shall respond with a DR, if it receives a valid probe for a user residing in the test tool's domain.*
AMHS SARPs reference	3.1.2.2.2 (ATS message server), 3.1.2.1.2.2 (AMHS information model)
Test class	Normal AMHS communications

CT304– Reject a message, if DL expansion is prohibited

CT304	**Reject a message, if DL expansion is prohibited**
Test criteria	This test is successful, if the IUT distributes a received IPM addressing a distribution list (DL) only, if the *dl-expansion-prohibited* flag is set to “false” and rejects the message, if the *dl-expansion-prohibited* flag is set to “true”. In the latter case, the IUT shall return a NDR.
Scenario description	From the AMHS Test Tool send two IPMs to the IUT’s transfer port *trp1*. The recipient in the message transfer envelope (MTE) shall address a distribution list. The distribution list, in turn, shall address three remote AMHS users, one reachable via transfer port *trp1*, one reachable via *trp2* and one via *trp3*. The first message shall have the *dl-expansion-prohibited* flag set to “false” and the second to “true”. Monitor the outcome of transfer ports *trp1*, *trp2* and *trp3*. Verify that: • only the first message is distributed by the IUT and three messages are received at the AMHS Test Tool, • a NDR is returned to trp1 for the second message.
AMHS SARPs reference	3.1.2.2.2.1.1 (DL functional group)
Test class	Normal AMHS communications

CT305– Loop detection

CT305	**Loop detection**
Test criteria	This test is successful, if the IUT detects that the received message, IPN, report and probe have traversed a loop.
Scenario description	Create a temporary routing loop, i.e. modify the routing table in MTA-2 to forward all messages addressed to AMHSLAND-2 to MTA-1, which in turn forwards those messages to the IUT. Configure the loop detection mechanism in the AMHS Test Tool (MTA-1 and MTA-2) to allow a message to run through the loop 32 times. From the AMHS Test Tool send an AMHS message (IPM) to the IUT addressing an AMHS user in AMHSLAND-2. Verify that: • the IUT detects the loop, • discards the message and • sends a NDR (before the test tool detects that the message has traversed the loop 32 times). Repeat the test for an IPN, a report and a probe. The IUT shall detect the loop in all cases and return a NDR for the IPN and the probe (but not for the report).
AMHS SARPs reference	3.1.1, Note 2a (ISO/IEC 10021), *See also ITU-T Rec. X.411 clause 14.3.1 and clause 12.3.1.*
Test class	MHS procedural errors

CT306– Generate a NDR, if transfer fails

CT306	**Generate a NDR, if transfer fails**
Test criteria	This test is successful, if the IUT correctly generates a NDR, if it can not transfer the received IPM towards the specified recipient.
Scenario description	From the AMHS Test Tool send a sequence of ATS messages (IPMs) to the IUT's transfer port *trp1*. All messages shall contain an unknown primary recipient address and have different combinations of settings for the *originator-report-request* flag and the *originating-mta-report-request* flag according to Table . Verify that in all cases the IUT returns a NDR. Verify that the report is always addressed to the originator of the message. Verify that the *originator-report-request* flag setting in the per-recipient-fields of the generated NDR is equal to the setting in the subject message.
AMHS SARPs reference	3.1.2.2.2.1.1 (AMH22/AMH11)
Test class	Normal AMHS communications

ATS Message	**Value of the originator-report-request element**	**Value of the originating-MTA-report-request element**	**Expected result**
1	no-report(0)	report(2)	IUT returns a NDR with the *originator-report-request* flag set to no-report(0).
2	non-delivery-report(1)	report(2)	IUT returns a NDR with the *originator-report-request* flag set to non-delivery-report(1).
3	report(2)	report(2)	IUT returns a NDR with the *originator-report-request* flag set to report(2).

***Table 9: CT306 report request settings*[5]**

[5] Note that the originating-MTA-report-request argument shall specify at least the level specified in the originator-report-request (see ITU-T recommendation X.411, clause 12.2.1.1.1.8)

4.4 Gateway Operations (AMHS to AFTN)

CT401 – Convert an incoming IPM to AFTN format

CT401	**Convert an incoming IPM to AFTN format**
Test criteria	This test is successful, if the IUT converts an IPM into AFTN format correctly.
Scenario description	From the AMHS Test Tool send a sequence of ATS messages (IPMs) over AMHS transfer port *trp1* to the IUT addressing an AFTN user. • The first ATS message shall have ATS-message-priority KK. • The second ATS message shall have ATS-message-priority GG. • The third ATS message shall have ATS-message-priority FF. • The fourth ATS message shall have ATS-message-priority DD. • The fifth ATS message shall have ATS-message-priority SS. Each message shall have different ATS-filing-time and ATS-message-text and address an AFTN user reachable via the AFTN/X.25 port *cid1*. The optional-heading-information element shall be empty[1]. The implicit-conversion-prohibited attribute of the AMHS message must be set to "false". Verify the messages received at the AFTN/X.25 interface of the AMHS Test Tool. Check the correct format of the AFTN message. Verify the AFTN priority and filing time for each received message. Compare the AFTN message text with the original ATS-message-text.
AMHS SARPs reference	3.1.2.3.5.2 (AMHS IPM conversion)
Test class	Normal AMHS communications

[1] There is a separate test case specified, that will test the conversion of the optional-heading-information element.

CT402 – Convert an IPM containing optional-heading-information in the ATS-message-header

CT402	**Convert an IPM containing optional-heading-information in the ATS-message-header**
Test criteria	This test is successful, if the IUT converts an IPM containing optional-heading-information (OHI) in the ATS-message-header correctly into AFTN format and returns a non-delivery report, if it cannot convert the message, because the OHI text is too long.
Scenario description	From the AMHS Test Tool send a sequence of ATS messages (IPMs) over the AMHS transfer port to the IUT. The sequence of IPMs shall address a remote AFTN user. • The first ATS message shall have FF priority and contain OHI text of less than 53 characters[1]. • The second ATS message shall have FF priority and contain OHI text of exactly 53 characters. • The third ATS message shall have FF priority and contain OHI text of more than 53 characters. • The fourth ATS message shall have SS priority and contain OHI text of less than 48 characters[2]. • The fifth ATS message shall have SS priority and contain OHI text of exactly 48 characters. • The sixth ATS message shall have SS priority and contain OHI text of more than 48 characters. Check the AFTN messages received at the X.25/AFTN port and verify the AFTN format. In particular, check the format and contents of the OHI. Verify that the IUT returns a NDR for the third and sixth ATS message containing the following elements (as specified in the AMHS SARPs, section 3.1.2.3.5.2.1.5-b): • "unable-to-transfer" for the *non-delivery-reason-code*, • "content-syntax-error" for the *non-delivery-diagnostic-code*, and • "unable to convert to AFTN due to ATS-Message-Header or Heading Fields syntax error" for the supplementary-information.
AMHS SARPs reference	3.1.2.3.5.2.2.8 (OHI), 3.1.2.2.3.2.3.4 (ATS Message Optional Heading Info), PDR M4100001
Test class	Normal AMHS communications

[1] OHI text of 53 characters is the maximum length for non-SS messages, if the total maximum line length is 69. (total line length = OHI text + space + 6 digit filing time + space + 8 characters originator.)
[2] OHI text of 48 characters is the maximum length for SS messages, if the total maximum line length is 69. (Total line length = OHI text + space + 6 digit filing time + 8 characters originator indicator + 5 character priority alarm.)

CT403 – Generate a DR for a successfully translated IPM

CT403	**Generate a DR for a successfully translated IPM**
Test criteria	This test is successful, if the IUT returns a DR for a successfully translated ATS message (IPM), if a report was requested by the originator or the originating MTA.
Scenario description	From the AMHS Test Tool send a sequence of ATS messages (IPMs) to the IUT addressing an AFTN user. The IPMs shall have ATS-Message-Priority "FF" and different combinations of settings for the *originator-report-request* flag and the *originating-mta-report-request* flag according to Table . The IUT shall convert all ATS messages into AFTN format and forward them via the AFTN/X.25 port *cid1* to the AMHS Test Tool. Check the messages received at the AMHS interface and verify that the IUT sends a DR for every ATS message, if: a) the *originator-report-request* element is set to "report", or b) the originating-mta-report-request element is set to "report" or "audited-report". (see Table).
AMHS SARPs reference	3.1.2.3.5.6.1.3 (generation of AMHS reports)
Test class	Normal AMHS communications

ATS Message	Value of the originator-report-request element	Value of the originating-MTA-report-request element	Expected result for conformance test CT403
1	no-report(0)	non-delivery-report(1)	IUT does not return a report
2	no-report(0)	report(2)	IUT returns a DR
3	no-report(0)	audited-report(3)	IUT returns a DR
4	non-delivery-report(1)	non-delivery-report(1)	IUT does not return a report
5	non-delivery-report(1)	report(2)	IUT returns a DR
6	non-delivery-report(1)	audited-report(3)	IUT returns a DR
7	report(2)	report(2)	IUT returns a DR
8	report(2)	audited-report(3)	IUT returns a DR

***Table 10: CT403 report request settings*[1]**

[1] Note that the originating-MTA-report-request argument shall specify at least the level specified in the originator-report-request (see ITU-T recommendation X.411, clause 12.2.1.1.1.8)

CT404 – Generate a NDR, if implicit conversion is prohibited

CT404	**Generate a NDR, if implicit conversion is prohibited**
Test criteria	This test is successful, if the IUT rejects a received IPM addressed to an AFTN user, if the *implicit-conversion-prohibited* attribute is set to “true” and generates a NDR.
Scenario description	From the AMHS Test Tool send two ATS messages (IPMs) to the IUT transfer port *trp1*. The IPMs shall have both the *originator-report-request* and the *originating-MTA-report-request* flag set to “non-delivery-report” and contain the recipient address of an AFTN user reachable via the AFTN/X.25 port *cid1*. The first message shall have the argument *implicit-conversion-prohibited* set to “false” and the second message set to “true”. Verify that only the first message is transferred over the AFTN/X.25 test interface to the AMHS Test Tool, and a NDR is generated for the second message and received by the AMHS Test Tool via the transfer port *trp1*. Verify that this NDR contains the following elements (as specified in the AMHS SARPs 3.1.2.3.5.2.1.2): • “conversion-not-performed” for the *non-delivery-reason-code*, • “implicit-conversion-prohibited” for the *non-delivery-diagnostic-code*, and • “unable to convert to AFTN” for the *supplementary-information*.
AMHS SARPs reference	3.1.2.3.5.2.1.2
Test class	Normal AMHS communications

CT405 – Generate a NDR, if the ATS-message-header has a syntax error

CT405	**Generate a NDR, if the ATS-message-header has a syntax error**
Test criteria	This test is successful, if the IUT generates a NDR, if it receives an IPM addressed to an AFTN user containing erroneous ATS-message-header or ATS-message-text.
Scenario description	From the AMHS Test Tool send a sequence of seven messages (IPMs) to the IUT addressed to an AFTN user reachable via the IUT's gateway. • The first message (IPM) shall contain an empty ATS-message-priority. • The second message (IPM) shall contain an invalid ATS-message-priority • The third message (IPM) shall contain an empty ATS-message-filing-time. • The fourth message (IPM) shall contain an invalid ATS-message-filing-time. • The fifth message (IPM) shall contain OHI text longer than 53 characters. • The sixth message (IPM) shall contain an empty ATS-message-header. • The seventh message (IPM) shall contain an empty ATS-message-text. Check the messages received at the AMHS- and X.25/AFTN-interfaces of the AMHS Test Tool. Verify that the IUT - except for the seventh message[10] - does not convert the received AMHS messages into AFTN, but returns a NDR for each message via its transfer port *trp1*. Verify that all NDRs contains the following elements (as specified in the AMHS SARPs, section 3.1.2.3.5.2.1.5-b): • "unable-to-transfer" for the *non-delivery-reason-code,* • "content-syntax-error" for the *non-delivery-diagnostic-code,* and • "unable to convert to AFTN due to ATS-Message-Header or Heading Fields syntax error" for the supplementary-information.
AMHS SARPs reference	3.1.2.3.5.2.1.5-b), 3.1.2.2.3.2.3 (ATS Message Header)
Test class	Erroneous AMHS parameters

[10] The AMHS SARPS (3.1.2.2.3.2.4) do not exclude an IPM containing empty ATS-message-text.

CT406 – Convert or reject an IPM, if the ATS-message-text contains more than 1800 characters

CT406	**Convert or reject an IPM, if the ATS-message-text contains more than 1800 characters**
Test criteria	This test is successful, if the IUT, when it receives an ATS message with long ATS-message-text of more than 1800 characters, a) rejects the message and returns a NDR, or b) splits the received IPM into several messages and converts the resulting messages into AFTN format as specified in ICAO Annex 10, Attm. B (changed from D to B with Amendment 78) . *Note. – The AMHS SARPS (3.1.2.3.5.2.1.7) specify that the message can be rejected (case a) or split into several messages (case b).*
Scenario description	From the AMHS Test Tool send an ATS message (IPM) to the IUT containing ATS-message-text of 4500 characters to an AFTN user recipient. If case a) is implemented: Verify that the IUT does not convert the IPM into AFTN format, but returns a NDR. Check the NDR contents received at the TSMS-AMHS interface. Verify that the NDR contains the following elements: • “unable-to-transfer” for the *non-delivery-reason-code*; • “content-too-long” for the *non-delivery-diagnostic-code*; and • “unable to convert to AFTN due to message text length” for the *supplementary-information*. If case b) is implemented: Verify that (at least) three AFTN messages are received at the AFTN/X.25 test interface. Check the correct format of the AFTN messages. Check the text field of all received AFTN messages. Verify that the text is complete and unchanged, i.e. compare the received data with the *ATS-message-text* provided in the original IPM.
AMHS SARPs reference	3.1.2.3.5.2.1.7
Test class	Normal AMHS communications

CT407 – Convert or reject an IPM, if the ATS-message-text contains lines with more than 69 characters

CT407	**Convert or reject an IPM, if the ATS-message-text contains lines with more than 69 characters**
Test criteria	This test is successful, if the IUT converts a received IPM containing an ATS-messages-text with lines of more than 69 characters, if *conversion-with-loss-prohibited* is set to “false”. Otherwise the IUT shall reject the message and generate a NDR.
Scenario description	From the AMHS Test Tool send two ATS messages (IPMs) to the IUT transfer port. The messages shall have both the *originator-report-request* and the *originating-MTA-report-request* flag set to “non-delivery-report” and contain the recipient address of an AFTN user reachable via the AFTN/X.25 port *cid1*. The IPM body shall contain ATS-message-text with lines exceeding 69 characters. In the first message the argument *conversion-with-loss-prohibited* shall be set to “false” and in the second message to the value “true”. Verify that only messages are received at the AFTN/X.25 test interface of the AMHS Test Tool, if the *conversion-with-loss-prohibited* was set to “false”. Check the correct format of the AFTN message. Verify that an additional line feed has been inserted for every text line exceeding 69 characters. In case of message rejection, verify that a NDR is generated and received by AMHS Test Tool via the transfer port *trp1* with the following values: • “conversion-not-performed” for the *non-delivery-reason-code*, and • “line-too-long” for the diagnostic code.
AMHS SARPs reference	3.1.2.3.5.2.1.6 a)
Test class	Normal AMHS communications

CT408 – Convert or reject an IPM, if the ATS-message-text contains characters not allowed by ICAO Annex 10

CT408	Convert or reject an IPM, if the ATS-message-text contains characters not allowed by ICAO Annex 10
Test criteria	This test is successful, if the IUT converts a received IPM containing an ATS-messages-text with characters not allowed by ICAO Annex 10, if *conversion-with-loss-prohibited* is set to “false”. Otherwise the IUT shall reject the message and generate a NDR.
Scenario description	From the AMHS Test Tool send two ATS messages (IPMs) to the IUT transfer port *trp1*. The messages shall have both the *originator-report-request* and the *originating-MTA-report-request* flag set to “non-delivery-report” and contain the recipient address of an AFTN user reachable via the AFTN/X.25 port *cid1*. • In the first message the ATS-Message-Text shall contain one or more IA-5 characters that are not allowed by ICAO Annex 10, e.g. the punctuation symbol “;” and have the *conversion-with-loss-prohibited* argument set to “false”, • The second message shall contain equal ATS-Message-Text, but have the *conversion-with-loss-prohibited* argument set to “true”, Verify that only messages are received at the AFTN/X.25 test interface of the AMHS Test Tool, if the *conversion-with-loss-prohibited* was set to “false”. In such a case, check the converted AFTN message format. In case of message rejection, verify that a NDR is generated and received by AMHS Test Tool via the transfer port *trp1* with the following values: • “conversion-not-performed” for the *non-delivery-reason-code*, and • “punctuation-symbol-loss” for the diagnostic code.
AMHS SARPs reference	3.1.2.3.5.2.1.6 c), d) and e)
Test class	Normal AMHS communications

CT409 – Reject an IPM with multiple body part

CT409	**Reject an IPM with multiple body part**
Test criteria	This test is successful, if the IUT generates a NDR, if it receives an IPM addressed to an AFTN user containing multiple body parts.
Scenario description	From the AMHS Test Tool send an ATS message (IPM) to the IUT transfer port *trp1*. The message shall contain two (or more) ia5-text body parts. Verify that a NDR is generated and received by AMHS Test Tool via the transfer port *trp1* with the following elements: • "unable-to-transfer" for the *non-delivery-reason-code*, • "content-syntax-error" for the *non-delivery-diagnostic-code*, and • "unable to convert to AFTN due to multiple body parts" for the *supplementary-information*.
AMHS SARPs reference	3.1.2.3.5.2.1.3
Test class	Erroneous AMHS parameters

CT410 – Distribute an IPM to AMHS and AFTN users

CT410	**Distribute an IPM to AMHS and AFTN users**
Test criteria	This test is successful, if the IUT distributes an IPM addressing both an AMHS and an AFTN user correctly.
Scenario description	From the AMHS Test Tool send two ATS messages (IPMs) addressing both AMHS and AFTN users to the IUT via transfer port *trp1*. • The IPM Heading of the first message shall contain two primary recipients, which are one AMHS and one AFTN user and two copy recipients, which are also one AMHS and one AFTN user. • The IPM Heading of the second message shall contain two primary recipients, which are one AMHS and one AFTN user and two blind copy recipients, which are also one AMHS and one AFTN user. The message shall have the *originator-report-request* flag set to “non-delivery-report”. Verify that both messages (IPMs) are: • relayed to AMHS transfer port *trp2*, and • relayed and converted to AFTN format and transferred via the AFTN/X.25 port *cid1*. Check the messages received at the AMHS-interface. Verify that: • both messages contain an MTE with all AMHS recipient addresses and an IPM heading with all AMHS <u>and</u> AFTN recipients. Check the messages received at the AFTN/X.25 port. Verify that: • both messages contain the addresses of both AFTN users.
AMHS SARPs reference	3.1.2.2.1 (ATS message user agent), 3.1.2.2.2 (ATS message server), 3.1.2.3.5.2 (IPM conversion)
Test class	Normal AMHS communications

CT411 – Expand a DL addressing both AMHS and AFTN users

<table>
<tr><th>CT411</th><th>Expand a DL addressing both AMHS and AFTN users</th></tr>
<tr><td>Test criteria</td><td>This test is successful, if the IUT distributes an IPM addressing AMHS and AFTN users in a distribution list correctly.</td></tr>
<tr><td>Scenario description</td><td>From the AMHS Test Tool send two ATS messages (IPM) to the IUT transfer port trp1. The recipient contained in the MTE, shall address a distribution list, for which the IUT is responsible. The distribution list shall address one AMHS user and two AFTN users. The AMHS user is reachable via the AMHS transfer port trp2 and the AFTN users are reachable via the X.25/AFTN port cid1. The first message shall have the dl-expansion-prohibited flag set to “false” and the second to “true”.
Check the messages received at the AMHS and X.25/AFTN interfaces of the AMHS Test Tool.
Verify that only the first IPM is:
transferred via AMHS transfer port trp2, and
converted to AFTN format and transferred via the X.25/AFTN port cid1.
Verify for the first IPM that:
one message is received at the AMHS-interface trp2 containing (only) the AMHS recipient address in the MTE and the DL recipient address in the IPM heading
one AFTN message is received at the X.25/AFTN-interface containing the addresses of both AFTN users
Verify for the second message that:
a NDR is returned to trp1.</td></tr>
<tr><td>AMHS SARPs reference</td><td>3.1.2.2.2.1.1 (DL functional group), 3.1.2.3.5.2 (IPM conversion)</td></tr>
<tr><td>Test class</td><td>Normal AMHS communications</td></tr>
</table>

CT412 –Split or reject an incoming IPM addressing more than 21 AFTN users

CT412	**Split or reject an incoming IPM addressing more than 21 AFTN users**
Test criteria	This test is successful, if the IUT receives an ATS message (IPM) addressing more than 21 AFTN users and a) splits the received IPM into several messages, each addressing 21 or less AFTN users if no more than 512 AFTN users are addressed, or b) rejects the received IPM and returns a NDR if more than 512 AFTN users are addressed. *Note. – With the resolution of PDR M4050004 a message with more than 21, but no more than 512 recipient addresses must not be rejected by the gateway*.
Scenario description	From the AMHS Test Tool send two ATS messages (IPM) to the IUT transfer port *trp1*. The message shall have the *originator-report-request* flag set to “non-delivery-report”. • Send one IPM with 512 recipients. Verify that this message is split into 25 AFTN messages, each of the first 24 messages containing 21 addresses, the last one containing 8 addresses. • Send one IPM with 513 recipients. Verify that the IUT does not convert the AMHS message into AFTN format, but returns a NDR via its transfer port *trp1* with the following elements: • “unable-to-transfer” for the *non-delivery-reason-code*, • “too-many-recipients” for the *non-delivery-diagnostic-code*, and • “unable to convert to AFTN due to number of recipients” for the *supplementary-information.*
AMHS SARPs reference	3.1.2.3.5.2.1.8, PDR M4050004
Test class	Normal AMHS communications

CT413 – Remove an unknown address before conversion into AFTN format

CT413	**Remove an unknown address before conversion into AFTN format**
Test criteria	This test is successful, if the IUT that receives an ATS message (IPM) addressed to multiple AFTN users removes any unknown address before conversion.
Scenario description	From the AMHS Test Tool send an ATS message (IPM) to the IUT via AMHS transfer port *trp1*. The message shall have two (primary) recipients addressing two AFTN users. Only the AMHS address of the first AFTN user can be translated by the MTCU into a valid AFTN addressee indicator, the AMHS address of the second AFTN user is unknown and the MTCU can not find a match in its address look-up table. Check the messages received at the AMHS- and X.25/AFTN-interfaces of the AMHS Test Tool. Verify that the IUT: • converts the received AMHS message into AFTN format, removes the unknown address and sends it via the X.25/AFTN-interfaces *cid1*, • returns a NDR via transfer port *trp1* for the unknown recipient. Verify that the NDR contains the following elements (as specified in the AMHS SARPs, section 3.1.2.3.5.2.2.6.2 d): • "unable-to-transfer" for the *non-delivery-reason-code*, and • "unrecognised-OR-name" for the *non-delivery-diagnostic-code*
AMHS SARPs reference	3.1.2.3.5.2.2.6.2
Test class	Normal AMHS communications

CT414 – Convert an incoming AFTN acknowledgement

CT414	**Convert an incoming AFTN acknowledgement**
Test criteria	This test is successful, if the IUT converts an AFTN acknowledgement (SS ACK message) to a receipt notification correctly.
Scenario description	From the AMHS Test Tool send an ATS message (IPM) via AMHS test interface *trp1* to the IUT addressing a remote AFTN user reachable via the AFTN/X.25 test interface *cid1*. The IPM shall have the *receipt-notification* request flag activated and the *ATS-message-priority* shall have the value "SS". The IUT shall convert the AMHS message to an AFTN message with priority indicator "SS" and send it via the AFTN/X.25 test interface *cid1* to the AMHS Test Tool. Upon receipt of the AFTN message, the AMHS Test Tool shall return an AFTN acknowledgement to the IUT (via the AFTN/X.25 test interface *cid1*). The subject message shall refer to the received AFTN user message. The IUT shall convert this AFTN acknowledgement to an AMHS receipt notification and send it via the AMHS test interface *trp1*. Verify that the AMHS Test Tool receives a receipt notification. In particular, verify that: • the originator indicator contained in the AFTN acknowledgement is translated to the *ipn-originator* (IPN) and the *originator-name* (MTE), • the *receipt-time* of the IPN is generated from the *filing time* of the AFTN acknowledgement, • the value of the *priority* element in the MTE is set to "urgent", • the values of *subject-ipm* and *recipient-name* are inserted correctly from log entries.
AMHS SARPs reference	3.1.2.3.4.3 (conversion AFTN ACK)
Test class	Normal AMHS communications

CT415 – Incoming AFTN acknowledgement with unknown AFTN originator

CT415	**Incoming AFTN acknowledgement with unknown AFTN originator**
Test criteria	This test is successful, if the IUT informs its control position, when the AFTN acknowledgement (SS ACK message) can not be converted because the AFTN originator is unknown.
Scenario description	From the AMHS Test Tool send an ATS message (IPM) via AMHS test interface *trp1* to the IUT addressing a remote AFTN user reachable via the AFTN/X.25 test interface *cid1*. The IPM shall have the *receipt-notification* request flag activated and the *ATS-message-priority* shall have the value “SS”. The IUT shall convert the AMHS message to an AFTN message with priority indicator “SS” and send it via the AFTN/X.25 test interface *cid1* to the AMHS Test Tool. Upon receipt of the AFTN message, the AMHS Test Tool shall return an AFTN acknowledgement (SS ACK) to the IUT (via the AFTN/X.25 test interface *cid1*). The subject message shall refer to the received AFTN user message, but the originator of the AFTN acknowledgement (SS ACK) message shall be unknown to the IUT, i.e. not contained in any of the IUT’s conversion or address mapping tables. Check the output of the IUT at the AMHS test interfaces and the control position. Verify that the IUT does not send any IPM nor IPN via the AMHS transfer port, but reports the error situation to the control position.
AMHS SARPs reference	3.1.2.3.4.3.2.3
Test class	Erroneous AMHS parameters

CT416 – Incoming AFTN acknowledgement relating to a subject message without receipt-notification request

CT416	**Incoming AFTN acknowledgement relating to a subject message without receipt-notification request**
Test criteria	This test is successful, if the IUT encapsulates a received AFTN acknowledgement (SS ACK message) into an IPM, if the subject message did not have the receipt notification flag set.
Scenario description	From the AMHS Test Tool send an ATS message (IPM) via AMHS test interface *trp1* to the IUT addressing a remote AFTN user reachable via the AFTN/X.25 test interface *cid1*. The message shall have the *ATS-message-priority* set to “SS”, however, the *receipt-notification-request* shall be deactivated. The IUT shall convert the AMHS message into an AFTN message with priority indicator “SS” and send it over the AFTN/X.25 test interface *cid1* to the AMHS Test Tool. Upon receipt of the AFTN user message the AMHS Test Tool shall return an AFTN SS acknowledgement to the IUT with the subject message relating to the previously received AFTN user message. Since the initial ATS message (IPM) did not have the *receipt-notification-request* activated, the IUT shall not convert the AFTN acknowledgement into a RN, but encapsulate the AFTN acknowledgement into an IPM, instead. Check the output of the IUT at the AMHS test interface *trp1* and the control position. Verify that the IUT sends an ATS message (IPM) with the addressed AMHS user as recipient. Verify that the message contains the original AFTN acknowledgement in the ATS-message-text of the IPM body.
AMHS SARPs reference	3.1.2.3.4.3.1.2
Test class	MHS procedural errors, Erroneous IPMS information objects

CT417 – Incoming AFTN acknowledgement without related subject message

CT417	Incoming AFTN acknowledgement without related subject message
Test criteria	This test is successful, if the IUT encapsulates a received AFTN acknowledgement (SS ACK message) into an IPM, if the subject message did not pass the gateway before.
Scenario description	From the AMHS Test Tool send an AFTN acknowledgement (SS ACK message) via the AFTN/X.25 test interface *cid1* to the IUT addressing an AMHS user. The AFTN acknowledgement shall have a fictitious origin subject message in the message text. Check the output of the IUT at the AMHS transfer port and the control position. Verify that the IUT sends an IPM with the addressed AMHS user as recipient. Verify that the IPM contains the original AFTN acknowledgement in the ATS-message-text of the IPM body.
AMHS SARPs reference	3.1.2.3.4.3.1.1
Test class	MHS procedural errors , Erroneous IPMS information objects

CT418 – Convert an AFTN SVC “Unknown Addressee Indicator” to a NDR

CT418	**Convert an AFTN SVC “Unknown Addressee Indicator” to a NDR**
Test criteria	This test is successful, if the IUT converts a received AFTN service message (SVC) of type “Unknown Addressee Indicator” to a NDR correctly.
Scenario description	From the AMHS Test Tool send an ATS message (IPM) via AMHS test interface *trp1* to the IUT addressing a remote AFTN user reachable via the AFTN/X.25 test interface *cid1*. The IUT shall convert the IPM to an AFTN user message and send it over AFTN/X.25 test interface *cid1* to the AMHS Test Tool. Upon receipt of the AFTN user message the AMHS Test Tool shall return an AFTN service message of type “Unknown Addressee Indicator” to the IUT that relates to the formerly received message. The IUT shall convert this AFTN service message to a NDR. Verify that a NDR is generated (as specified in the AMHS SARPs, section 3.1.2.3.4.4) and received by AMHS Test Tool via the AMHS test interface *trp1* with the following elements: • for the report-destination-name the *originator-name* of the subject AMHS message, for the subject-identifier the *message-identifier* of the subject AMHS message, for the actual-recipient-name the *unknown addressee indicator* reported with the SVC, • “unable-to-transfer” for the *non-delivery-reason-code*, and • “unrecognised-OR-name” for the *non-delivery-diagnostic-code*.
AMHS SARPs reference	3.1.2.3.4.4 (conversion AFTN SVC unknown)
Test class	Normal AMHS communications

CT419 – Incoming AFTN SVC “Unknown Addressee Indicator” without related subject message

CT419	**Incoming AFTN SVC “Unknown Addressee Indicator” without related subject message**
Test criteria	This test is successful, if the IUT encapsulates a received AFTN service message (SVC) of type “Unknown Addressee Indicator” into an IPM, if the subject message did not pass the gateway before.
Scenario description	From the AMHS Test Tool send an AFTN service message of type “Unknown Addressee Indicator” to the IUT addressing an AMHS user. The AFTN service message shall have a fictitious origin subject message in the message text. Check the output of the IUT at the AMHS transfer port. Verify that the IUT sends an IPM with the addressed AMHS user as recipient. Verify that the IPM contains the original AFTN SVC in the IPM body (ATS-message-text).
AMHS SARPs reference	3.1.2.3.4.4.1.1 b)
Test class	Normal AMHS communications

CT420 – Processing of an incoming SVC QTA RPT Message

CT420	Processing of an incoming SVC QTA RPT Message
Test criteria	This test is successful, if the IUT sends an AFTN user message a second time, if it receives an SVC QTA RPT message.
Scenario description	From the AMHS Test Tool send an ATS message (IPM) to the IUT addressing an AFTN user. The IUT shall convert the message into AFTN format and send it over the AFTN/X.25 test interface to the AMHS Test Tool. Upon receipt of the AFTN user message the AMHS Test Tool shall return an AFTN service message of type QTA RPT related to the previously received AFTN message. Verify that the IUT does not translate the AFTN service message into an IPM, but processes the QTA RPT so that the previous message is sent to the AFTN user (automatically or by operator intervention) a second time.
AMHS SARPs reference	3.1.2.3.2.1.12
Test class	Normal AMHS communications

CT421 – Probe Conveyance Test

CT421	Probe Conveyance Test
Test criteria	This test is successful, if the IUT (receiving a probe with an AFTN user as intended recipient) generates a DR, if conversion to AFTN is possible or an NDR, if conversion to AFTN is not possible.
Scenario description	From the AMHS Test Tool send a sequence of AMHS probes to the IUT. • Probe 1 shall specify a content-length of 1800 and address an AFTN user recipient reachable via the AMHS/AFTN gateway. • Probe 2 shall specify a content-length of 1800 and address an AFTN user recipient, which is routed by the IUT via the gateway (MTCU), but which can not be mapped onto a valid AFTN address by the MTCU. • Probe 3 shall specify a content-length of 1800 and address two AFTN user recipients, one which can be mapped and one which can not be mapped onto a valid AFTN address. • Probe 4 shall specify a content-length of 10.000 and address an AFTN user recipient reachable via the AMHS/AFTN gateway. • Probe 5 shall specify a content-length of 100.000 and address an AFTN user recipient reachable via the AMHS/AFTN gateway. • Probe 6 shall have a recipient argument addressing 512 AFTN users. • Probe 7 shall have a recipient argument addressing more than 512 AFTN users. Check the messages received at the AMHS Test Tool-AMHS interface. Verify that the IUT returns a report for each probe. Check the report contents and determine if it is a DR, NDR or combined report: • A DR shall be returned in response to probe 1. • A NDR shall be returned in response to probe 2. • A DR and NDR (one combined report or two reports) shall be returned in response to probe 3. • Depending on the gateway’s capabilities, a DR or NDR shall be returned for probe 4 and 5. • A DR shall be returned for Probe 6. • A NDR shall be returned for Probe 7.
AMHS SARPs reference	3.1.2.3.5.5 (reception of AMHS probe), PDR M4050004, PDR M601003
Test class	Normal AMHS communications

CT422 – Reject an IPM with unsupported content-type

CT422	**Reject an IPM with unsupported content-type**
Test criteria	This test is successful, if the IUT's gateway component rejects an incoming message of content-type other than IPM 84 or IPM 88 and generates a NDR.
Scenario description	From the AMHS Test Tool send a sequence of messages to the IUT via transfer port *trp1* addressed to an AFTN user recipient. The messages shall have different values for the content-type contained in the MTE. • The 1st message shall contain a *built-in content-type* value "interpersonal-messaging-1984(2)". • The 2nd message shall contain a *built-in content-type* value "interpersonal-messaging-1988(22)". • The 3rd message shall contain a *built-in content-type* value "edi-messaging(35)". • The 4th message shall contain a *built-in content-type* value "unidentified(0)". All messages shall contain an IPM body with ATS-message-header and ATS-message-text.[11] Verify that the IUT's gateway component accepts and converts the 1st and 2nd message, but rejects the 3rd and 4th message. Verify that the IUT returns a NDR for the 3rd and 4th message containing: • "unable-to-transfer" for the *non-delivery-reason-code*, and • "content-type-not-supported" for the *non-delivery-diagnostic-code*.
AMHS SARPs reference	3.1.2.3.5.1.1
Test class	Normal AMHS communications, Erroneous AMHS parameters

[11] It is assumed that MTAs on the relay path do not verify the specified content-type against the contained body part(s) and transfer all type of messages towards the gateway (MTCU).

CT423 – Processing of the original-encoded-information-types (EIT)

<table>
<tr><th>CT423</th><th>Processing of the original-encoded-information-types (EIT)</th></tr>
<tr><td>Test criteria</td><td>This test is successful, if the IUT’s gateway component evaluates the original-encoded-information-types contained in the incoming ATS message and:
accepts (and converts) the message, if it contains one of those values specified in section 3.1.2.3.5.2.1.1 of the AMHS SARPs, or
rejects the message, if it does not contain any of those values and generates a NDR.</td></tr>
<tr><td>Scenario description</td><td>From the AMHS Test Tool send a sequence of ATS messages (IPMs) over AMHS transfer port trp1 to the IUT addressing an AFTN user. The messages shall have the following values for the original-encoded-information-types (EIT) contained in the Message Transfer Envelope (MTE)
The 1st message shall contain built-in-encoded-information-types with value ”ia5-text(2)”.
The 2nd message shall contain built-in-encoded-information-types with value ”unknown(0)”.
The 3rd message shall contain extended-encoded-information-types with OID “2.6.3.4.2” for ia5-text information types.
The 4th message shall contain extended-encoded-information-types with OID “2.6.3.4.0” for unknown information types.
The 5th message shall contain extended-encoded-information-types with OID {id-cs-eit-authority 1}.
The 6th message shall contain extended-encoded-information-types with OID {id-cs-eit-authority 1} and OID {id-cs-eit-authority 6}.
The 7th message shall contain extended-encoded-information-types with OID {id-cs-eit-authority 1}, OID {id-cs-eit-authority 6} and OID {id-cs-eit-authority 100}.
The 8th message shall contain extended-encoded-information-types with (invalid) OID {id-cs-eit-authority 3}.
The 9th message shall contain extended-encoded-information-types with OID {id-cs-eit-authority 1}, OID {id-cs-eit-authority 6} and (invalid) OID {id-cs-eit-authority 7}.
The 10th message shall contain built-in-encoded-information-types with value ”ia5-text(2)” and extended-encoded-information-types with OID “2.6.3.4.2” for ia5-text as well as OID {id-cs-eit-authority 1} and OID {id-cs-eit-authority 6}.
The messages shall contain a body part corresponding to the (first valid) original-encoded-information-types value.
Verify that all messages with valid EIT argument are accepted by the IUT’s gateway component, converted to AFTN format and received at the AFTN/X.25 test interface of the AMHS Test Tool.
Verify that all messages with any invalid EIT argument are rejected by the IUT and a NDR is returned via transfer port trp1 with the following elements:
“unable-to-transfer” for the non-delivery-reason-code, and
“encoded-information-types-unsupported” for the non-delivery-diagnostic-code.</td></tr>
</table>

AMHS SARPs reference	3.1.2.3.5.2.1.1
Test class	Normal AMHS communications and Erroneous AMHS parameters

CT 424 – Incoming IPM with extended body part of type "ia5-text-body-part"

CT424	Incoming IPM with extended body part of type "ia5-text-body-part"
Test criteria	This test is successful, if the IUT's gateway component accepts a received ATS message (IPM) with extended body part of type "ia5-text-body-part" and converts the IPM into AFTN format correctly.
Scenario description	From the AMHS Test Tool send a sequence of ATS messages (IPMs) over AMHS transfer port *trp1* to the IUT addressing an AFTN user. • The first message shall contain an extended body part of type "ia5-text-body-part", which includes an ATS-message-header and ATS-message-text with IA5-text characters. The *original-encoded-information-types* attribute shall contain *extended-encoded-information-types* with OID "2.6.3.4.2" (ia5-text). • The second message shall be equal except for the *original-encoded-information-types*, which has a built-in value for ia5-text(2)[12]. • The third message shall be equal to the first, but the *repertoire* argument in the body shall be different from ia5(5). • The fourth message shall be equal to the first, but the body part data shall contain characters different from IA5String, e.g. special characters of local language – as in German "ä", "ö" and "ü" or in French "é". Verify that the first and second message are accepted by the IUT's gateway component, converted to AFTN format and received at the AFTN/X.25 test interface of the AMHS Test Tool. Verify that the other messages are converted or rejected by the IUT and an NDR is returned via transfer port *trp1* with the following elements: • "unable-to-transfer" for the *non-delivery-reason-code,* • "content-syntax-error" for the *non-delivery-diagnostic-code*, and • "unable to convert to AFTN due to unsupported body part type" for the *supplementary-information*.
AMHS SARPs reference	3.1.2.3.5.2.1.4 a) 2)
Test class	Normal AMHS communications

[12] It is assumed that an extended ia5-text-body-part can be associated with either a built-in EIT or extended EIT value for ia5-text.

CT425 – Incoming IPM with extended body part type "general-text-body-part" and ISO 646 repertoire

CT425	**Incoming IPM with extended body part type "general-text-body-part" and ISO 646 repertoire**
Test criteria	This test is successful, if the IUT's gateway component accepts a received ATS message (IPM) with extended body part type "general-text-body-part" of which the repertoire set description is Basic (ISO 646) and converts the IPM into AFTN format correctly.
Scenario description	From the AMHS Test Tool send a sequence of ATS messages (IPMs) over AMHS transfer port *trp1* to the IUT addressing an AFTN user recipient. All messages shall contain an extended body part of type "general-text-body-part", which includes an ATS-message-header and ATS-message-text with general-text data. The *original-encoded-information-types* shall be set to *extended-encoded-information-types* with OID {id-cs-eit-authority 1} and OID {id-cs-eit-authority 6}. The message text (data part) shall include ISO 646 (US-ASCII) characters, only. The parameter argument in the IPM body part shall specify the following character sets: • The 1st message shall contain character set registration numbers 1 and 6, which specify the Basic ISO 646 repertoire. • The 2nd message shall contain character set registration numbers 1 and 5. • The 3rd message shall contain character set registration numbers 2 and 5. • The 4th message shall contain an empty set of character registration. The message text (data part) shall include ISO 646 (US-ASCII – see Table 11) characters, only. Verify that only the first message is accepted by the IUT's gateway component, converted to AFTN format and received at the X.25/AFTN interface of the AMHS Test Tool. Analyse the received AFTN messages with respect to the AFTN message text. Verify that all other messages are rejected by the IUT and an NDR is returned via transfer port *trp1* with the following elements: • "unable-to-transfer" for the *non-delivery-reason-code,* • "content-syntax-error" for the *non-delivery-diagnostic-code*, and • "unable to convert to AFTN due to unsupported body part type" for the *supplementary-information*.
AMHS SARPs reference	3.1.2.3.5.2.1.4 a) 3)
Test class	Normal AMHS communications and Erroneous AMHS parameters

20	21 !	22 "	23 #	24 $	25 %	26 &	27 '	28 (	29)	2A *	2B +	2C ,	2D -	2E .	2F /
30 0	31 1	32 2	33 3	34 4	35 5	36 6	37 7	38 8	39 9	3A :	3B ;	3C <	3D =	3E >	3F ?
40 @	41 A	42 B	43 C	44 D	45 E	46 F	47 G	48 H	49 I	4A J	4B K	4C L	4D M	4E N	4F O
50 P	51 Q	52 R	53 S	54 T	55 U	56 V	57 W	58 X	59 Y	5A Z	5B [	5C \	5D]	5E ^	5F _
60 `	61 a	62 b	63 c	64 d	65 e	66 f	67 g	68 h	69 i	6A j	6B k	6C l	6D m	6E n	6F o
70 p	71 q	72 r	73 s	74 t	75 u	76 v	77 w	78 x	79 y	7A z	7B {	7C |	7D }	7E ~	

Table 11: The ISO 646 (US-ASCII) character set

CT426 – Incoming IPM with extended body part type "general-text-body-part" and ISO 8859-1 repertoire

CT426	**Incoming IPM with extended body part type "general-text-body-part" and ISO 8859-1 repertoire**
Test criteria	This test is successful, if the IUT's gateway component processes a received ATS message (IPM) with extended body part type "general-text-body-part" of which the repertoire set description is Basic-1 (ISO 8859-1) according to its local AMHS Management Domain policy. *Note. – Depending on the local policy of the AMHS Management Domain a received message with extended body part type "general-text-body-part" of which the repertoire set description is Basic-1 (ISO 8859-1) can be converted or rejected.*
Scenario description	From the AMHS Test Tool send a sequence of ATS messages (IPMs) over AMHS transfer port *trp1* to the IUT addressing an AFTN user recipient. All messages shall contain an extended body part of type "general-text-body-part", which includes an ATS-message-header and ATS-message-text with general-text data. The *original-encoded-information-types* shall be set to *extended-encoded-information-types* with OID {id-cs-eit-authority 1}, OID {id-cs-eit-authority 6} and OID {id-cs-eit-authority 100}. The message text (data part) shall include ISO 8859-1 characters (Latin-1, Western Europe – see Table 12). The parameter argument in the IPM body part shall specify the following character sets: • The 1st message shall contain character set registration numbers 1, 6 and 100 which specify the ISO 8859-1 repertoire. • The 2nd message shall contain character set registration numbers 1 and 6, which specify the Basic ISO 646 repertoire. • The 3rd message shall contain an empty set of character registration. The characters used in the message text (data part) shall be equal for all messages. Check, if the messages are converted or rejected by the IUT according to its local policy. In case of conversion, analyse the received AFTN messages with respect to the characters contained in the AFTN message text. In case of message rejection, check, if the NDR returned via transfer port *trp1* contains the following elements: • "unable-to-transfer" for the *non-delivery-reason-code*, • "content-syntax-error" for the *non-delivery-diagnostic-code*, and • "unable to convert to AFTN due to unsupported body part type" for the *supplementary-information*.
AMHS SARPs reference	3.1.2.3.5.2.1.4 a) 4) 3.1.2.3.5.2.1.4 b)
Test class	Normal AMHS communications and Erroneous AMHS parameters

A0	A1 ¡	A2 ¢	A3 £	A4 ¤	A5 ¥	A6 ¦	A7 §	A8 ¨	A9 ©	AA ª	AB «	AC ¬	AD -	AE ®	AF ¯
B0 °	B1 ±	B2 ²	B3 ³	B4 ´	B5 µ	B6 ¶	B7 ·	B8 ¸	B9 ¹	BA º	BB »	BC ¼	BD ½	BE ¾	BF ¿
C0 À	C1 Á	C2 Â	C3 Ã	C4 Ä	C5 Å	C6 Æ	C7 Ç	C8 È	C9 É	CA Ê	CB Ë	CC Ì	CD Í	CE Î	CF Ï
D0 Ð	D1 Ñ	D2 Ò	D3 Ó	D4 Ô	D5 Õ	D6 Ö	D7 ×	D8 Ø	D9 Ù	DA Ú	DB Û	DC Ü	DD Ý	DE Þ	DF ß
E0 à	E1 á	E2 â	E3 ã	E4 ä	E5 å	E6 æ	E7 ç	E8 è	E9 é	EA ê	EB ë	EC ì	ED í	EE î	EF ï
F0 ð	F1 ñ	F2 ò	F3 ó	F4 ô	F5 õ	F6 ö	F7 ÷	F8 ø	F9 ù	FA ú	FB û	FC ü	FD ý	FE þ	FF ÿ

Table 12: The ISO 8859-1 character set

4.5 Gateway Operations (AFTN to AMHS)

CT501 – Convert an AFTN user message to AMHS format

CT501	**Convert an AFTN user message to AMHS format**
Test criteria	This test is successful, if the IUT converts an AFTN user message to an AMHS message (IPM) correctly.
Scenario description	From the AMHS Test Tool send a sequence of AFTN user messages over the AFTN/X.25 test interface to the IUT. The sequence of AFTN user messages shall address a remote AMHS user and consist of five messages, one for each AFTN priority, i.e. SS, DD, FF, GG, KK. The filing time shall be different for each message and the OHI field shall be empty for all messages[1]. Check the IPMs that the AMHS Test Tool receives from the IUT via the AMHS transfer port. Verify that the IUT has converted the messages correctly according to Table 3.1.2-8 of the AMHS SARPs – see section 3.1.2.3.4.2. Check message envelopes and contents. In particular, verify that: • the *ATS-message-header* and *ATS-message-text* in the IPM body part has the correct format, • the AFTN message text is correctly inserted in the *ATS-message-text* field, • the AFTN message priority is correctly inserted in the *ATS-message-priority* field, • that the IUT has translated the AFTN priority indicator and inserted the correct priority in the message transfer envelope (MTE) – see Table 13, • the addressee indicator is correctly translated in the corresponding AMHS OR address and entered as *primary-recipient* in the IPM heading and as *recipient-name* in the MTE, • the AFTN originator is translated in the AMHS OR address which was registered for identification of the AFTN originator in the AMHS and allocated to the elements *originator* (MTE), *originator-name* and the sub-component user of the element *this-IPM* (IPM heading), • the filing time is correctly inserted in the *ATS-message-header*.
AMHS SARPs reference	3.1.2.3.4.2
Test class	Normal AMHS communications

AFTN Priority Indicator	AMHS MTE priority	AMHS ATS-Message-Priority priority-indicator
SS	Urgent	SS
DD	Normal	DD
FF	Normal	FF
GG	non-urgent	GG
KK	non-urgent	KK

Table 13: Mapping of AFTN Priority Indicator for the Basic ATS Message Handling Service[2]

[1] Conversion of the optional-heading-information element is subject to another test.
[2] The mapping of the AFTN priority indicator is specified in table 3.1.2-7 of the AMHS SARPs

CT502 – Convert an AFTN user message containing optional heading information

CT502	**Convert an AFTN user message containing optional heading information**
Test criteria	This test is successful, if the IUT converts an AFTN user message containing optional heading information (OHI) correctly into an AMHS message (IPM).
Scenario description	From the AMHS Test Tool send a sequence of AFTN user messages over the AFTN/X.25 test interface to the IUT. The sequence of AFTN user messages shall address a remote AMHS user and consist of • a normal (non-SS) priority AFTN message containing (short) OHI text, • a normal (non-SS) priority AFTN message containing OHI filling the originator line, • an SS priority AFTN message containing (short) OHI text, • an SS priority AFTN message containing OHI filling the originator line. Check the IPMs transferred via the AMHS transfer port. Verify that the IUT has converted the messages correctly. Check envelopes and contents. In particular, verify the correct format of the ATS-message-header.
AMHS SARPs reference	3.1.2.3.4.2.1.6
Test class	Normal AMHS communications

CT503 – Generate an AFTN service message of the type “Unknown Addressee Indicator”

CT503	**Generate an AFTN service message of the type “Unknown Addressee Indicator”**
Test criteria	This test is successful, if the IUT returns an AFTN service message of the type “Unknown Addressee Indicator”, if the translation of addressee indicator fails.
Scenario description	From the AMHS Test Tool send an AFTN messages over the AFTN/X.25 test interface to the IUT. The AFTN message shall contain an addressee indicator which can not be mapped by the IUT. Verify that the IUT does not convert the received AFTN message into an AMHS message (IPM), but returns an AFTN service message of the type “Unknown Addressee Indicator” over the AFTN/X.25 test interface.
AMHS SARPs reference	3.1.2.3.5.4 (NDR conversion)
Test class	Normal AMHS communications

CT504 – Incoming AFTN user message with unknown originator indicator

CT504	**Incoming AFTN message with unknown originator indicator**
Test criteria	This test is successful, if the IUT informs its control position, if during the conversion process the translation of the originator indicator fails.
Scenario description	From the AMHS Test Tool send an AFTN messages over the AFTN/X.25 test interface to the IUT. The AFTN message shall contain an originator indicator which is unknown in the IUT. Verify that the IUT does not send any message via the X.25/AFTN or AMHS interface but informs its control position that the gateway is not able to translate the originator indicator.
AMHS SARPs reference	3.1.2.3.4.2.1.4.1
Test class	Erroneous AMHS parameters

CT505 – Convert a receipt notification

CT505	**Convert a receipt notification**
Test criteria	This test is successful, if the IUT converts a received IPN containing a receipt notification (RN) to an AFTN acknowledgement correctly.
Scenario description	From the AMHS Test Tool send an AFTN user message with priority “SS” via the AFTN/X.25 test interface to the IUT. The message shall address an AMHS user and be converted by the IUT into AMHS format and sent as an IPM to the AMHS Test Tool via transfer port *trp1*. Upon receipt of the IPM the AMHS Test Tool returns a RN. Verify that the IUT converts the received RN correctly into an AFTN acknowledgement. In particular, verify that: • the *originator-name* is translated into the *Originator Indicator* of the AFTN acknowledgement,the *receipt-time* forms the *Filing Time* of the AFTN acknowledgement, logged elements of the previously handled *subject AFTN message* are used and inserted correctly into the AFTN acknowledgement.
AMHS SARPs reference	3.1.2.3.5.3 (RN conversion),
Test class	Normal AMHS communications

CT506 – Incoming non-receipt notification

CT506	Incoming non-receipt notification
Test criteria	This test is successful, if the IUT reports to its control position and stores the message, if it receives an IPN containing a NRN addressed to an AFTN user.
Scenario description	From the AMHS Test Tool send an AFTN message with priority “SS” via the AFTN/X.25 test interface to the IUT. The message shall address an AMHS user and be converted by the IUT into AMHS format and sent to the AMHS Test Tool via transfer port *trp1*. Upon receipt of the AMHS message the AMHS Test Tool returns a NRN. Verify that the IUT behaves as specified in the AMHS SARPs, section 3.1.2.3.5.1.2, i.e. • logs the error situation and reports to a control position, and • stores the message for appropriate processing at the control position.
AMHS SARPs reference	3.1.2.3.5.1.2 c) (processing of NRN)
Test class	Erroneous AMHS parameters

CT507 – Generate a NDR as a result of misrouted RN

CT507	**Generate a NDR as a result of misrouted RN**
Test criteria	This test is successful, if the IUT rejects a misrouted IPN containing a receipt notification (RN) and returns a NDR.
Scenario description	From the AMHS Test Tool send a RN to the IUT via transfer port trp1 addressed to an AFTN user. The RN contains a fictitious value for the subject-ipm (subject AFTN message) and is not related to any message that had previously passed the IUT. Verify that the IUT does not transfer any AFTN acknowledgement over the AFTN/X.25 test interface to the AMHS Test Tool, but generates a NDR and sends it via the transfer port *trp1* to the AMHS Test Tool. Verify that the NDR contains the following elements as specified in the AMHS SARPS, section 3.1.2.3.5.3.1.1: • “unable-to-transfer” for the *non-delivery-reason-code*; • “invalid-arguments” for the *non-delivery-diagnostic-code*; and • “unable to convert RN to AFTN ACK service message due to misrouted RN” for the *supplementary-information*.
AMHS SARPs reference	3.1.2.3.5.3.1.1
Test class	MHS procedural errors

CT508 – Convert a non-delivery report (NDR)

CT508	**Convert a non-delivery report (NDR)**
Test criteria	This test is successful, if the IUT converts a received NDR with a *non-delivery-diagnostic-code* of the value "unrecognised-OR-name" to an AFTN service message (SVC) of the type "Unknown Addressee".
Scenario description	From the AMHS Test Tool send an AFTN message via the AFTN/X.25 test interface to the IUT. The message shall address an AMHS user and be converted by the IUT into AMHS format and sent to the AMHS Test Tool via transfer port *trp1*. The AMHS Test Tool shall return a NDR related to the received message and with a *non-delivery-diagnostic-code* of the value "unrecognised-OR-name". Verify that the IUT converts the received NDR into an AFTN service message (SVC) and sends it over the AFTN/X.25 test interface to the AMHS Test Tool. In particular, verify that: • the *actual-recipient-name* elements (provided with the *per-recipient-fields* in the Report Transfer Content) are converted into AFTN addresses which form the *unknown-addressee-indicators* in the text of the AFTN SVC,priority indicator, addressee indicator, origin and the first-address-line of the subject message are taken from log entries made for the handled subject message, and the filing time is generated correctly by the gateway component of the IUT. • the originator indicator of the service message is the AFTN Address of the AFTN Component of the AFTN/AMHS Gateway
AMHS SARPs reference	3.1.2.3.5.4 (NDR conversion), 3.1.2.3.5.4.2.7
Test class	Normal AMHS communications

CT509 – NDR conversion process failures

CT509	**NDR conversion process failures**
Test criteria	This test is successful, if the IUT reports to its control position, whenever an error occurs in the NDR conversion process.
Scenario description	From the AMHS Test Tool send three AFTN messages via the X.25/AFTN interface to the IUT. The messages shall address an AMHS user and be converted by the IUT into AMHS format and sent to the AMHS Test Tool via transfer port *trp1*. The AMHS Test Tool shall return a NDR for each received message. • The 1st NDR shall contain a *non-delivery-diagnostic-code* different from “unrecognised-OR-name”.The 2nd NDR shall contain an unknown address in the *actual-recipient-name* element. • The 3rd NDR shall refer to a fictitious subject message that did never pass the gateway before. Check the output of the IUT at the control position. Verify that for each NDR the IUT behaves as specified in the relevant sections of the AMHS SARPs, i.e. • logs the non-delivery situation and reports to a control position, and • stores the non-delivery report for appropriate processing at the control position.
AMHS SARPs reference	3.1.2.3.5.4.1.1, 3.1.2.3.5.4.1.3
Test class	Erroneous AMHS parameters

4.6 Naming and Addressing

CT601 – Address conversion from AMHS CAAS- and XF-addresses to AFTN addresses

CT601	**Address conversion from AMHS CAAS- and XF-addresses to AFTN addresses**
Test criteria	This test is successful, if the IUT when converting an AMHS message (IPM) to an AFTN message translates the originator and recipient addresses to the AFTN originator indicator and addressee indicators correctly. Conversion shall be correct for both types, i.e. CAAS and XF-addresses.
Scenario description	From the AMHS Test Tool send a sequence of ATS messages (IPMs) over AMHS transfer ports *trp1*, *trp2* and *trp3* to the IUT, addressing different AFTN users reachable via the AFTN/X.25 port *cid1*. • The 1st ATS message shall be sent via MTA-1 with originator from AMHSLAND-1 addressing an AFTN user in AFTNLAND-1. Note that both PRMDs (AMHSLAND-1 and AFTNLAND-1) implement the CAAS with one single organisation-name value for all location indicators within the PRMD. • The 2nd ATS message shall be sent via MTA-2 with originator from AMHSLAND-2 addressing an AFTN user in AFTNLAND-2. Note that both PRMDs (AMHSLAND-2 and AFTNLAND-2) implement the CAAS with multiple organisation-name values for different sets of location indicators within the PRMD. • The 3rd ATS message shall be sent via MTA-3 with originator from AMHSLAND-3 addressing an AFTN user in AFTNLAND-3. Note that both PRMDs (AMHSLAND-3 and AFTNLAND-3) implement the XF addressing scheme. • The 4th message shall be sent via MTA-1 with originator from AMHSLAND-1 addressing three AFTN users, one in AFTNLAND-1, one in AFTNLAND-2 and one in AFTNLAND-3. All messages shall have an IA5-text body part with ATS-message-header. The implicit-conversion-prohibited attribute in the MTE shall be set to “false”. Originator and recipient addresses in the IPM heading shall be equal to those in the MTE or empty[1]. Check the messages received at the X.25/AFTN interface. Verify that the IUT was able to map all AMHS O/R addresses to AFTN addresses. Verify the correct AFTN originator indicator and addressee indicator in the received AFTN messages.
AMHS SARPs reference	3.1.2.1.5 (Naming and Addressing Principles) 3.1.2.3.5.2.2.6.1 (Generation of the AFTN originator indicator) 3.1.2.3.5.2.2.6.2 (Generation of the AFTN addressee indicator)
Test class	Normal AMHS communications

[1] Originator and recipient addresses in the IPM heading may be empty. According to SARPs 3.1.2.3.5.2.3 “Use of IPM elements” those addresses are discarded by the MTCU.

CT602 – Address conversion from AFTN addresses to AMHS CAAS- and XF-addresses

CT602	**Address conversion from AFTN addresses to AMHS CAAS- and XF-addresses**
Test criteria	This test is successful, if the IUT that converts an AFTN user message to AMHS translates the AFTN originator indicator and all addressee indicators into correct AMHS addresses, which may be either XF- or CAAS addresses.
Scenario description	From the AMHS Test Tool send a sequence of AFTN user messages over the AFTN/X.25 port *cid1* to the IUT addressing different AMHS users reachable via the AMHS transfer ports *trp1, trp2* and *trp3*. • The 1st AFTN user message shall be sent with originator from AFTNLAND-1 addressing an AMHS user in AMHSLAND-1. Note that both PRMDs (AFTNLAND-1 and AMHSLAND-1) implement the CAAS with one single organisation-name value for all location indicators within the PRMD. • The 2nd ATS message shall be sent with originator from AFTNLAND-2 addressing an AMHS user in AMHSLAND-2. Note that both PRMDs (AFTNLAND-2 and AMHSLAND-2) implement the CAAS with multiple organisation-name values for different sets of location indicators within the PRMD. • The 3rd ATS message shall be sent with originator from AFTNLAND-3 addressing an AMHS user in AMHSLAND-3. Note that both PRMDs (AFTNLAND-3 and AMHSLAND-3) implement the XF addressing scheme. • The 4th message shall be sent with originator from AFTNLAND-1 addressing three AMHS users, one in AMHSLAND-1, one in AMHSLAND-2 and one in AMHSLAND-3. Check the messages received at AMHS transfer ports *trp1*, *trp2* and *trp3*. Verify that the IUT was able to map all AFTN originator and addressee indicators to AMHS O/R addresses. Verify the correct AMHS O/R addresses in the originator and recipient fields of both MTE and IPM headings.
AMHS SARPs reference	3.1.2.1.5 (Naming and Addressing Principles) 3.1.2.3.4.2.1.4.1 (Translation of the AFTN originator indicator) 3.1.2.3.4.2.1.4.2 (Translation of the AFTN addressee indicator)
Test class	Normal AMHS communications

CT603 – Reject an IPM with invalid recipient address (CAAS)

CT603	Reject an IPM with invalid recipient address (CAAS)
Test criteria	This test is successful, if the IUT generates a NDR, when it receives an ATS message (IPM) that contains a recipient address of type CAAS which can not be mapped to a valid AFTN addressee indicator.
Scenario description	From the AMHS Test Tool send a sequence of ATS messages (IPMs) over AMHS transfer port *trp1* to the IUT addressing an AFTN user in the PRMD "AFTNLAND-1" that implements the CAAS. All messages shall have a valid originator address and an erroneous recipient address in the MTE. Originator and recipient addresses in the IPM heading shall be equal to those in the MTE or empty[1]. • The 1st ATS message shall contain a recipient address with the value "AFTN" in the *organization-name* attribute, which is not correct for the CAAS. • The 2nd ATS message shall contain a recipient address with an invalid *common-name* attribute, that contains 9 letters, e.g. "BAAAFTABC". • The 3rd ATS message shall contain a recipient address with an invalid *common-name* attribute, that contains only 6 letters, e.g. "BAAAFT". • The 4th ATS message shall contain a recipient address with a valid *common-name* attribute "BAAAFTAA", but an empty *organizational-unit-names* attribute. • The 5th ATS message shall contain a recipient address with a valid *common-name* attribute "BAAAFTAA", but an *organizational-unit-names* attribute that is different from the first 4 letters of the *common-name* attribute, e.g. "BAAX". Verify that for each message a NDR is generated by the IUT with the following elements: • "unable-to-transfer" for the *non-delivery-reason-code*, and • "unrecognised-OR-name" for the non-delivery-diagnostic-code.
AMHS SARPs reference	3.1.2.3.5.2.2.6.1 (Generation of the AFTN originator indicator) 3.1.2.3.5.2.2.6.2 (Generation of the AFTN addressee indicator)
Test class	Erroneous AMHS parameters

[1] Originator and recipient addresses in the IPM heading may be empty. According to SARPs 3.1.2.3.5.2.3 "Use of IPM elements" those addresses are discarded by the MTCU.

CT604 – Reject an IPM with invalid recipient address (XF)

CT604	**Reject an IPM with invalid recipient address (XF)**
Test criteria	This test is successful, if the IUT generates a NDR, when it receives an ATS message (IPM) that contains a recipient address of type XF which can not be mapped to a valid AFTN addressee indicator.
Scenario description	From the AMHS Test Tool send a sequence of ATS messages (IPMs) over AMHS transfer port *trp1* to the IUT addressing an AFTN user in the PRMD "AFTNLAND-3" that implements the XF addressing scheme. All messages shall have a valid originator address and an erroneous recipient address in the MTE. Originator and recipient addresses in the IPM heading shall be equal to those in the MTE or empty[1]. • The 1st ATS message shall contain a recipient address of type CAAS, which is not valid for AFTNLAND-3. • The 2nd message shall contain a recipient address with the value "AFTN" in the *organization-name* attribute, but the four letter location indicator in the *organizational-unit-names* attribute and the AFTN address in the *common-name* attribute value. • The 3rd message shall contain a recipient address with the value "AFTN" in the *organization-name* attribute, but an invalid *organizational-unit-names* attribute, e.g. value "BCAAFTABC". • The 4th message shall contain a recipient address with the value "AFTN" in the *organization-name* attribute, but an invalid *organizational-unit-names* attribute, e.g. value "BCAAFT". • The 5th message shall contain a recipient address with the value "AFTN" in the *organization-name* attribute, but an empty *organizational-unit-names* attribute. Verify that for each message a NDR is generated by the IUT with the following elements: • "unable-to-transfer" for the *non-delivery-reason-code*, and • "unrecognised-OR-name" for the *non-delivery-diagnostic-code*.
AMHS SARPs reference	3.1.2.3.5.2.2.6.1 (Generation of the AFTN originator indicator) 3.1.2.3.5.2.2.6.2 (Generation of the AFTN addressee indicator)
Test class	Erroneous AMHS parameters

[1] Originator and recipient addresses in the IPM heading may be empty. According to SARPs 3.1.2.3.5.2.3 "Use of IPM elements" those addresses are discarded by the MTCU.

CT605 – Reject an IPM with invalid originator address (CAAS)

CT605	**Reject an IPM with invalid originator address (CAAS)**
Test criteria	This test is successful, if the IUT generates a NDR, when it receives an ATS message (IPM) that contains an originator address of type CAAS which can not be mapped to a valid AFTN originator indicator.
Scenario description	From the AMHS Test Tool send a sequence of ATS messages (IPMs) over AMHS transfer port *trp1* to the IUT addressing an AFTN user reachable via the AFTN/X.25 port *cid1*. All messages shall be originated from the PRMD "AMHSLAND-1" which implements the CAAS. They shall have a valid recipient address for the PRMD "AFTNLAND-1", but an erroneous originator address in the MTE. Originator and recipient addresses in the IPM heading shall be equal to those in the MTE or empty[18]. • The 1st ATS message shall contain an originator address with the value "AFTN" in the *organization-name* attribute, which is not correct for the CAAS. • The 2nd ATS message shall contain an originator address with an invalid *common-name* attribute, e.g. "AAAAMHABC". • The 3rd ATS message shall contain an originator address with an invalid *common-name* attribute that contains only 6 letters, e.g. "AAAAMH". • The 4th ATS message shall contain an originator address with a valid *common-name* attribute "AAAAMHAA", but an empty *organizational-unit-names* attribute. • The 5th ATS message shall contain a recipient address with a valid *common-name* attribute "AAAAMHAA", but an *organizational-unit-names* attribute that is different from the first 4 letters of the *common-name* attribute, e.g. "AAAX". Verify that for each message a NDR is generated by the IUT with the following elements: • "unable-to-transfer" for the *non-delivery-reason-code*, • "invalid-arguments" for the *non-delivery-diagnostic-code*, and • "unable to convert to AFTN due to unrecognized originator O/R address" for the *supplementary-information*.
AMHS SARPs reference	3.1.2.3.5.2.2.6.1 (Generation of the AFTN originator indicator) 3.1.2.3.5.2.2.6.2 (Generation of the AFTN addressee indicator)
Test class	Erroneous AMHS parameters

[18] Originator and recipient addresses in the IPM heading may be empty. According to SARPs 3.1.2.3.5.2.3 "Use of IPM elements" those addresses are discarded by the MTCU.

CT606 – Reject an IPM with invalid originator address (XF)

CT606	**Reject an IPM with invalid originator address (XF)**
Test criteria	This test is successful, if the IUT generates a NDR, when it receives an ATS message (IPM) that contains an originator address of type XF which can not be mapped to a valid AFTN originator indicator.
Scenario description	From the AMHS Test Tool send a sequence of ATS messages (IPMs) over AMHS transfer port *trp3* to the IUT addressing an AFTN user reachable via the AFTN/X.25 port *cid1*. All messages shall be originated from the PRMD "AMHSLAND-3" which implements the XF addressing scheme. They shall have a valid recipient address for the PRMD "AFTNLAND-3", but an erroneous originator address in the MTE. Originator and recipient addresses in the IPM heading shall be equal to those in the MTE or empty[1]. • The 1st ATS message shall contain an originator address of type CAAS, which is not valid for AMHSLAND-3. • The 2nd message shall contain an originator address with the value "AFTN" in the *organization-name* attribute, but the four letter location indicator in the *organizational-unit-names* attribute and the AFTN address in the *common-name* attribute value. • The 3rd message shall contain an originator address with the value "AFTN" in the *organization-name* attribute, but an invalid *organizational-unit-names* attribute, e.g. value "ACCCMHABC". • The 4th message shall contain an originator address with the value "AFTN" in the *organization-name* attribute, but an invalid *organizational-unit-names* attribute, e.g. value "ACCCMH". • The 5th message shall contain an originator address with the value "AFTN" in the *organization-name* attribute, but an empty *organizational-unit-names* attribute.
AMHS SARPs reference	3.1.2.3.5.2.2.6.1 (Generation of the AFTN originator indicator) 3.1.2.3.5.2.2.6.2 (Generation of the AFTN addressee indicator)
Test class	Erroneous AMHS parameters 1)

[1] Originator and recipient addresses in the IPM heading may be empty. According to SARPs 3.1.2.3.5.2.3 "Use of IPM elements" those addresses are discarded by the MTCU.

Annex C

Test Procedure
for
ATN Router Connection Test

Annex C

Of

AMHS Manual

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1 Introduction

1.1 This document describes the test procedure for the Ground-Ground (G/G) Aeronautical Telecommunication Network (ATN) router connection, up to 3 ATN router interconnections.

2 References

[1] Asia/Pacific Regional ATN G/G Router ICD for ISO/IEC 8202 Sub-Network.

[2] ASIA/PAC Interface Control Document (ICD) for ATN G/G Router

[3] Test Plan for AMHS Technical Trial between Hong Kong, China and Japan.

[4] "Technical Memorandum of Cooperation between Engineering & Systems Division, Civil Aviation Department, Hong Kong China and Operations and Flight Inspection Division, Civil Aviation Bureau, Ministry of Land, Infrastructure and Transport, Japan: AMHS Trials and Service between Japan and Hong Kong, China", February 2003. (Amended 24 August 2004)

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3 Test Overview and Scope

3.1 A joint ATN Router Connection Test between AMHSLAND1 and AMHSLAND2 using a 9.6kbps X.25 PSDN (packet-switched data network) circuit.

3.2 An ATN Router Connection Test is scheduled to verify the connectivity, interoperability, data relaying/routing and redundancy capabilities (where applicable) of the ATN Ground-Ground routers in AMHSLAND1 and AMHSLAND2.

3.3 The ATN Router Connection Test will also confirm that the functions of the AMHSLAND1 and AMHSLAND2 ATN routers were configured in preparation for more than 2 routers tests.

3.4 The system configuration for the test is shown in Figure 3. routers in AMHSLAND1 and AMHSLAND2 are linked by an X.25 virtual circuit (VC) over a leased line connection (e.g.64 kbps).

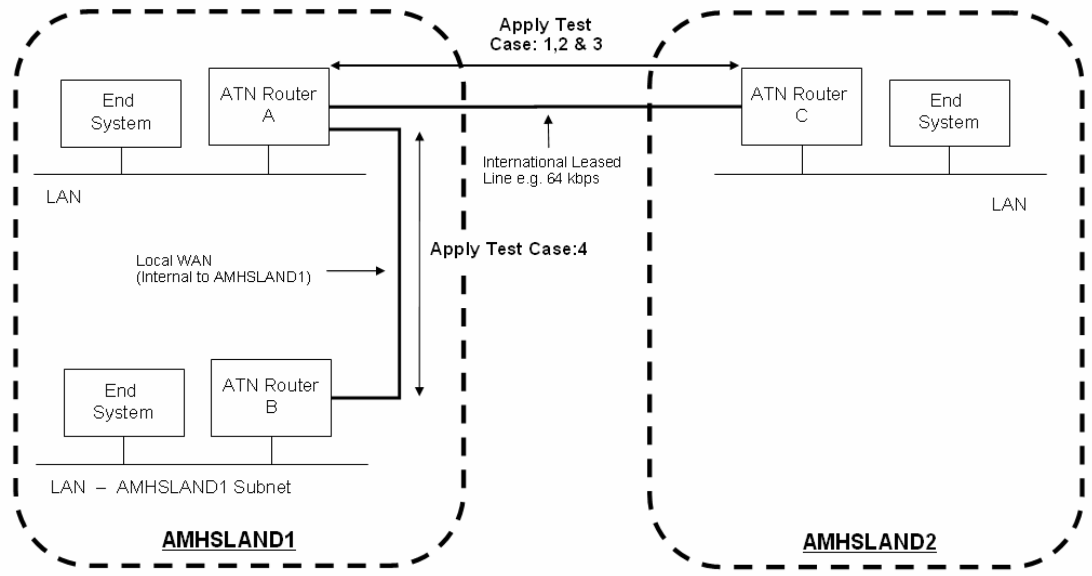


Figure 3 ATN Router Connection Test Configuration

3.5 To test data relay and routing functions, CLNP Echo Request (ERQ) Network Protocol Data Units (NPDU) will be generated by the routers and End Systems. To support these tests, all Intermediate Systems shall be capable of generating CLNP ERQ PDUs, and all Intermediate Systems and End Systems shall be capable of transmitting CLNP Echo Response (ERP) PDUs in response to the receipt of ERQ PDUs. Further, it is desirable that End Systems be capable of generating CLNP ERQ PDUs. Execution of some test items is contingent on End Systems' capabilities.

3.6 Since both AMHSLAND1 and AMHSLAND2 are ATN backbone sites, the proper updating of their routing tables should be tested in detail. This will ensure that the router could relay the data received from its counterpart to another router either within or outside its own domain/ATN site.

3.7 A summary of test items for the ATN Router Connection Test is shown in Table 5.

Table 5 Summary of Test Items for ATN Router Connection Test

No.	Test Item	Details
1	Router Connection Establishment and Maintenance	Establish LAPB, X.25 VC and IDRP connections between routers. Exchange of KEEPALIVE PDUs to maintain IDRP connection.
2	NPDU Relay	Tests to confirm CLNP Echo function of routers, correct NPDU relay, and validation of handling of PDUs with invalid security option parameter.
3	Router end-to-end tests	IDRP route addition/deletion, carrier medium failure/restoration and router failure/recovery.
4	ATN router environment tests	Multiple router route addition/deletion, carrier medium failure/restoration and router failure/recovery in three-domain configurations.

Communication Parameters

4.1 The proposed communication parameters for the connection between the routers of AMHSLAND1 and AMHSLAND2 are listed in Table 6.

4.2 The proposed CLNP communication parameters for the End Systems are listed in Table 7. It is proposed to use the NSAP addresses of the AMHS systems that will be used in actual operation for the ES NSAP addresses.

Schedule and Test Item Overview

5.1 The test items and planned schedule are shown in Table 8.

Table 6 Router Communication Parameters

Protocol	Item No.	Item	Parameter		Notes
			Router (AMHSLAND1)	Router (AMHSLAND2)	
	1.1	NSAP/NET	ROUTER A: 47.0027.81.81524A.00.010101.0302.000000000000.00 ROUTER B: 47.0027.81.854b00.00.010101.0302.000000000000.00	ROUTER C: 47.0027.81.815648.00.010101.0202.0202.012A.0100.00	1
CLNP (RPDU)	2.1	Priority	14	14	2
IDRP	3.1	NLRI	ROUTER A: 47.0027.81.81524A.00.010101 ROUTER B: 47.0027.81.854b00.00.010101	ROUTER C: 47.0027.81.815648.00.010101	
	3.2	RDI	ROUTER A: 47.0027.81.81524A.00.010101 ROUTER B: 47.0027.81.854b00.00.010101	ROUTER C: 47.0027.81.815648.00.010101	
	3.3	SecurityRegistrationID	06 04 2B 1B 00 00	06 04 2B 1B 00 00	2
	3.4	Tag Set Name	07 (ATSC Class Security Tag Set)	07 (ATSC Class Security Tag Set)	2
	3.5	ATSC Class	Class C	Class C	2
	3.6	Holding Time	180 sec	180 sec	2
	3.7	KEEPALIVE Send Timer	60 sec	60 sec	2, 3
	3.8	OPEN PDU Transmission	ROUTER A: AMHSLAND1-AMHSLAND2 : OPEN-PDU send ROUTER A: local circuit: OPEN-PDU send ROUTER B: OPEN-PDU receive	ROUTER C: AMHSLAND2 -AMHSLAND1: OPEN-PDU receive ROUTER C: local circuit: OPEN-PDU send	

Note 1: Compliant with Asia/Pacific ATN addressing plan.

Note 2: For all routers used in tests.

Note 3: The value of the KEEPALIVE send timer is the holding timer value divided by 3.

Table 6 Router Communication Parameters (continued)

<table>
<tr><th rowspan="2">Protocol</th><th rowspan="2">Item No.</th><th rowspan="2">Item</th><th colspan="2">Parameter</th><th rowspan="2">Notes</th></tr>
<tr><th>Router (AMHSLAND1)</th><th>Router (AMHSLAND2)</th></tr>
<tr><td rowspan="17">X.25</td><td>4.1</td><td>DTE Address</td><td>ROUTER A AMHSLAND1-AMHSLAND2 : 44442000023903
ROUTER A local circuit: 44442000023903
ROUTER B local circuit: 44440110110202</td><td>ROUTER C AMHSLAND1-AMHSLAND2 : 48404701021800
ROUTER C local circuit: local matter</td><td></td></tr>
<tr><td>4.2</td><td>LCGN</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>4.3</td><td>LCN</td><td>10</td><td>10</td><td>4</td></tr>
<tr><td>4.4</td><td>Packet Size</td><td>1024</td><td>1024</td><td>4</td></tr>
<tr><td>4.5</td><td>Window Size</td><td>7</td><td>7</td><td>4</td></tr>
<tr><td>4.6</td><td>Window Size Negotiation</td><td>Yes</td><td>Yes</td><td>4</td></tr>
<tr><td>4.7</td><td>CR Packet Transmission</td><td>ROUTER A AMHSLAND1-AMHSLAND2 : Caller (CR send)
ROUTER A local circuit: Caller (CR send)
ROUTER B local circuit: Called (CR receive)</td><td>ROUTER C AMHSLAND1-AMHSLAND2 : Called (CR receive)
ROUTER C local circuit: Caller (CR send)</td><td></td></tr>
<tr><td>4.8</td><td>Use of SQ</td><td>Yes</td><td>Yes</td><td>4</td></tr>
<tr><td>4.9</td><td>Packet Sequence</td><td>Modulo 8</td><td>Modulo 8</td><td>4</td></tr>
<tr><td>4.10</td><td>Packet Negotiation</td><td>Yes</td><td>Yes</td><td>4</td></tr>
<tr><td>4.11</td><td>D Bit</td><td>OFF</td><td>OFF</td><td>4</td></tr>
<tr><td>4.12</td><td>M Bit</td><td>Yes</td><td>Yes</td><td>4</td></tr>
<tr><td>4.13</td><td>Restart Request Retransmission Count (R20)</td><td>1</td><td>1</td><td>4</td></tr>
<tr><td>4.14</td><td>Reset Request Retransmission (R22)</td><td>1</td><td>1</td><td>4</td></tr>
<tr><td>4.15</td><td>Clear Request Retransmission Count (R23)</td><td>1</td><td>1</td><td>4</td></tr>
<tr><td>4.16</td><td>Restart Request Timer (T20)</td><td>180 sec</td><td>180 sec</td><td>4</td></tr>
<tr><td>4.17</td><td>DTE Call Request timer (T21)</td><td>200 sec</td><td>200 sec</td><td>4</td></tr>
</table>

	4.18	Reset Confirmation Timer (T22)	180 sec	180 sec	4
	4.19	DTE Clear Confirmation Timer (T23)	180 sec	180 sec	4

Note 4: For AMHSLAND1-AMHSLAND2 circuit. Parameters for local circuits used in more than 2 routers tests are a local matter.

Table 6 Router Communication Parameters (continued)

Protocol	Item No.	Item	Parameter		Notes
			Router (AMHSLAND1)	Router (AMHSLAND2)	
LAPB	5.1	Address	ROUTER A AMHSLAND1-AMHSLAND2 : 03 ROUTER A local circuit: 03 ROUTER B local circuit: 01	ROUTER C AMHSLAND1-AMHSLAND2 : 01 ROUTER C local circuit: local matter	
	5.2	Max Outstanding Number	7	7	5
	5.3	Idle Channel State Timer (T3)	60 sec	60 sec	5, 6
	5.4	ACK Receipt Timer (T1)	3 sec	3 sec	5, 7
	5.5	Frame Retransmission Count	5	5	5
	5.6	Maximum Number of bits in I-Frame (N1)	8248	8248	5, 8
	5.7	Frame Sequence	Modulo 8	Modulo 8	5
Physical	6.1	Interface	X.21/V.11 (Line Speed: 64 kbps)	V.11 (Line Speed: 64 kbps)	5
	6.2	Clock	Local Matter	Local Matter	5

Note 5: For AMHSLAND1-AMHSLAND2 circuit. Parameters for local circuits used in more than 2 routers tests are a local matter.

Note 6: APAC ROUTER ICD (ref. [1]) specifies router A: 18–60 seconds, router B: 12–60 seconds.

Note 7: APAC ROUTER ICD (ref. [1]) specifies 6 sec, based on 9,600bps line speed and 256 byte packets.

Note 8: Value depends on the max. X.25 packet size. N1 = packet header size (3) + packet size (bytes) + LAPB address part (1) + LAPB control part (1) + LAPB FCS part (2) in BITS. So if the packet size is 1024 bytes, then N1 is (3 + 1024 + 1 + 1 + 2) * 8 = 8248 bits.

Table 7 End System CLNP Communication Parameters

Protocol	Item No.	Item	Parameter	
			End System (AMHSLAND1)	End System (AMHSLAND2)
	7.1	NSAP	AMHSLAND1 ES: 470027.81.81524a.00.010101.0302.128001091001.01 Third domain ES: 470027.81.854b00.00.010101.0302.000000010051.01	AMHSLAND2 ES: 47.0027.81.815648.00.010101.0202.0202.8002.0100.01
CLNP	7.1	Traffic Type	1 (ATSC/No Traffic Type Policy Preference)	1 (ATSC/No Traffic Type Policy Preference)
	7.2	Security Class	1 (Unclassified)	1 (Unclassified)
	7.3	Priority	8	8
	7.4	Partial Route Recording	No	No

Table 8 Test Items and Schedule

Schedule (UTC) Day	Time	Test Item No.			Description
		1			**Router Connection Establishment and Maintenance**
			1	1～2	Data link establishment
			2	1～4	X.25 VC establishment
			3	1～2	IDRP connection establishment
			4	1～2	Exchange of routing information (UPDATE PDU transmission)
			5	1～2	Maintenance of IDRP connection (KEEPALIVE PDU transmission)
		2			**NPDU Relay**
			1	1～3	ERQ/ERP NPDU transmission /reply from AMHSLAND1 router to AMHSLAND2 router
			2	1～3	ERQ/ERP NPDU transmission /reply from AMHSLAND2 router to AMHSLAND1 router
			3	1～3	ERQ/ERP NPDU transmission/reply from AMHSLAND1 ES to valid destination in AMHSLAND2 domain
			4	1～3	ERQ/ERP NPDU transmission from AMHSLAND2 ES to valid destination in AMHSLAND1 domain (Subject to AMHSLAND2 ES ERQ NDU transmission capability.)
			5	1～2	ERQ NPDU transmission from AMHSLAND1 ES to unreachable ES in AMHSLAND2 domain
			6	1～2	ERQ NPDU transmission from AMHSLAND2 ES to unreachable ES in AMHSLAND1 domain (Subject to AMHSLAND2 ES ERQ NDU transmission capability.)
			7	1～2	Routing process in AMHSLAND1 router for NPDU with invalid security option parameter
			8	1～2	Routing process in AMHSLAND2 router for NPDU with invalid security option parameter (Subject to AMHSLAND2 ES ERQ NDU transmission capability.)
		3			**Router end-to-end tests**
			1	1～5	Manual router disconnection at AMHSLAND1 router and route deletion
			2	1	Route activation from AMHSLAND1 router
			3	1～5	Manual router disconnection at AMHSLAND2 router and route deletion
			4	1	Route activation from AMHSLAND2 router
			5	1～3	Carrier medium failure and route deletion at AMHSLAND1 router
			6	1	Carrier medium restoration and route addition at AMHSLAND1 router

Schedule (UTC)		Test Item No.			Description
Day	Time				
			7	1～3	Carrier medium failure and route deletion at AMHSLAND2 router
			8	1	Carrier medium restoration and route addition at AMHSLAND2 router
			9	1～2	Failure and recovery of AMHSLAND1 router (redundant configuration)
			10	1～2	Failure and recovery of AMHSLAND2 router
		4			**ATN Router Tests: Third Domain connected to AMHSLAND1**
			1	1～5	Router connection of ROUTER B to ROUTER A (ROUTER A–ROUTER C connection already established)
			2	1～5	Manual router disconnection at ROUTER A of ROUTER A–ROUTER B route
			3	1～4	Re-activation at ROUTER A of ROUTER A-ROUTER B route
			4	1～5	Manual router disconnection at ROUTER B of ROUTER A-ROUTER B route
			5	1～4	Re-activation at ROUTER B of ROUTER A–ROUTER B route
			6	1～5	Router connection of ROUTER C to ROUTER A (ROUTER A-ROUTER B connection already established)
			7	1～5	Manual router disconnection at ROUTER C of ROUTER C–ROUTER A route
			8	1～4	Re-activation at ROUTER C of ROUTER C-ROUTER A route
			9	1～5	Manual router disconnection at ROUTER A of ROUTER C–ROUTER A route
			10	1～4	Re-activation at ROUTER A of ROUTER C–ROUTER A route
			11	1～3	Carrier medium failure of ROUTER A–ROUTER B circuit
			12	1～4	Carrier medium recovery of ROUTER A–ROUTER B circuit
			13	1～3	Carrier medium failure of ROUTER C–ROUTER A circuit
			14	1～4	Carrier medium recovery of ROUTER C–ROUTER A circuit
			15	1～2	Failure and recovery of ROUTER C
			16	1～2	Failure and recovery of ROUTER A
			17	1～2	Failure and recovery of ROUTER B
			18	1～6	End-to-End CLNP Echo Test between end systems in ROUTER C and ROUTER B domains (Subject to AMHSLAND2 ES ERQ NDU transmission capability.)

Test Cases

The table below shows the protocol abbreviations used in sequence diagrams.

Table 9 Protocol Abbreviations

Abbreviation	Protocol	Name
SABM	LAPB	Set Asynchronous Balanced Mode
UA	LAPB	Acknowledgement frame
SQ	X.25	Restart Request
SI	X.25	Restart Indication
SF	X.25	Restart Confirmation
CR	X.25	Call Request
CC	X.25	Call Connected
CQ	X.25	Clear Request
CF	X.25	Clear Confirmation
OPEN PDU	IDRP	OPEN Protocol Data Unit
UPDATE PDU	IDRP	UPDATE Protocol Data Unit
KEEPALIVE PDU	IDRP	KEEPALIVE Protocol Data Unit
CEASE PDU	IDRP	CEASE Protocol Data Unit
ERQ NPDU	CLNP	Echo request Network PDU
ERP NPDU	CLNP	Echo response Network PDU
ER NPDU	CLNP	Error report Network PDU

Test Case 1 : Router Connection Establishment and Maintenance

a) **Objective.**

This test is to verify the establishment of LAPB data link, X.25 Virtual Circuit and IDRP connections between the AMHSLAND2 and AMHSLAND1 routers, the exchange of routing information by UPDATE PDUs, and the maintenance of the IDRP connection by the periodic exchange of KEEPALIVE PDUs. The test configuration is shown in Figure 4.

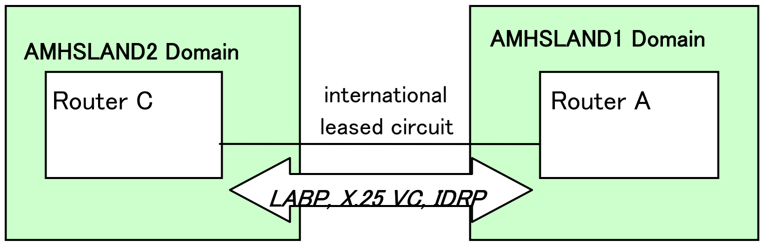


Figure 4 Configuration for router Connection & Maintenance Test

b) **Test items.**

- 1-1: Data link (LAPB) establishment
- 1-2: X.25 Virtual Circuit establishment
- 1-3: IDRP connection establishment (exchange of OPEN PDUs)
- 1-4: Exchange of routing information (exchange of UPDATE PDUs)
- 1-5: Maintenance of IDRP connection (exchange of KEEPALIVE PDUs)

Table 10 Router Connection Establishment & Maintenance Test Procedure

1. Router Connection Establishment & Maintenance		**Test Item**	**Procedure**	**Result**	**Date/Time**
Data link establishment	SABM transmission	1-1-1	Send SABM frame (address: 01) from ROUTER A and confirm ROUTER C receives it.	OK / NG	/ /
	UA transmission	1-1-2	Send UA frame (address: 03) from ROUTER C and confirm ROUTER A receives it and data link is established.	OK / NG	/ /
VC establishment	SQ transmission	1-2-1	Confirm ROUTER A sends SQ packet and ROUTER C receives it. (ROUTER C may send SQ packet, depending on the situation.)	OK / NG	/ /
	SI transmission	1-2-2	After receiving SQ packet from ROUTER A, confirm ROUTER C sends SI packet and ROUTER A receives it. (ROUTER C may send SQ packet, depending on the situation.)	OK / NG	/ /
	CR transmission	1-2-3	Confirm ROUTER A sends CR packet (packet size: 1024, LCGN: 0, LCN: 10, calling DTE address: ROUTER A DTE address, called DTE address: ROUTER C DTE address). Confirm ROUTER C receives it.	OK / NG	/ /
	CC transmission	1-2-4	Confirm ROUTER C sends CC packet (packet size: 1024, LCGN: 0, LCN: 10, calling DTE address: ROUTER A DTE address, called DTE address: ROUTER C DTE address). Confirm ROUTER A receives it, and VC is established.	OK / NG	/ /
IDRP connection establishment	OPEN PDU transmission from ROUTER A	1-3-1	After VC establishment, confirm ROUTER A sends an OPEN PDU. Confirm ROUTER C receives it.	OK / NG	/ /
	OPEN PDU transmission from ROUTER C	1-3-2	After receiving OPEN PDU from ROUTER A, confirm ROUTER C sends an OPEN PDU. Confirm that ROUTER A receives it, and IDRP connection is established.	OK / NG	/ /
UPDATE PDU transmission	UPDATE PDU transmission from ROUTER A	1-4-1	After IDRP connection established, confirm ROUTER A sends an UPDATE PDU (security registration ID: 06042B1B0000, tag set name: 07, ATSC Class: ATSC Class C, holding timer: 180 sec) to ROUTER C. At ROUTER C, confirm UPDATE PDU is received, and routing information for ROUTER A is added.	OK / NG	/ /

1. Router Connection Establishment & Maintenance		Test Item	Procedure	Result	Date/Time
	UPDATE PDU transmission from ROUTER C	1-4-2	After IDRP connection established, confirm ROUTER C sends an UPDATE PDU (security registration ID: 06042B1B0000, tag set name: 07, ATSC Class: ATSC Class C, holding timer: 180 sec) to ROUTER A. At ROUTER A, confirm UPDATE PDU is received, and routing information for ROUTER C is added.	OK / NG	/ /
IDRP connection maintenance	KEEPALIVE PDU transmission from ROUTER A	1-5-1	After IDRP connection established, confirm ROUTER A sends a KEEPALIVE PDU to ROUTER C every 60 seconds. At ROUTER C, confirm routing information received from ROUTER A is not deleted by receiving KEEPALIVE PDU continuously.	OK / NG	/ /
	KEEPALIVE PDU transmission from ROUTER C	1-5-2	After IDRP connection established, confirm ROUTER C sends a KEEPALIVE PDU to ROUTER A every 60 seconds. At ROUTER A, confirm routing information received from ROUTER C is not deleted by receiving KEEPALIVE PDU continuously.	OK / NG	/ /

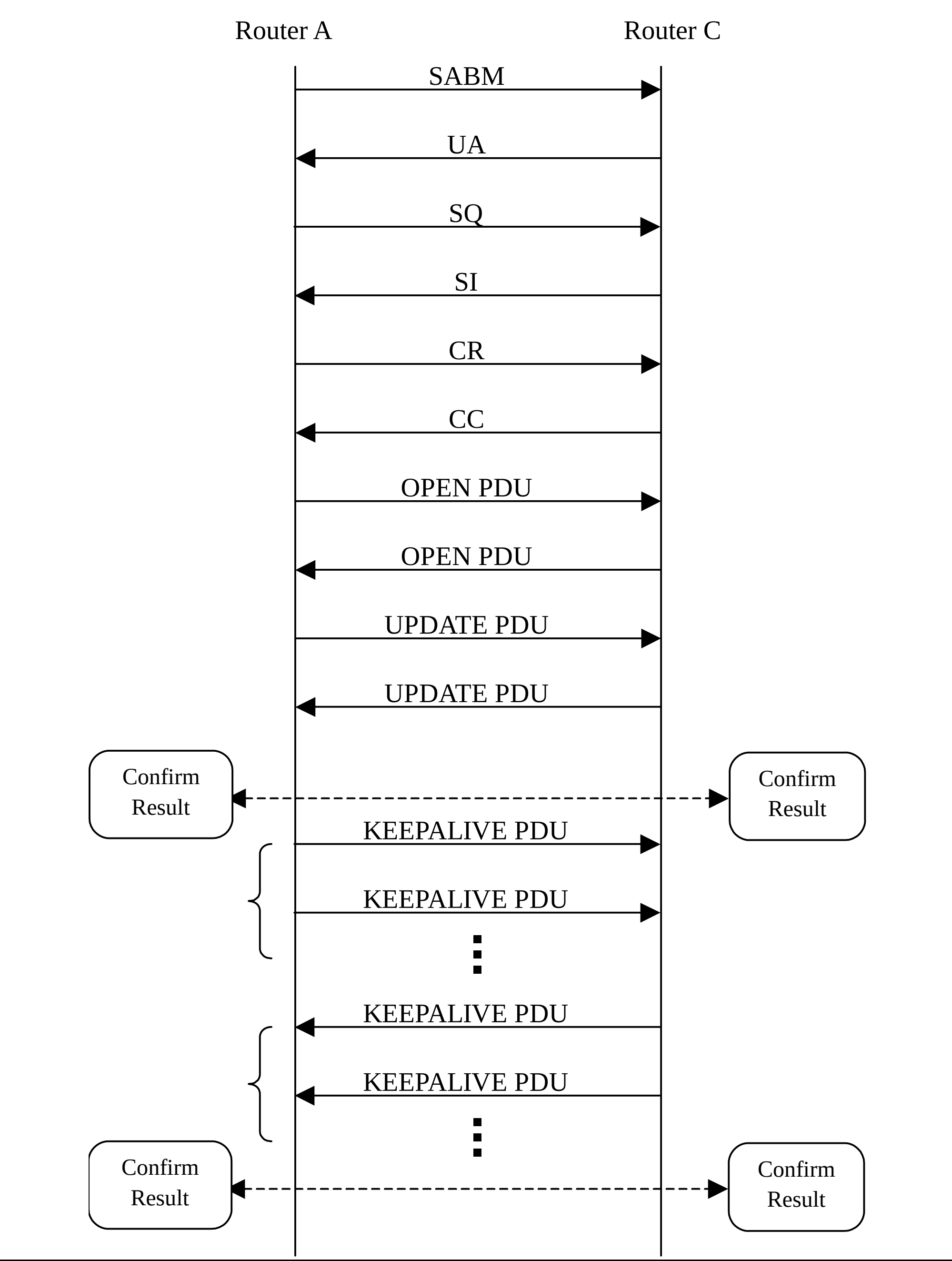
Test No.			Sequence Diagram
1	1	1	
1	1	2	
1	2	1	
1	2	2	
1	2	3	
1	2	4	
1	3	1	
1	3	2	
1	4	1	
1	4	2	
1	5	1	
1	5	2	

Figure 5 Sequence: Router Connection Establishment and Maintenance

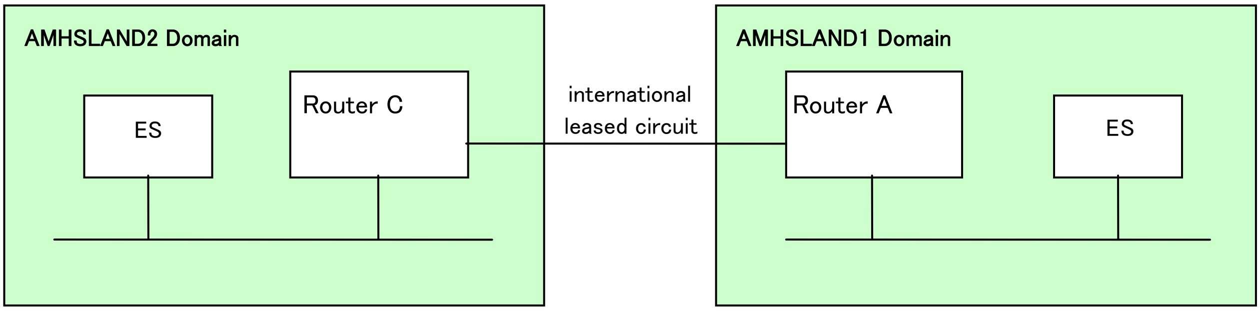
Test Case 2 : NPDU Relay

a) **Overview.**

This test uses the CLNP Echo function to test correct relay and routing of CLNP NPDUs by the AMHSLAND2 and AMHSLAND1 routers. End Systems in both domains are used to verify end-to-end transmission of CLNP PDUs via the routers. The test configuration is shown in Figure 4. The test verifies the following:

(i) CLNP Echo Request/Echo Response function of both routers.
(ii) Relay of CLNP NPDUs by routers to the peer domain.
(iii) ER-PDU returned by peer router when sending a CLNP NPDU to an unknown address in the peer domain.
(iv) Non-relay of CLNP PDUs with incorrect security parameter by own domain router .

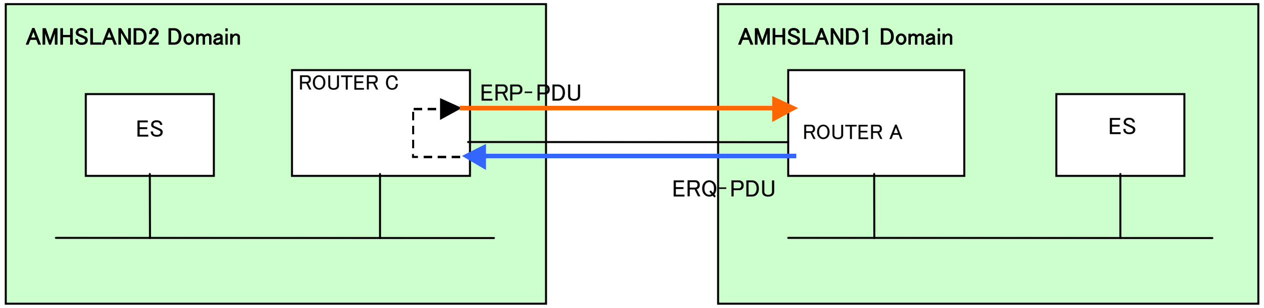
Figure 6 NPDU Transmission and Relay Test Configuration



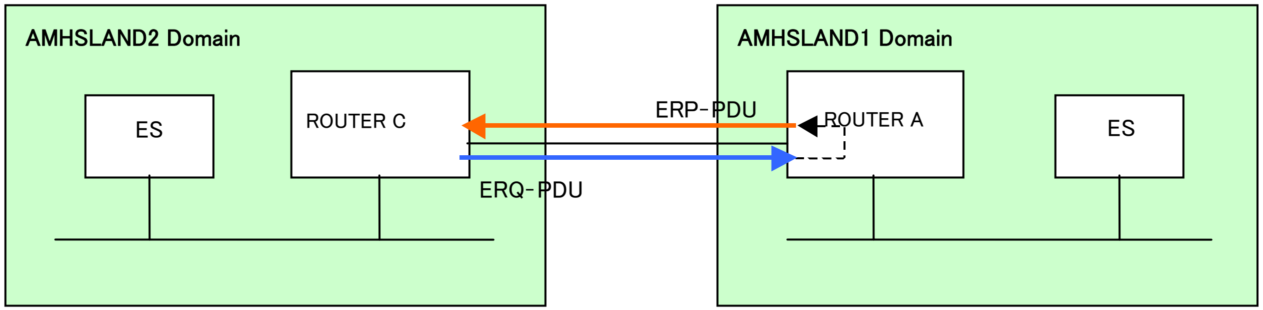
b) **Test Items.**

Note: Some of these test items may not be carried out, depending on the capability of End Systems in each domain in to transmit ERQ-PDUs.

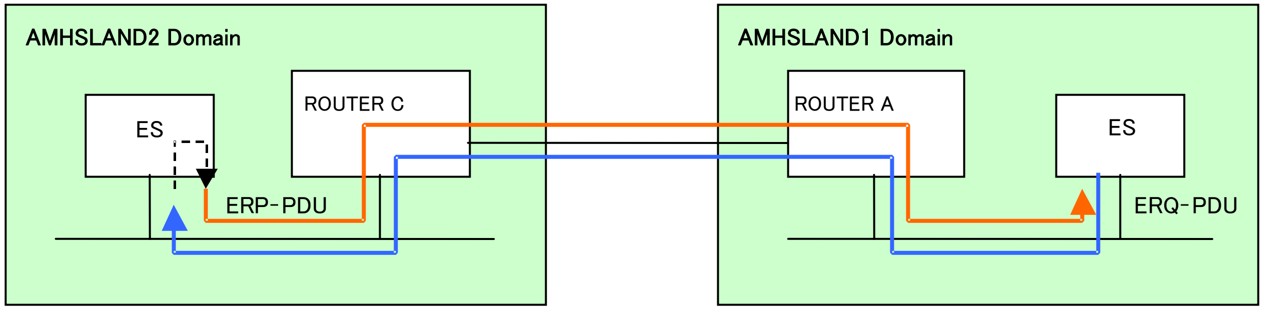
- 2-1: CLNP Echo from AMHSLAND1 router to AMHSLAND2 router.



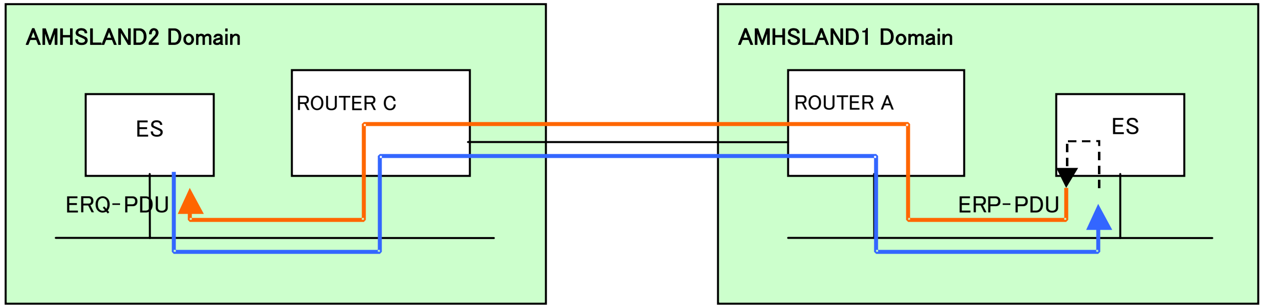
- 2-2: CLNP Echo from AMHSLAND2 router to AMHSLAND1 router .



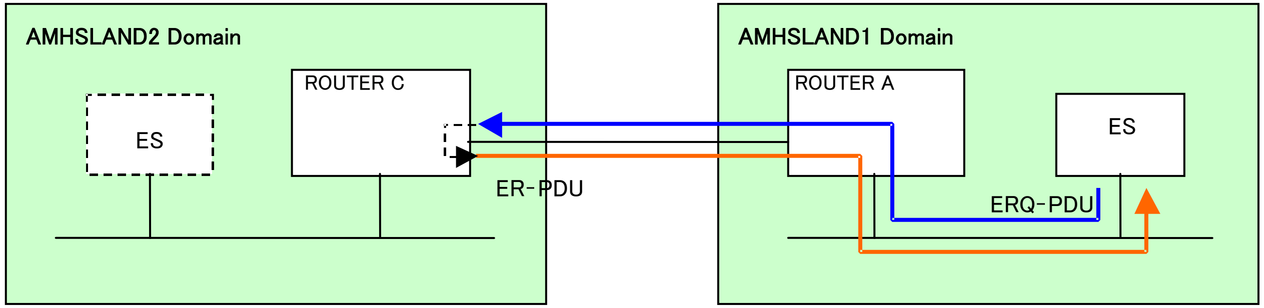
- 2-3: CLNP Echo from AMHSLAND1 End System to valid destination at AMHSLAND2.



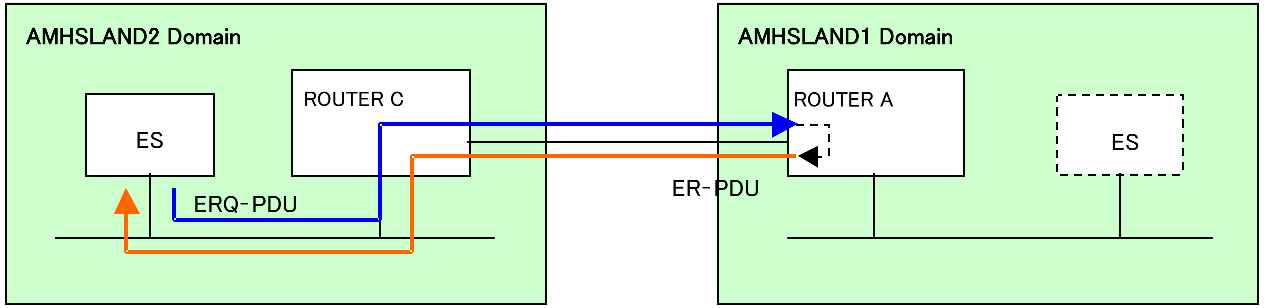
- 2-4: CLNP Echo from AMHSLAND2 End System to valid destination at AMHSLAND1.



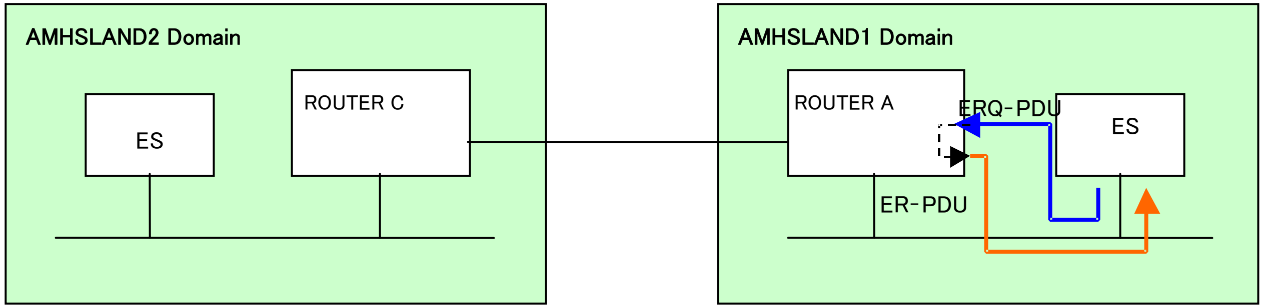
- 2-5: CLNP Echo from AMHSLAND1 End System to unreachable AMHSLAND2 End System.



- 2-6: CLNP Echo from AMHSLAND2 End System to unreachable AMHSLAND1 End System.



- 2-7: Routing process in AMHSLAND1 router for NPDU with invalid security parameter.
  Note: Transmission of ER NPDU depends on a value in the ERQ NPDU header.



- 2-8: Routing process in AMHSLAND2 router for NPDU with invalid security parameter.
  Note: Transmission of ER NPDU depends on a value in the ERQ NPDU header.

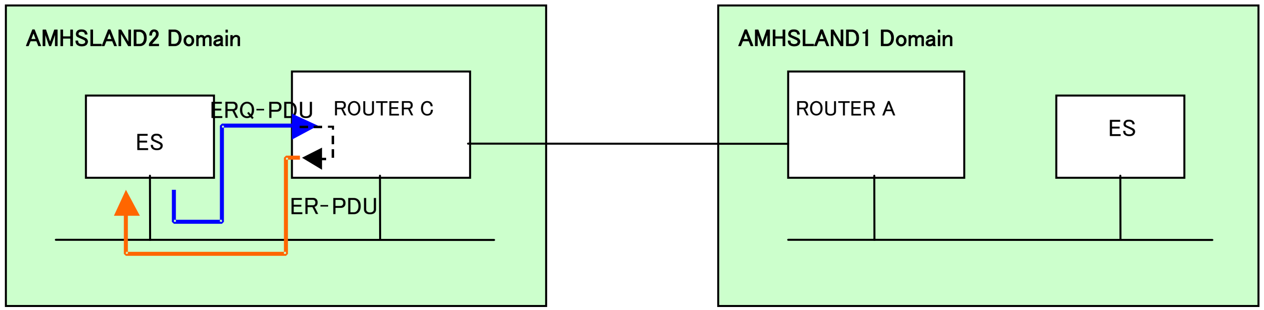


Table 11 NPDU Relay Test Procedure

2. NPDU Relay		Test Item	Procedure	Result	Date/Time
ERQ NPDU transmission from AMHSLAND 1 router	ERQ NPDU transmission	2-1-1	Send ERQ NPDU from ROUTER A to ROUTER C. Confirm ROUTER C receives it.	OK / NG	/ /
	ERP NPDU transmission	2-1-2	After receiving ERQ NPDU, ROUTER C sends ERP NPDU to ROUTER A. Confirm ROUTER A receives it.	OK / NG	/ /
	Continuous ERQ/ERP NPDU transmission	2-1-3	Repeat from 2-1-1 to 2-1-2 ten times and confirm there is no problem with ERQ/ERP transmission.	OK / NG	/ /
ERQ NPDU transmission from AMHSLAND 2 router	ERQ NPDU transmission	2-2-1	Send ERQ NPDU from ROUTER C to ROUTER A. Confirm ROUTER A receives it.	OK / NG	/ /
	ERP NPDU transmission	2-2-2	After receiving ERQ NPDU, ROUTER A sends an ERP NPDU to ROUTER C. Confirm ROUTER C receives it.	OK / NG	/ /
	Continuous ERQ/ERP NPDU transmission	2-2-3	Repeat from 2-2-1 to 2-2-2 ten times and confirm there is no problem with ERQ/ERP transmission.	OK / NG	/ /
ERQ NPDU transmission from AMHSLAND 1 ES	ERQ NPDU transmission	2-3-1	Send ERQ NPDU from AMHSLAND1 ES to AMHSLAND2 ES. Confirm the AMHSLAND2 ES receives it.	OK / NG	/ /
	ERP NPDU transmission	2-3-2	After receiving ERQ NPDU, the AMHSLAND2 ES sends an ERP NPDU to the AMHSLAND1 ES. Confirm the AMHSLAND1 ES receives it.	OK / NG	/ /
	Continuous ERQ/ERP transmission	2-3-3	Repeat from 2-3-1 to 2-3-2 ten times and confirm there is no problem with ERQ/ERP transmission.	OK / NG	/ /
ERQ NPDU transmission from	ERQ NPDU transmission	2-4-1	Send ERQ NPDU from the AMHSLAND2 ES to the AMHSLAND1 ES. Confirm the AMHSLAND1 ES receives it.	OK / NG	/ /

2. NPDU Relay		Test Item	Procedure	Result	Date/Time
AMHSLAND 2 ES	ERP NPDU transmission	2-4-2	After receiving ERQ NPDU, the AMHSLAND1 ES sends an ERP NPDU to the AMHSLAND2 ES. Confirm the AMHSLAND2 ES receives it.	OK / NG	/ /
	Continuous ERQ/ERP transmission	2-4-3	Repeat from 2-4-1 to 2-4-2 ten times and confirm there is no problem with ERQ/ERP transmission.	OK / NG	/ /
ERQ NPDU transmission from AMHSLAND 1 ES to unreachable system in AMHSLAND 2 domain	ERQ NPDU transmission from AMHSLAND1 ES	2-5-1	AMHSLAND1 ES sends an ERQ NPDU with destination NSAP address set to an unreachable address in AMHSLAND2 domain. Confirm ROUTER C receives it.	OK / NG	/ /
	ERQ NPDU handling in AMHSLAND2 router	2-5-2	Confirm that ROUTER C discards the ERQ NPDU from AMHSLAND1 ES. Confirm that ROUTER C sends an ER NPDU to the AMHSLAND1 ES, and that the AMHSLAND1 ES receives it.	OK / NG	/ /
ERQ NPDU transmission from AMHSLAND 2 ES to unreachable system in AMHSLAND 1 domain	ERQ NPDU transmission from AMHSLAND2 ES	2-6-1	AMHSLAND2 ES sends an ERQ NPDU with destination NSAP address set to an unreachable address in AMHSLAND1 domain. Confirm ROUTER A receives it.	OK / NG	/ /
	ERQ NPDU handling in AMHSLAND1 router	2-6-2	Confirm that ROUTER A discards the ERQ NPDU. Confirm that ROUTER A sends an ER NPDU to the AMHSLAND2 ES, and that the AMHSLAND2 ES receives it.	OK / NG	/ /
Routing process in AMHSLAND 1 router for	ERQ NPDU transmission from AMHSLAND1 ES	2-7-1	AMHSLAND1 ES sends an ERQ NPDU with an invalid security option parameter (ATN Systems Management Communications/No Traffic Policy Preference) addressed to the AMHSLAND2 ES. Confirm ROUTER A receives it.	OK / NG	/ /

2. NPDU Relay		Test Item	Procedure	Result	Date/Time
NPDU with invalid security option parameter	ERQ NPDU processing in AMHSLAND1 router	2-7-2	Confirm ROUTER A discards ERQ NPDU and sends an ER NPDU to AMHSLAND1 ES. Confirm the AMHSLAND1 ES receives the ER NPDU.	OK / NG	/ /
Routing process in AMHSLAND 2 router for NPDU with invalid security option parameter	ERQ NPDU transmission from AMHSLAND2 ES	2-8-1	AMHSLAND2 ES sends ERQ NPDU with an invalid security option parameter (ATN Systems Management Communications/No Traffic Policy Preference) addressed to the AMHSLAND1 ES. Confirm ROUTER C receives it.	OK / NG	/ /
	ERQ NPDU processing in AMHSLAND2 router	2-8-2	Confirm ROUTER C discards ERQ NPDU and ROUTER C sends an ER NPDU to the AMHSLAND2 ES. Confirm the AMHSLAND2 ES receives the ER NPDU.	OK / NG	/ /

Test No.			Sequence Diagram
2	1	1	
2	1	2	
2	1	3	
2	2	1	
2	2	2	
2	2	3	

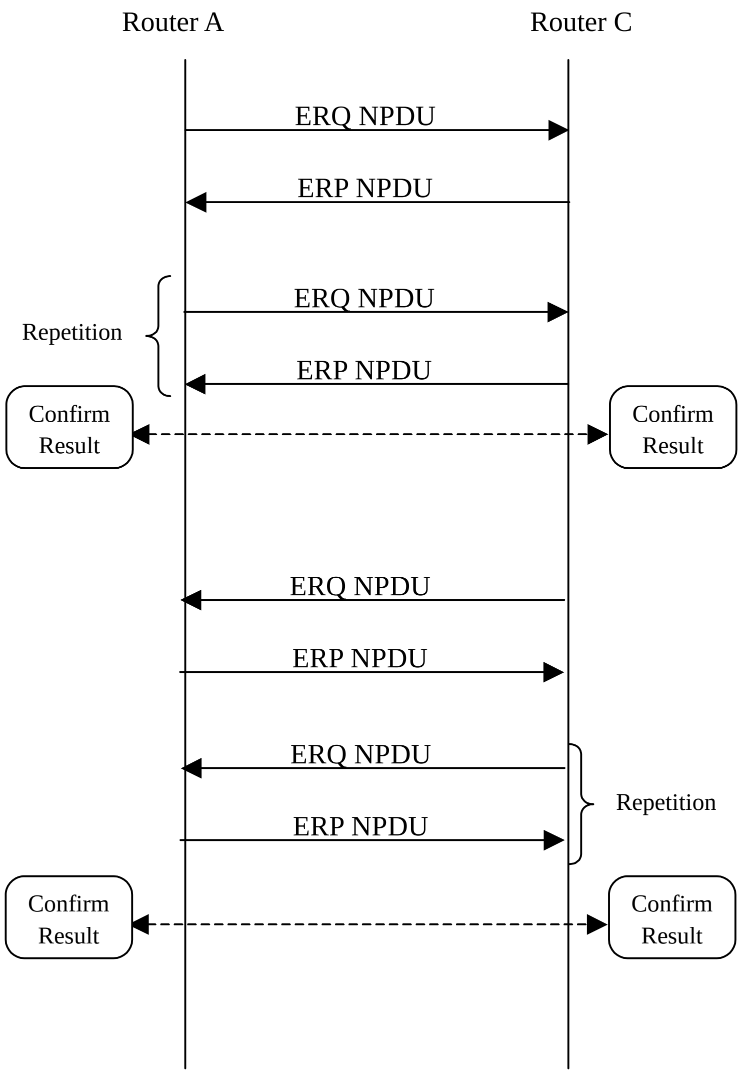


Figure 7 Sequence: NPDU Transmission between Routers

Test No.			Sequence Diagram
2	3	1	
2	3	2	
2	3	3	
2	4	1	
2	4	2	
2	4	3	

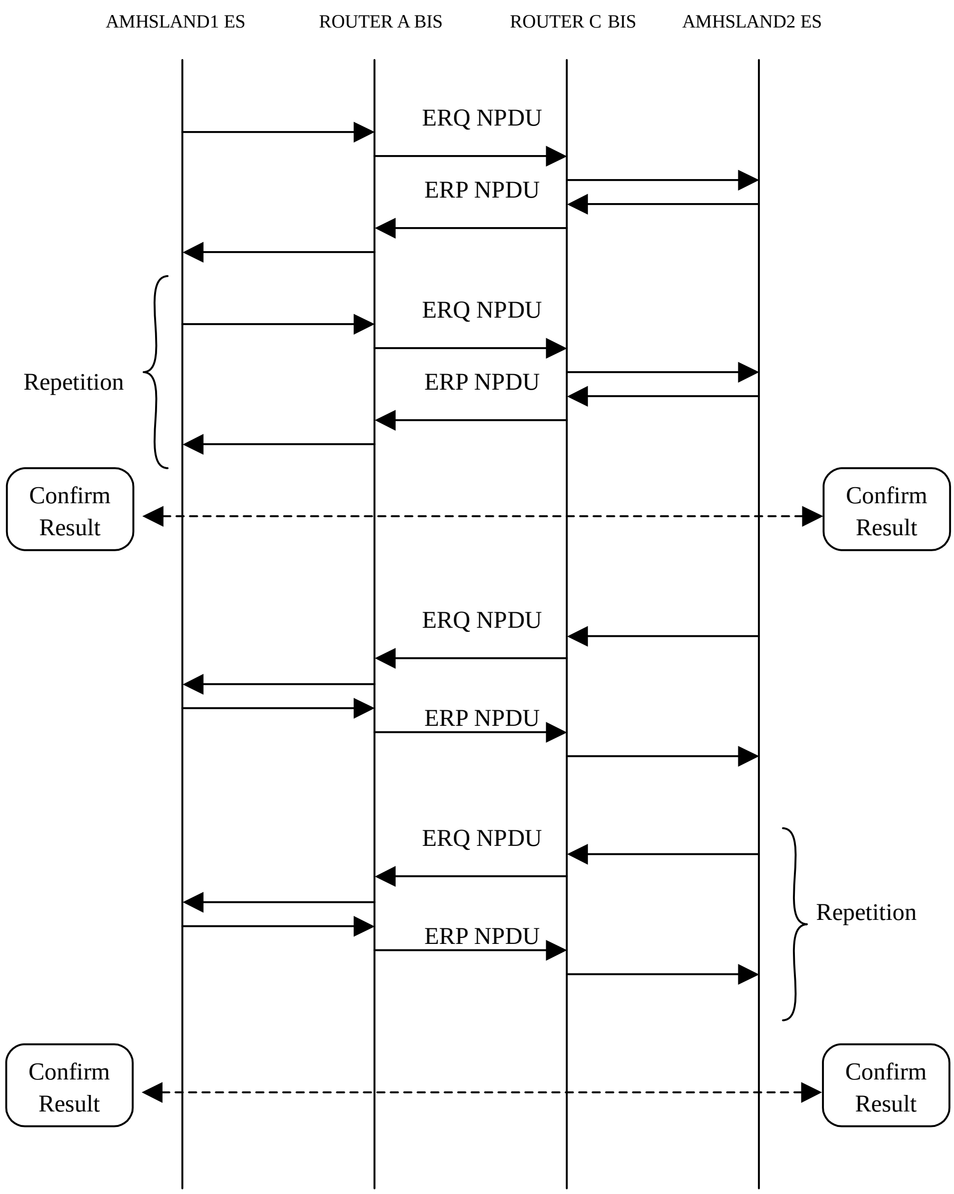


Figure 8 Sequence: NPDU Transmission between End Systems

Test No.		
2	5	1
2	5	2
2	6	1
2	6	2
2	7	1
2	7	2
2	8	1
2	8	2

Sequence Diagram

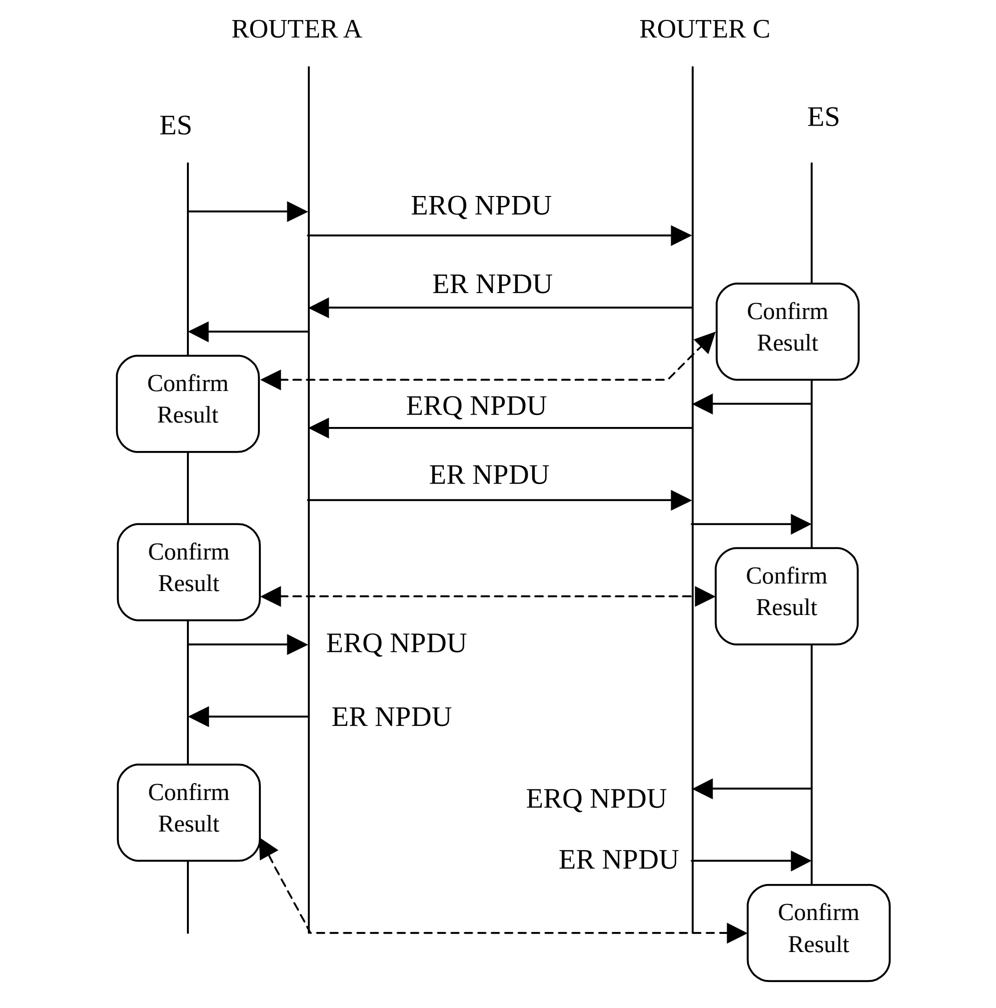


Figure 9 Sequence: NPDU Transmission to Unreachable ES and Handling of NPDU with Invalid Security Parameter

Test Case 3 : Router End-to-End Tests

a) **Objective**

Technical trial to verify the automatic updating of routing tables in the ATN routers through IDRP protocol with routers connecting in end-to-end configuration between AMHSLAND1 and AMHSLAND2.

b) **Test Configuration**

The configuration for this test is shown in Figure 10.

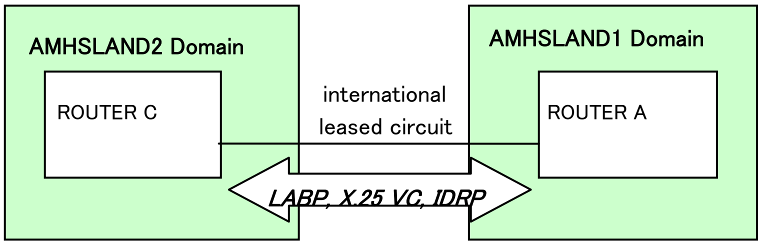


Figure 10 Router End-to-End Test Configuration

c) **Test Item Overview**

3-1: Manual router disconnection at AMHSLAND1 router and route deletion

3-2: Route addition (re-activation of connection) from AMHSLAND1 router

3-3: Manual router disconnection at AMHSLAND2 router and route deletion

3-4: Route addition (re-activation of connection) from AMHSLAND2 router

3-5: Carrier medium failure and route deletion at AMHSLAND1 router

3-6: Carrier medium restoration and route addition at AMHSLAND1 router

3-7: Carrier medium failure and route deletion at AMHSLAND2 router

3-8: Carrier medium restoration and route addition at AMHSLAND2 router

3-9: Failure and recovery of AMHSLAND1 router (redundant configuration)

3-10: Failure and recovery of AMHSLAND2 router

Note: A detailed tests of normal router connection (LAPB, X.25 VC and IDRP) is carried out in Test Items 1-1 through 1-5, and so is not repeated here.

Table 12 Router End-to-End Tests Test Procedure

3. Router End-to-End Tests		Test Item	Procedure	Result	Date/Time
Manual router disconnection at AMHSLAND 1 router and route deletion	CEASE PDU transmission from AMHSLAND1 router	3-1-1	At ROUTER A, manually close the router connection to ROUTER C. Confirm ROUTER A sends CEASE PDU.	OK / NG	/ /
	CEASE PDU transmission from AMHSLAND2 router and route deletion	3-1-2	Confirm ROUTER C receives CEASE PDU. After receiving CEASE PDU, confirm that ROUTER C sends CEASE PDU to ROUTER A, and that routing information for ROUTER A is deleted.	OK / NG	/ /
	Route deletion at AMHSLAND1 router	3-1-3	Confirm that ROUTER A receives CEASE PDU from ROUTER C, and that routing information for ROUTER C is deleted.	OK / NG	/ /
	CQ transmission	3-1-4	After IDRP disconnected, confirm ROUTER A sends CQ packet to ROUTER C. Confirm ROUTER C receives it.	OK / NG	/ /
	CF transmission	3-1-5	After receiving CQ packet, confirm ROUTER C sends CF packet to ROUTER A. Confirm ROUTER A receives CF packet, and VC is closed.	OK / NG	/ /
Route addition (re-activation of connection) from AMHSLAND 1 router	Router connection restoration after disconnection	3-2-1	At ROUTER A, manually initiate router connection with ROUTER C. (VC call: originate, OPEN PDU: send.) Confirm the router connection is re-established.	OK / NG	/ /
Manual router disconnection at AMHSLAND	CEASE PDU transmission from AMHSLAND2 router	3-3-1	At ROUTER C, manually close the router connection to ROUTER A. Confirm ROUTER C sends CEASE PDU.	OK / NG	/ /

3. Router End-to-End Tests		Test Item	Procedure	Result	Date/Time
2 router and route deletion	CEASE PDU transmission from AMHSLAND1 router and route deletion	3-3-2	Confirm ROUTER A receives CEASE PDU. After receiving CEASE PDU, confirm that ROUTER A sends CEASE PDU to ROUTER C, and that routing information for ROUTER C is deleted.	OK / NG	/ /
	Route deletion at AMHSLAND2 router	3-3-3	Confirm that ROUTER C receives CEASE PDU from ROUTER A, and that routing information for ROUTER A is deleted.	OK / NG	/ /
	CQ transmission	3-3-4	After IDRP disconnected, confirm ROUTER C sends CQ packet to ROUTER A. Confirm ROUTER A receives it.	OK / NG	/ /
	CF transmission	3-3-5	After receiving CQ packet, confirm ROUTER A sends CF packet to ROUTER C. Confirm ROUTER C receives CF packet, and VC is closed.	OK / NG	/ /
Route addition (re-activation of connection) from AMHSLAND 2 router	Router connection restoration after disconnection	3-4-1	At ROUTER C, manually initiate router connection to ROUTER A. (VC call: receive, OPEN PDU: receive.) Confirm the router connection is re-established.	OK / NG	/ /
Carrier medium failure and route deletion at AMHSLAND 1 router	Data link and VC disconnection	3-5-1	At ROUTER A, simulate a circuit failure by physically disconnecting ROUTER A from the DSU/modem. Confirm that the data link and VC are disconnected between ROUTER A and ROUTER C.	OK / NG	/ /
	IDRP disconnection at AMHSLAND1	3-5-2	After circuit failure, confirm IDRP connection at ROUTER A is closed.	OK / NG	/ /
	IDRP disconnection at AMHSLAND2	3-5-3	After circuit failure, confirm IDRP connection at ROUTER C is closed when the IDRP holding timer expires.	OK / NG	/ /

3. Router End-to-End Tests		Test Item	Procedure	Result	Date/Time
Carrier medium restoration and route addition at AMHSLAND 1 router	Data link, VC, and router connection re-establishment	3-6-1	At ROUTER A, restore the circuit by re-connecting ROUTER A to the DSU/modem. Confirm router connection is re-established between ROUTER A and ROUTER C.	OK / NG	/ /
Carrier medium failure and route deletion at AMHSLAND 2 router	Data link and VC disconnection	3-7-1	At ROUTER C, simulate a circuit failure by disconnecting the leased line circuit from the modem. Confirm data link and VC are disconnected between ROUTER A and ROUTER C.	OK / NG	/ /
	IDRP disconnection at AMHSLAND2	3-7-2	After circuit failure, confirm IDRP connection at ROUTER C is closed when the IDRP holding timer expires.	OK / NG	/ /
	IDRP disconnection at AMHSLAND1	3-7-3	After circuit failure, confirm IDRP connection at ROUTER A is closed.	OK / NG	/ /
Carrier medium restoration and route addition at AMHSLAND 2 router	Data link, VC, and router connection re-establishment	3-8-1	At ROUTER C, restore circuit. Confirm the router connection is re-established between ROUTER A and ROUTER C.	OK / NG	/ /
Failure and recovery of AMHSLAND 1 router	Failover from active to standby node	3-9-1	At ROUTER A, force failover from active node (#1) to standby node (#2) by rebooting active node. At ROUTER A, confirm WAN line switches from active to standby node. Confirm that router connection is closed and then re-established.	OK / NG	/ /

3. Router End-to-End Tests		Test Item	Procedure	Result	Date/Time
	Failover back to previous active node	3-9-2	At ROUTER A, force failover from active node (#2) to standby node (#1) by rebooting active node. At ROUTER A, confirm WAN line switches from active to standby node. Confirm that router connection is closed and then re-established.	OK / NG	/ /
Failure and recovery of AMHSLAND 2 router	Failover from active to standby node	3-10-1	At ROUTER C, force failover from active node (#1) to standby node (#2). At ROUTER C, confirm WAN line switches from active to standby node. Confirm that router connection is closed and then re-established.	OK / NG	/ /
	Failover back to previous active node	3-10-2	At ROUTER C, force failover from active node (#2) to standby node (#1). At ROUTER C, confirm WAN line switches from active to standby node. Confirm that router connection is closed and then re-established.	OK / NG	/ /

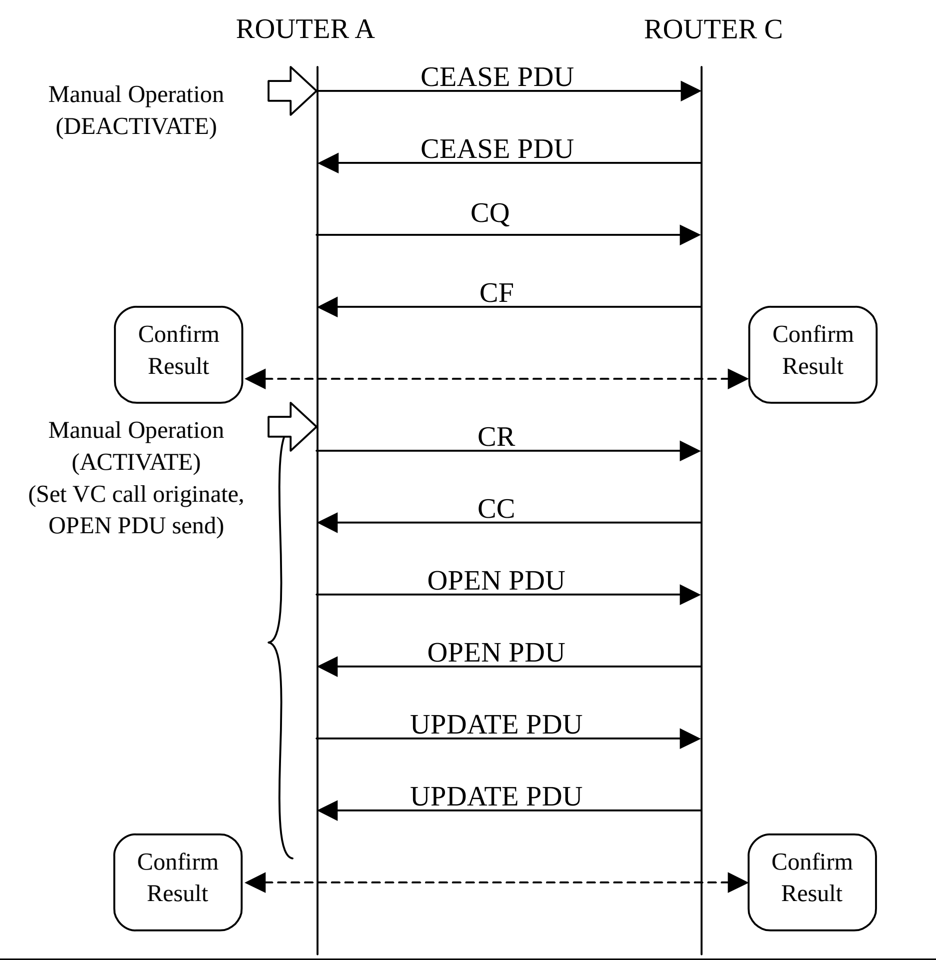
Test No.			Sequence Diagram
3	1	1	
3	1	2	
3	1	3	
3	1	4	
3	1	5	
3	2	1	

Figure 11 Sequence: Manual router Disconnection and Re-connection at AMHSLAND1 router

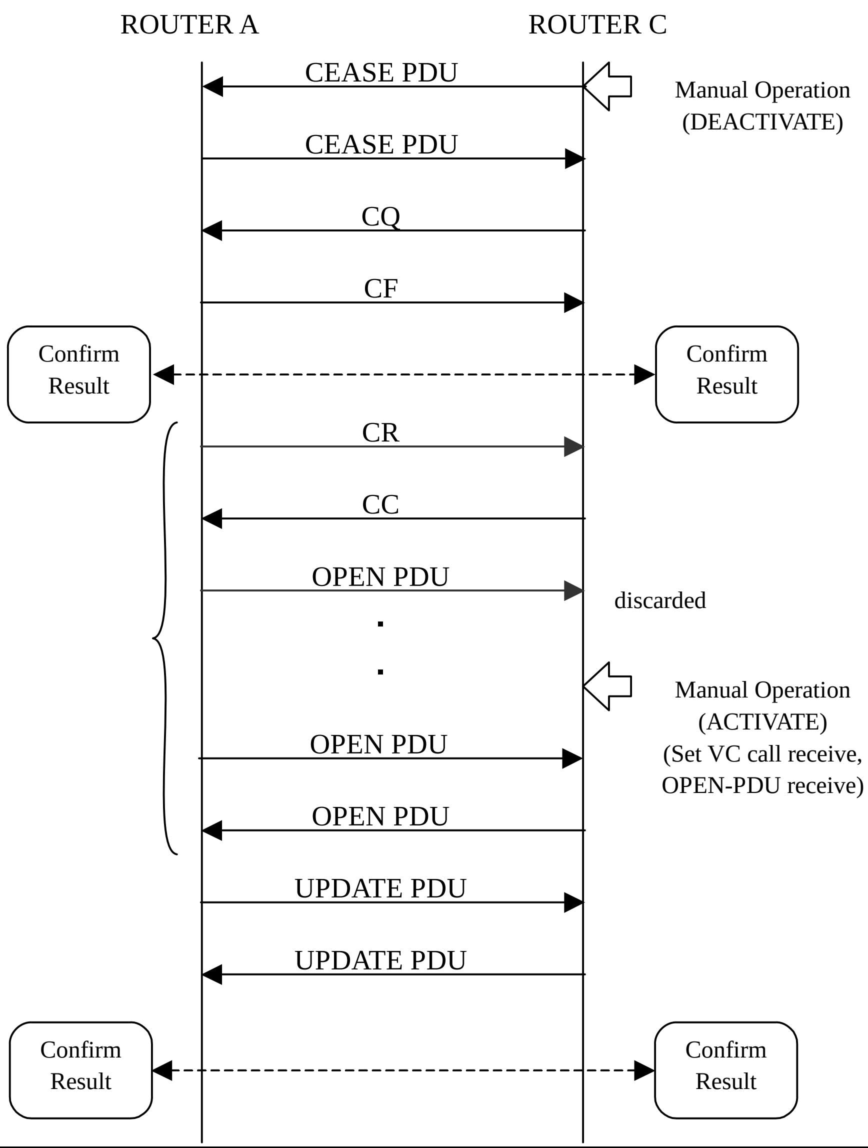
Test No.			Sequence Diagram
3	3	1	
3	3	2	
3	3	3	
3	3	4	
3	3	5	
3	4	1	

Figure 12 Sequence: Manual router Disconnection and Re-connection at AMHSLAND2 router

Test No.			Sequence Diagram
3	5	1	
3	5	2	
3	5	3	
3	6	1	

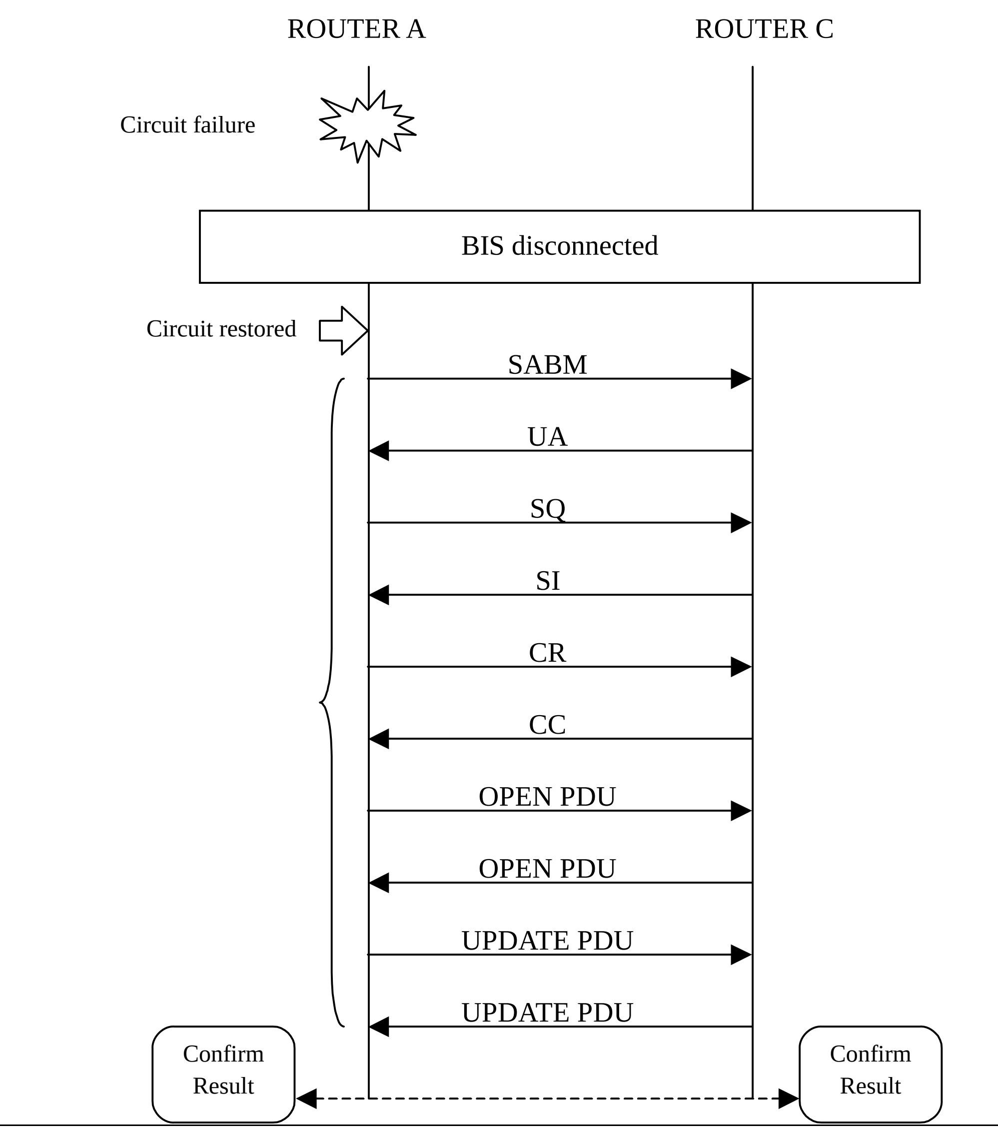


Figure 13 Sequence: Carrier medium failure and recovery at AMHSLAND1 router

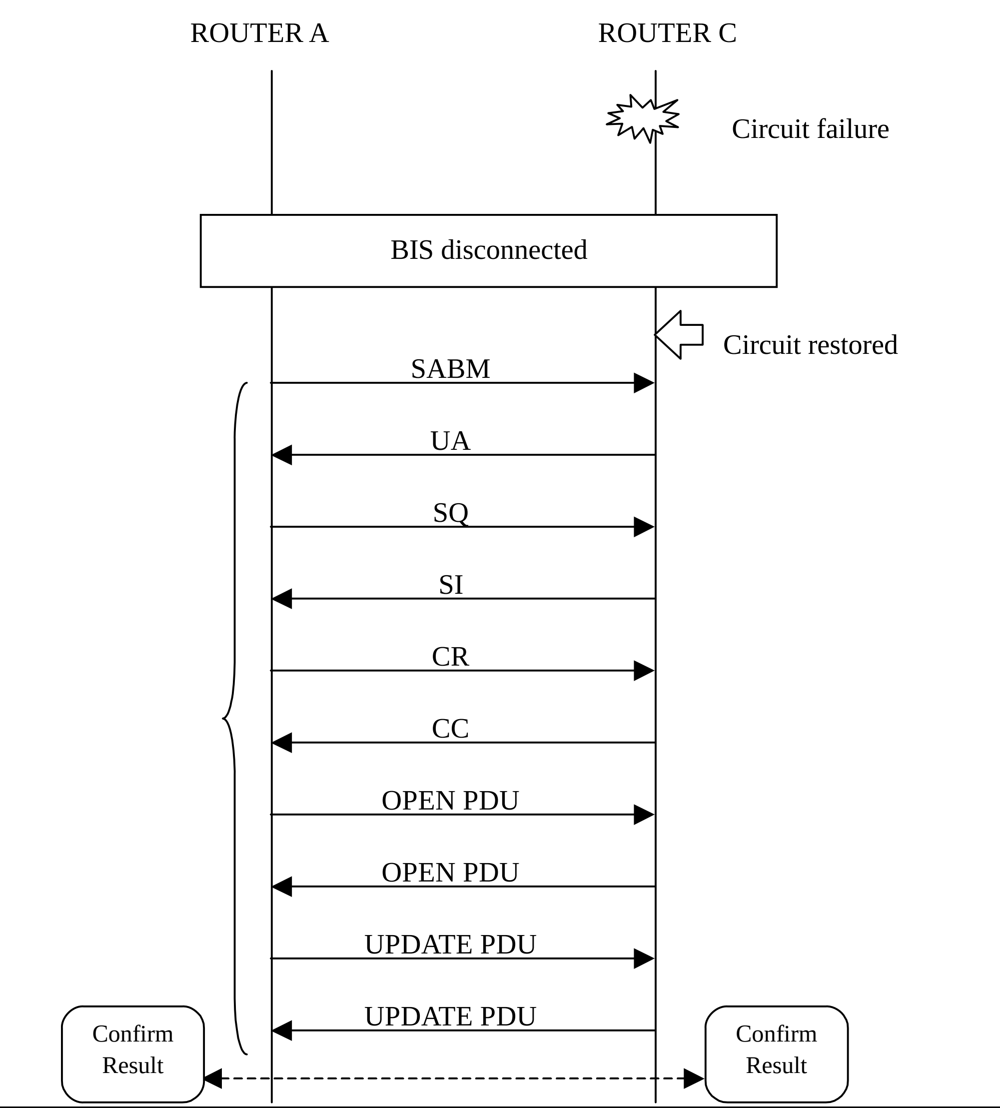
Test No.			Sequence Diagram
3	7	1	
3	7	2	
3	7	3	
3	8	1	

Figure 14 Sequence: Carrier medium failure and recovery at AMHSLAND2 router

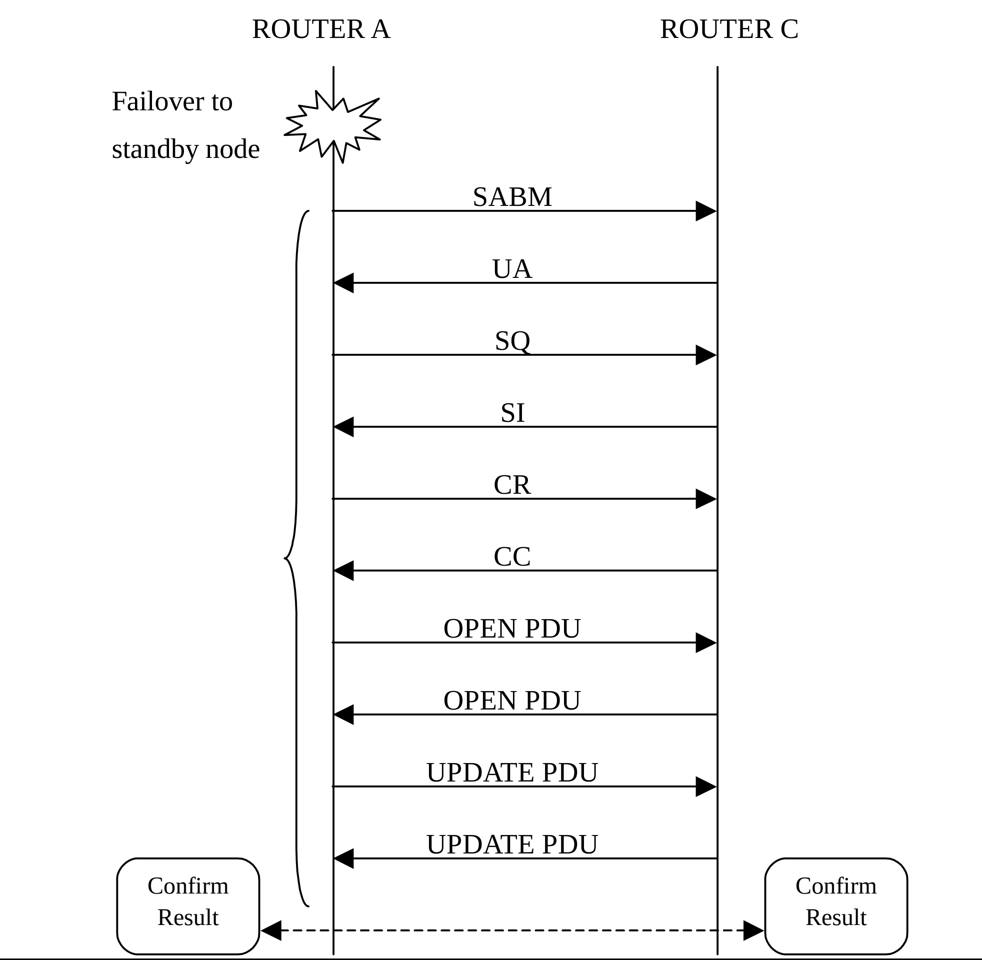
Test No.			Sequence Diagram
3 3	9 9	1 2	

Figure 15 Sequence: AMHSLAND1 router Failure and Recovery

Test No.			Sequence Diagram
3	10	1	
3	10	2	

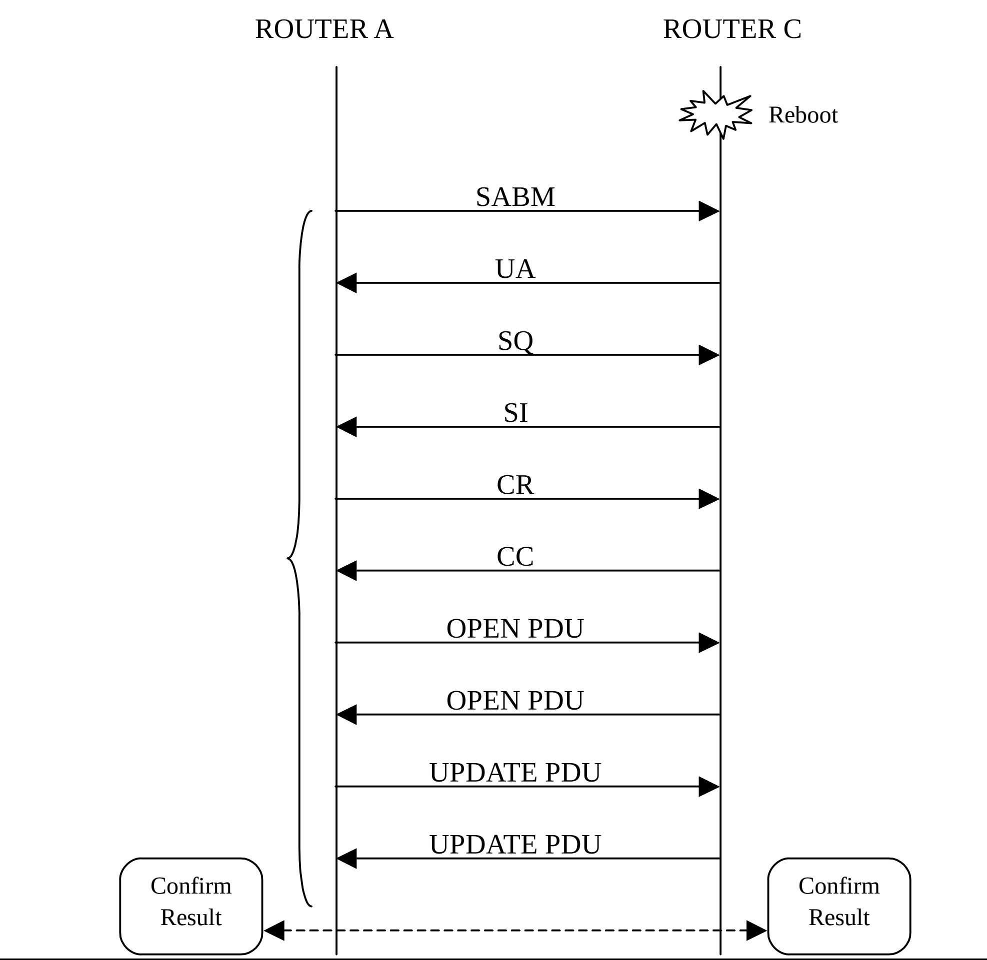


Figure 16 Sequence: AMHSLAND2 router Failure and Recovery

Test Case 4 : ATN Router Tests (This cover additional tests for subnetwork)

a) **Objective**

Technical trial to verify the automatic updating of routing tables in ATN routers through the IDRP protocol with routers connected in 3routers configurations between AMHSLAND1, AMHSLAND2 and simulated third domains connected to AMHSLAND1 and AMHSLAND2. The test configurations are shown below.

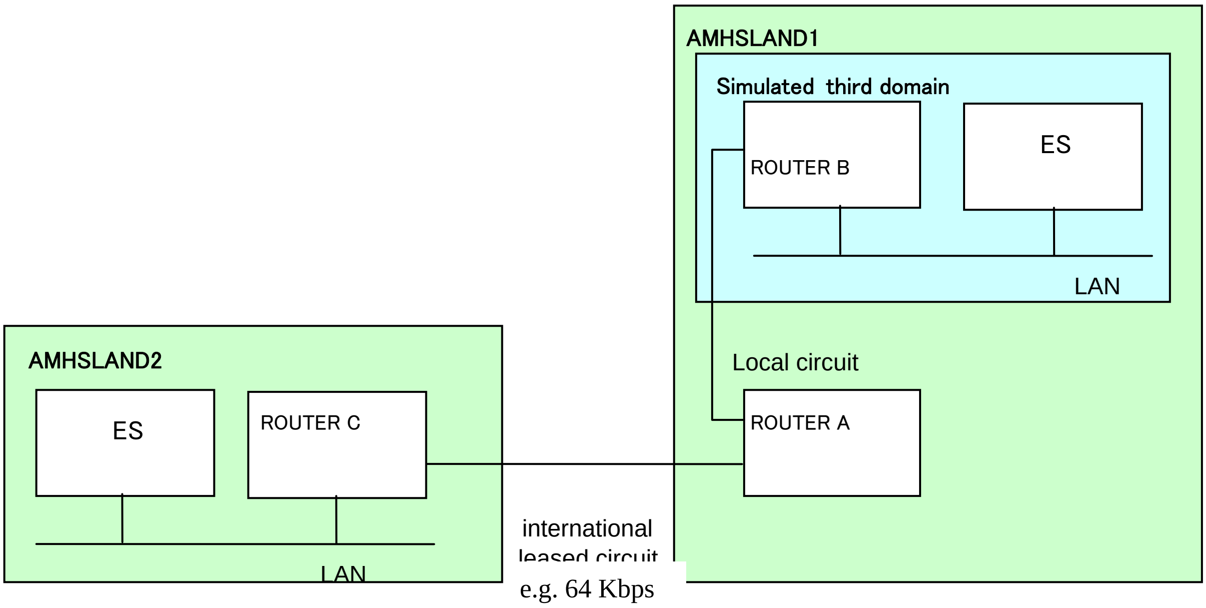


Figure 14 Test Configuration: Simulated Third Domain connected to AMHSLAND1

c) **Test Overview**

(i) Simulated third domain connected to AMHSLAND1.

ROUTER CONNECTION, DISCONNECTION AND RE-ACTIVATION

4-1: Router connection of ROUTER B to ROUTER A (ROUTER A-ROUTER C already established).

4-2,3: Manual router disconnection at ROUTER A of ROUTER A-ROUTER B route and re-activation.

4-4,5: Manual router disconnection at ROUTER B of ROUTER A-ROUTER B route and re-activation.

4-6: Router connection of ROUTER C to ROUTER A (ROUTER B-ROUTER A already established).

4-7,8: Manual router disconnection at ROUTER C of ROUTER C-ROUTER A route and re-activation.

4-9,10: Manual router disconnection at ROUTER A of ROUTER C-ROUTER A route and re-activation.

COMMUNICATION CIRCUIT FAILURE AND RECOVERY

4-11,12: Failure and recovery of ROUTER A-ROUTER B circuit.

4-13,14: Failure and recovery of ROUTER C-ROUTER A circuit.

ROUTER FAILURE AND RECOVERY

4-15: Failure and recovery of ROUTER C.

4-16: Failure and recovery of ROUTER A.

4-17: Failure and recovery of ROUTER B.

END-TO-END DATA RELAY

4-18: End-to-End CLNP Echo Test between End Systems in ROUTER C and ROUTER B domains. (Subject to End System ERQ-PDU transmission capabilities.)

Table 9 Router Connection, Disconnection and Re-activation Test Procedure: ROUTER A-ROUTER B

4. ATN Router Tests		Test Item	Procedure	Result	Date/Time
Router connection of ROUTER B to ROUTER A	Data link establishment between ROUTER A and ROUTER B	4-1-1	With VC and IDRP connections established between ROUTER C and ROUTER A, switch on ROUTER B to initiate router connection. Check and confirm data link and VC are established between ROUTER A and ROUTER B.	OK / NG	/ /
	IDRP connection establishment between ROUTER A and ROUTER B	4-1-2	After VC establishment, check and confirm IDRP connection established between ROUTER A and ROUTER B by exchange of OPEN PDUs. (First OPEN PDU sent by ROUTER A.)	OK / NG	/ /
	UPDATE PDU transmission from ROUTER A to ROUTER B	4-1-3	After IDRP connection established, confirm ROUTER A sends an UPDATE PDU to ROUTER B. At ROUTER B, after receiving UPDATE PDU from ROUTER A, check that route information on ROUTER A and ROUTER C are added.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER B to ROUTER A	4-1-4	After IDRP connection established, confirm ROUTER B sends an UPDATE PDU to ROUTER A. At ROUTER A, after receiving UPDATE PDU from ROUTER B, check and confirm route information of ROUTER B is updated correctly.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER A to ROUTER C	4-1-5	At ROUTER A, after receiving UPDATE PDU from ROUTER B, confirm ROUTER A sends an UPDATE PDU to ROUTER C. At ROUTER C, confirm that UPDATE PDU is received, and that route information of ROUTER B is added.	OK / NG	/ /
Manual router disconnection at ROUTER A of ROUTER A-ROUTER B route	CEASE PDU transmission from ROUTER A	4-2-1	At ROUTER A, manually close the router connection to ROUTER B. Confirm ROUTER A sends a CEASE PDU to ROUTER B.	OK / NG	/ /
	CEASE PDU transmission from ROUTER B and route deletion	4-2-2	At ROUTER B, confirm receipt of CEASE PDU from ROUTER A. Confirm ROUTER B sends a CEASE PDU to ROUTER A, and that route information for ROUTER A and ROUTER C are deleted.	OK / NG	/ /

4. ATN Router Tests		Test Item	Procedure	Result	Date/Time
	Route deletion at ROUTER A	4-2-3	At ROUTER A, confirm receipt of CEASE PDU from ROUTER B, and that route information for ROUTER B is deleted.	OK / NG	/ /
	VC disconnection between ROUTER A and ROUTER B	4-2-4	Confirm that the VC between ROUTER A and ROUTER B is closed normally.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER A to ROUTER C, and route deletion	4-2-5	Confirm that ROUTER A sends an UPDATE PDU to ROUTER C. At ROUTER C, confirm that UPDATE PDU is received from ROUTER A, and that route information for ROUTER B is deleted.	OK / NG	/ /
Route re-activation from ROUTER A	Router connection re-activation from ROUTER A	4-3-1	At ROUTER A, manually initiate router connection to ROUTER B (VC call: caller, OPEN PDU: send). Confirm the X.25 VC and IDRP connection are established.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER A to ROUTER B	4-3-2	Confirm that ROUTER A sends an UPDATE PDU to ROUTER B. At ROUTER B, check that route information to ROUTER A and ROUTER C are added.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER B to ROUTER A	4-3-3	Confirm that ROUTER B sends an UPDATE PDU to ROUTER A. At ROUTER A, check that route information to ROUTER B is added.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER A to ROUTER C and route addition	4-3-4	Confirm that ROUTER A sends an UPDATE PDU to ROUTER C. At ROUTER C, check that route information to ROUTER B is added.	OK / NG	/ /
Manual router disconnection at ROUTER B	CEASE PDU transmission from ROUTER B	4-4-1	At ROUTER B, manually close the router connection to ROUTER A. Confirm ROUTER B sends a CEASE PDU to ROUTER A.	OK / NG	/ /

4. ATN Router Tests		Test Item	Procedure	Result	Date/Time
of ROUTER A-ROUTER B route	CEASE PDU transmission from ROUTER A and route deletion	4-4-2	At ROUTER A, confirm receipt of CEASE PDU from ROUTER B. Confirm ROUTER A sends CEASE PDU to ROUTER B, and that route information for ROUTER B is deleted.	OK / NG	/ /
	Route deletion at ROUTER B	4-4-3	At ROUTER B, confirm receipt of CEASE PDU from ROUTER A, and that route information for ROUTER A and ROUTER C are deleted.	OK / NG	/ /
	VC disconnection between ROUTER A and ROUTER B	4-4-4	Confirm that the VC between ROUTER A and ROUTER B is closed normally.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER A to ROUTER C, and route deletion	4-4-5	Confirm that ROUTER A sends an UPDATE PDU to ROUTER C. At ROUTER C, confirm that an UPDATE PDU is received from ROUTER A, and that route information for ROUTER B is deleted.	OK / NG	/ /
Route re-activation from ROUTER B	Router connection re-activation from ROUTER B	4-5-1	At ROUTER B, manually initiate router connection to ROUTER A (VC call: called, OPEN PDU: receive). Confirm the X.25 VC and IDRP connection are established.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER A to ROUTER B	4-5-2	Confirm that ROUTER A sends an UPDATE PDU to ROUTER B. At ROUTER B, confirm UPDATE PDU is received, and that route information to ROUTER A and ROUTER C are added.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER B to ROUTER A	4-5-3	Confirm that ROUTER B sends an UPDATE PDU to ROUTER A. At ROUTER A, confirm UPDATE PDU is received, and that route information to ROUTER B is added.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER A to ROUTER C and route addition	4-5-4	Confirm that ROUTER A sends an UPDATE PDU to ROUTER C. At ROUTER C, confirm UPDATE PDU is received, and that route information to ROUTER B is added.	OK / NG	/ /

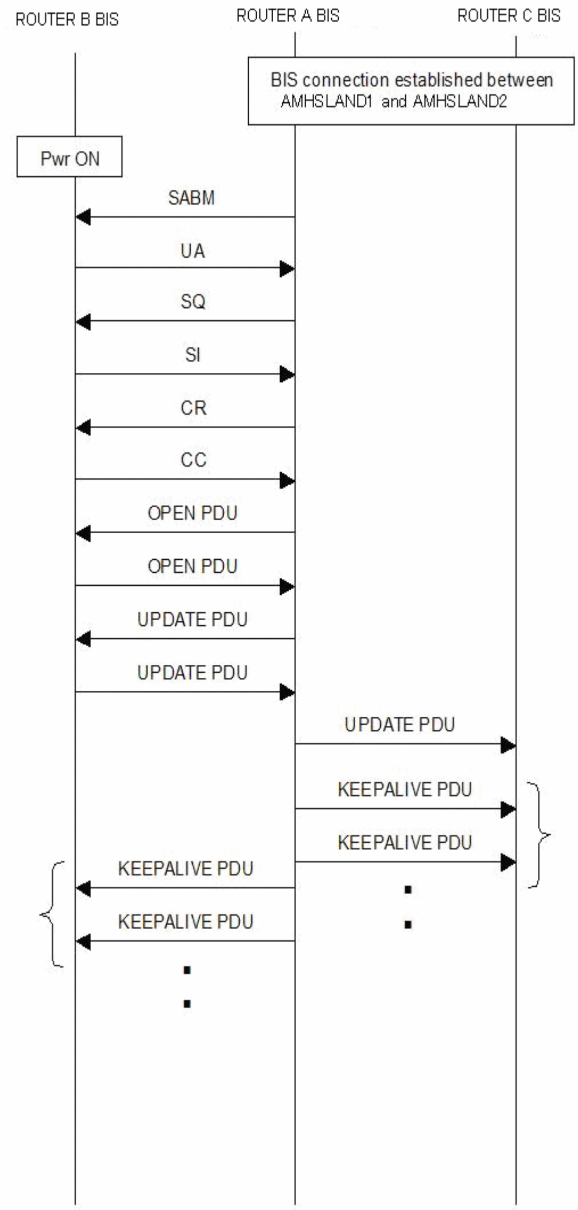
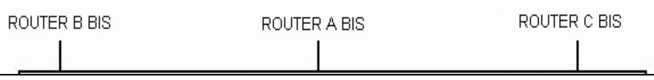
Test No.			Sequence Diagram
4	1	1	
4	1	2	
4	1	3	
4	1	4	
4	1	5	

Figure 15 Sequence: router connection of ROUTER B to ROUTER A (ROUTER A-ROUTER C already established)

Test No.			Sequence Diagram

4	2	1	
4	2	2	
4	2	3	
4	2	4	
4	2	5	
4	3	1	
4	3	2	
4	3	3	
4	3	4	

Figure 16 Sequence: Manual router disconnection at ROUTER A of ROUTER A-ROUTER B route and re-activation.

Test No.			Sequence Diagram
			

4	4	1	
4	4	2	
4	4	3	
4	4	4	
4	4	5	
4	5	1	
4	5	2	
4	5	3	
4	5	4	

Figure 17 Sequence: Manual router disconnection at ROUTER B of ROUTER A-ROUTER B route and re-activation.

Table 10 Router Connection, Disconnection and Re-activation Test Procedure: ROUTER C-ROUTER A

4. ATN Router Tests		Test Item	Procedure	Result	Date/Time
Router connection of ROUTER C to ROUTER A	Data link establishment between ROUTER C and ROUTER A	4-6-1	With VC and IDRP connections established between ROUTER A and ROUTER B, at ROUTER A, initiate router connection to ROUTER C. Check and confirm data link and VC are established between ROUTER C and ROUTER A.	OK / NG	/ /
	IDRP connection establishment between ROUTER C and ROUTER A	4-6-2	After VC establishment, check and confirm IDRP connection established between ROUTER C and ROUTER A by exchange of OPEN PDUs. (First OPEN PDU sent by ROUTER A.)	OK / NG	/ /
	UPDATE PDU transmission from ROUTER A to ROUTER C	4-6-3	After IDRP connection established, confirm ROUTER A sends an UPDATE PDU to ROUTER C. At ROUTER C, after receiving UPDATE PDU from ROUTER A, check that route information on ROUTER A and ROUTER B are added.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER C to ROUTER A	4-6-4	After IDRP connection established, confirm ROUTER C sends an UPDATE PDU to ROUTER A. At ROUTER A, after receiving UPDATE PDU from ROUTER C, confirm route information of ROUTER C is added.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER A to ROUTER B	4-6-5	At ROUTER A, after receiving UPDATE PDU from ROUTER C, confirm ROUTER A sends an UPDATE PDU to ROUTER B. At ROUTER B, after receiving UPDATE PDU from ROUTER A, confirm that route information of ROUTER C is added.	OK / NG	/ /
Manual router disconnection at ROUTER C of ROUTER C-ROUTER A route	CEASE PDU transmission from ROUTER C	4-7-1	At ROUTER C, manually close the router connection to ROUTER A. Confirm ROUTER C sends a CEASE PDU to ROUTER A.	OK / NG	/ /
	CEASE PDU transmission from ROUTER A and route deletion	4-7-2	At ROUTER A, confirm receipt of CEASE PDU from ROUTER C. Confirm ROUTER A sends CEASE PDU to ROUTER C, and that route information for ROUTER C is deleted.	OK / NG	/ /

4. ATN Router Tests		Test Item	Procedure	Result	Date/Time
	Route deletion at ROUTER C	4-7-3	At ROUTER C, confirm receipt of CEASE PDU from ROUTER A, and that route information for ROUTER A and ROUTER B are deleted.	OK / NG	/ /
	VC disconnection between ROUTER C and ROUTER A	4-7-4	Confirm that the VC between ROUTER C and ROUTER A is closed normally.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER A to ROUTER B, and route deletion	4-7-5	Confirm that ROUTER A sends an UPDATE PDU to ROUTER B. At ROUTER B, confirm that UPDATE PDU is received from ROUTER A, and that route information for ROUTER C is deleted.	OK / NG	/ /
Route re-activation from ROUTER C	Router connection re-activation from ROUTER C	4-8-1	At ROUTER C, manually initiate router connection to ROUTER A (VC call: called, OPEN PDU: receive). Confirm the X.25 VC and IDRP connection are established.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER A to ROUTER C	4-8-2	Confirm that ROUTER A sends an UPDATE PDU to ROUTER C. At ROUTER C, confirm UPDATE PDU is received, and that route information to ROUTER A and ROUTER B are added.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER C to ROUTER A	4-8-3	Confirm that ROUTER C sends an UPDATE PDU to ROUTER A. At ROUTER A, confirm UPDATE PDU is received, and that route information to ROUTER C is added.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER A to ROUTER B and route addition	4-8-4	Confirm that ROUTER A sends an UPDATE PDU to ROUTER B. At ROUTER B, confirm that UPDATE PDU is received, and that route information to ROUTER C is added.	OK / NG	/ /
Manual router disconnection at ROUTER A	CEASE PDU transmission from ROUTER A	4-9-1	At ROUTER A, manually close the router connection to ROUTER C. Confirm ROUTER A sends a CEASE PDU to ROUTER C.	OK / NG	/ /

4. ATN Router Tests		Test Item	Procedure	Result	Date/Time
of ROUTER C-ROUTER A route	CEASE PDU transmission from ROUTER C and route deletion	4-9-2	At ROUTER C, confirm receipt of CEASE PDU from ROUTER A, and that route information for ROUTER A and ROUTER B are deleted.	OK / NG	/ /
	Route deletion at ROUTER A	4-9-3	At ROUTER A, confirm receipt of CEASE PDU from ROUTER C, and that route information for ROUTER C is deleted.	OK / NG	/ /
	VC disconnection between ROUTER C and ROUTER A	4-9-4	Confirm that the VC between ROUTER C and ROUTER A is closed normally.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER A to ROUTER B, and route deletion	4-9-5	Confirm that ROUTER A sends an UPDATE PDU to ROUTER B. At ROUTER B, confirm UPDATE PDU is received from ROUTER A, and that route information for ROUTER C is deleted.	OK / NG	/ /
Route re-activation from ROUTER A	Router connection re-activation from ROUTER A	4-10-1	At ROUTER A, manually initiate router connection to ROUTER C (VC call: caller, OPEN PDU: send). Confirm the X.25 VC and IDRP connection are established.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER A to ROUTER C	4-10-2	Confirm that ROUTER A sends an UPDATE PDU to ROUTER C. At ROUTER C, confirm UPDATE PDU is received, and that route information to ROUTER A and ROUTER B are added.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER C to ROUTER A	4-10-3	Confirm that ROUTER C sends an UPDATE PDU to ROUTER A. At ROUTER A, confirm UPDATE PDU is received, and that route information to ROUTER C is added.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER A to ROUTER B and route addition	4-10-4	Confirm that ROUTER A sends an UPDATE PDU to ROUTER B. At ROUTER B, confirm UPDATE PDU is received, and that route information to ROUTER C is added.	OK / NG	/ /

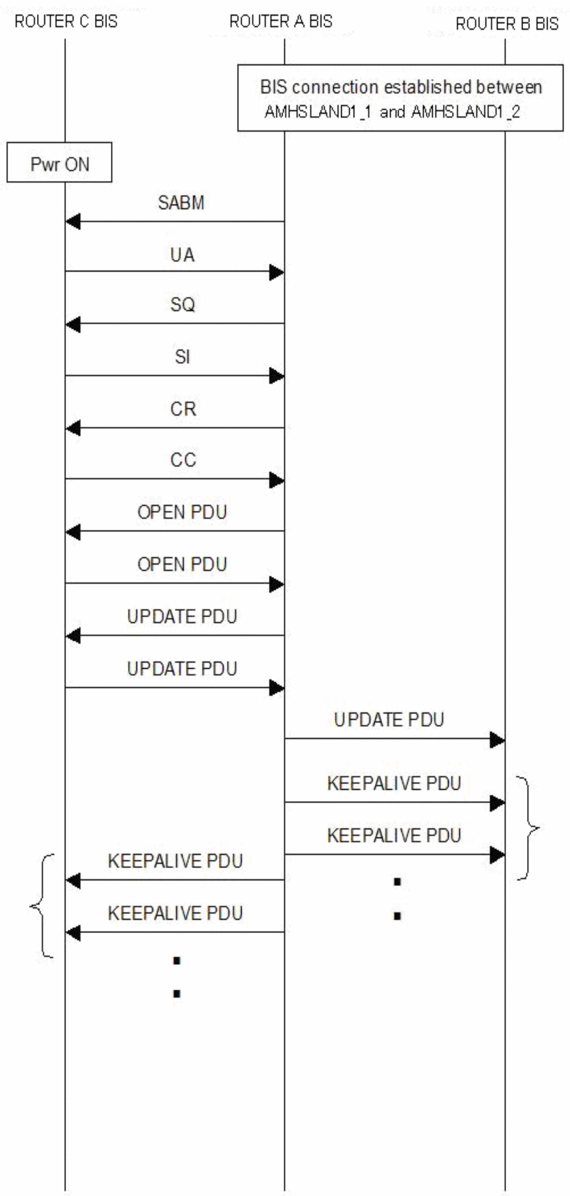
Test No.			Sequence Diagram
4	6	1	
4	6	2	
4	6	3	
4	6	4	
4	6	5	

Figure 18 Sequence: Router connection of ROUTER C to ROUTER A (ROUTER B-ROUTER A already established)

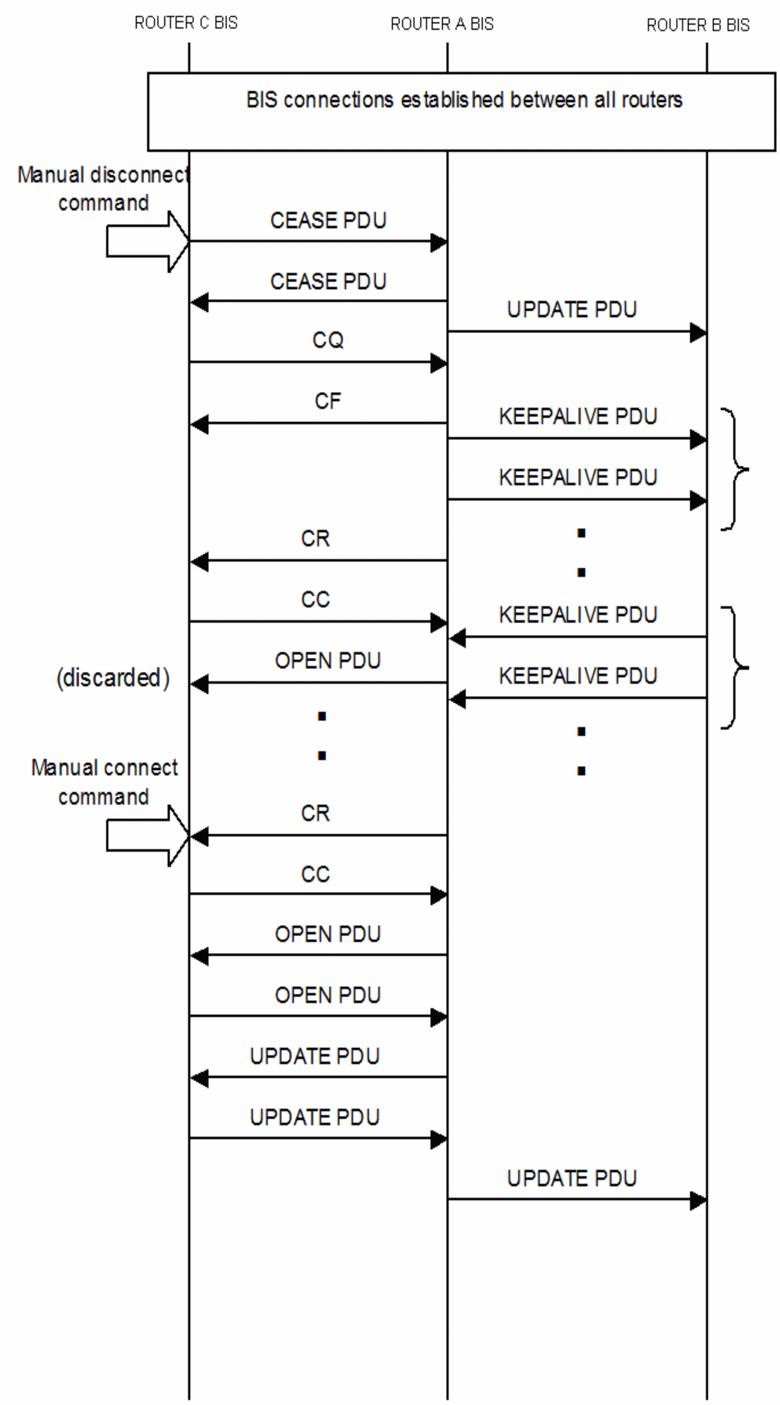
Test No.			Sequence Diagram
4	7	1	
4	7	2	
4	7	3	
4	7	4	
4	7	5	
4	8	1	
4	8	2	
4	8	3	
4	8	4	

Figure 19 Sequence: Manual router disconnection at ROUTER C of ROUTER C-ROUTER A route and re-activation

Test No.			Sequence Diagram
4	9	1	
4	9	2	
4	9	3	
4	9	4	
4	9	5	
4	10	1	
4	10	2	
4	10	3	
4	10	4	

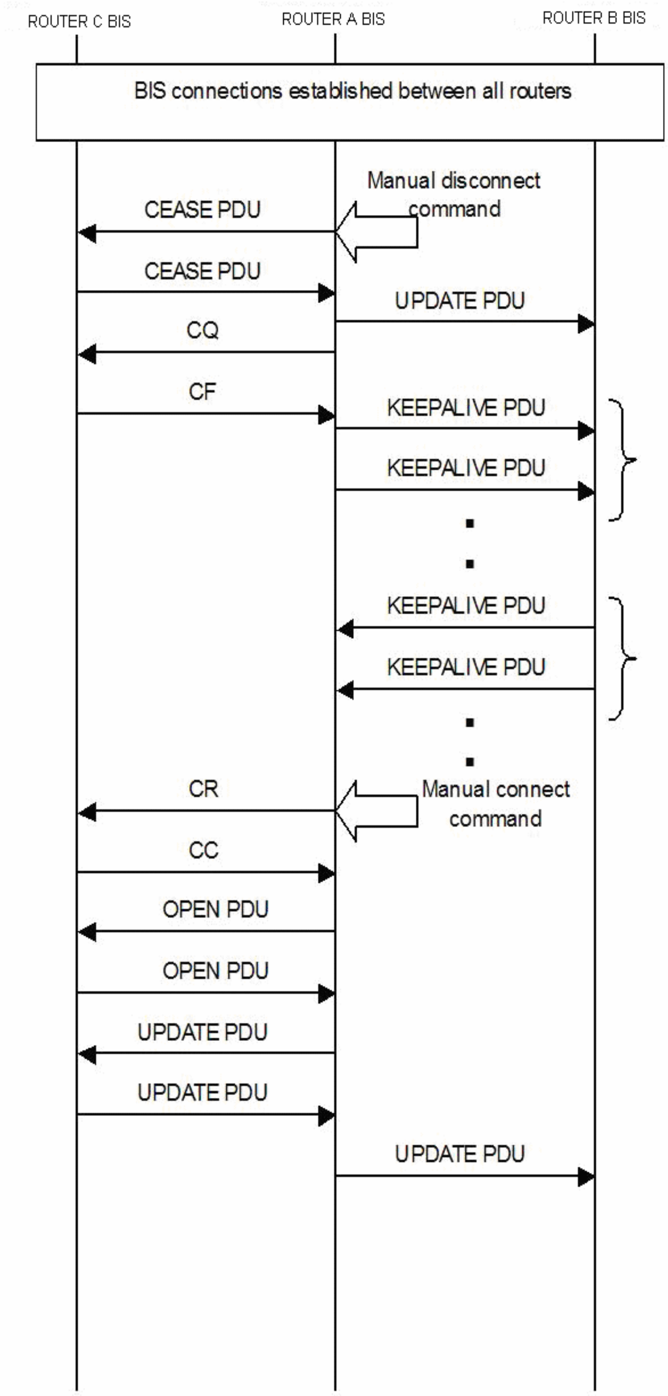


Figure 20 Sequence: Manual router disconnection at ROUTER A of ROUTER C-ROUTER A route and re-activation

Table 11 Communication Circuit Failure and Recovery Test Procedure: Third Domain connected to AMHSLAND1

4. ATN Router Tests		**Test Item**	**Procedure**	**Result**	**Date/Time**
Carrier media failure of ROUTER A-ROUTER B circuit and route deletion	Data link and VC disconnection	4-11-1	Simulate carrier medium failure between ROUTER A and ROUTER B by disconnecting WAN cable from ROUTER B. Check and confirm data link and VC are disconnected between ROUTER A and ROUTER B.	OK / NG	/ /
	IDRP disconnection and route update	4-11-2	Check and confirm that IDRP connection between ROUTER A and ROUTER B is closed. At ROUTER A, check that route information for ROUTER B is deleted. At ROUTER B, check that route information for ROUTER A and ROUTER C is deleted.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER A and route update	4-11-3	Check that ROUTER A sends an UPDATE PDU to ROUTER C. At ROUTER C, check UPDATE PDU is received from ROUTER A, and that route information for ROUTER B is deleted.	OK / NG	/ /
Carrier media restoration of ROUTER A-ROUTER B circuit and route addition	Data link, VC, and router connection re-establishment	4-12-1	Restore the ROUTER A-ROUTER B router connection. Confirm router connection is re-established between ROUTER A and ROUTER B.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER A	4-12-2	After IDRP connection is established, confirm that ROUTER A sends an UPDATE PDU to ROUTER B. At ROUTER B, check that an UPDATE PDU is received from ROUTER A, and that route information for ROUTER A and ROUTER C are added.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER B	4-12-3	After receiving UPDATE PDU from ROUTER A, check that ROUTER B sends an UPDATE PDU to ROUTER A. At ROUTER A, after receiving UPDATE PDU from ROUTER B, check that route information is added for ROUTER B.	OK / NG	/ /

4. ATN Router Tests		Test Item	Procedure	Result	Date/Time
	UPDATE PDU transmission from ROUTER A	4-12-4	Check that ROUTER A sends an UPDATE PDU to ROUTER C. At ROUTER C, check that an UPDATE PDU is received from ROUTER A, and that route information is added for ROUTER B.	OK / NG	/ /
Carrier media failure of ROUTER C-ROUTER A circuit and route deletion	Data link and VC disconnection	4-13-1	Simulate carrier medium failure between ROUTER C and ROUTER A by disconnecting WAN cable from ROUTER C. Check and confirm data link and VC are disconnected between ROUTER C and ROUTER A.	OK / NG	/ /
	IDRP disconnection and route update	4-13-2	Check and confirm that IDRP connection between ROUTER C and ROUTER A is closed. At ROUTER C, check that route information for ROUTER A and ROUTER B are deleted. At ROUTER A, check that route information for ROUTER C is deleted.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER A and route update	4-13-3	Check that ROUTER A sends an UPDATE PDU to ROUTER B. At ROUTER B, check that UPDATE PDU is received from ROUTER A, and that route information for ROUTER C is deleted.	OK / NG	/ /
Carrier media restoration of ROUTER C-ROUTER A circuit and route addition	Data link, VC, and Router connection re-establishment	4-14-1	Restore the ROUTER C-ROUTER A router connection. Confirm router connection is re-established between ROUTER C and ROUTER A.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER A	4-14-2	After IDRP connection is established, confirm that ROUTER A sends an UPDATE PDU to ROUTER C. At ROUTER C, check that an UPDATE PDU is received from ROUTER A, and that route information for ROUTER A and ROUTER B are added.	OK / NG	/ /
	UPDATE PDU transmission from ROUTER C	4-14-3	After receiving UPDATE PDU from ROUTER A, check that ROUTER C sends an UPDATE PDU to ROUTER A. At ROUTER A, after receiving UPDATE PDU from ROUTER C, check that route information is added for ROUTER C.	OK / NG	/ /

4. ATN Router Tests		Test Item	Procedure	Result	Date/Time
	UPDATE PDU transmission from ROUTER A	4-14-4	Check that ROUTER A sends an UPDATE PDU to ROUTER B. At ROUTER B, check that an UPDATE PDU is received from ROUTER A, and that route information is added for ROUTER C.	OK / NG	/ /

Test No.			Sequence Diagram
4	11	1	
4	11	2	
4	11	3	
4	12	1	
4	12	2	
4	12	3	
4	12	4	

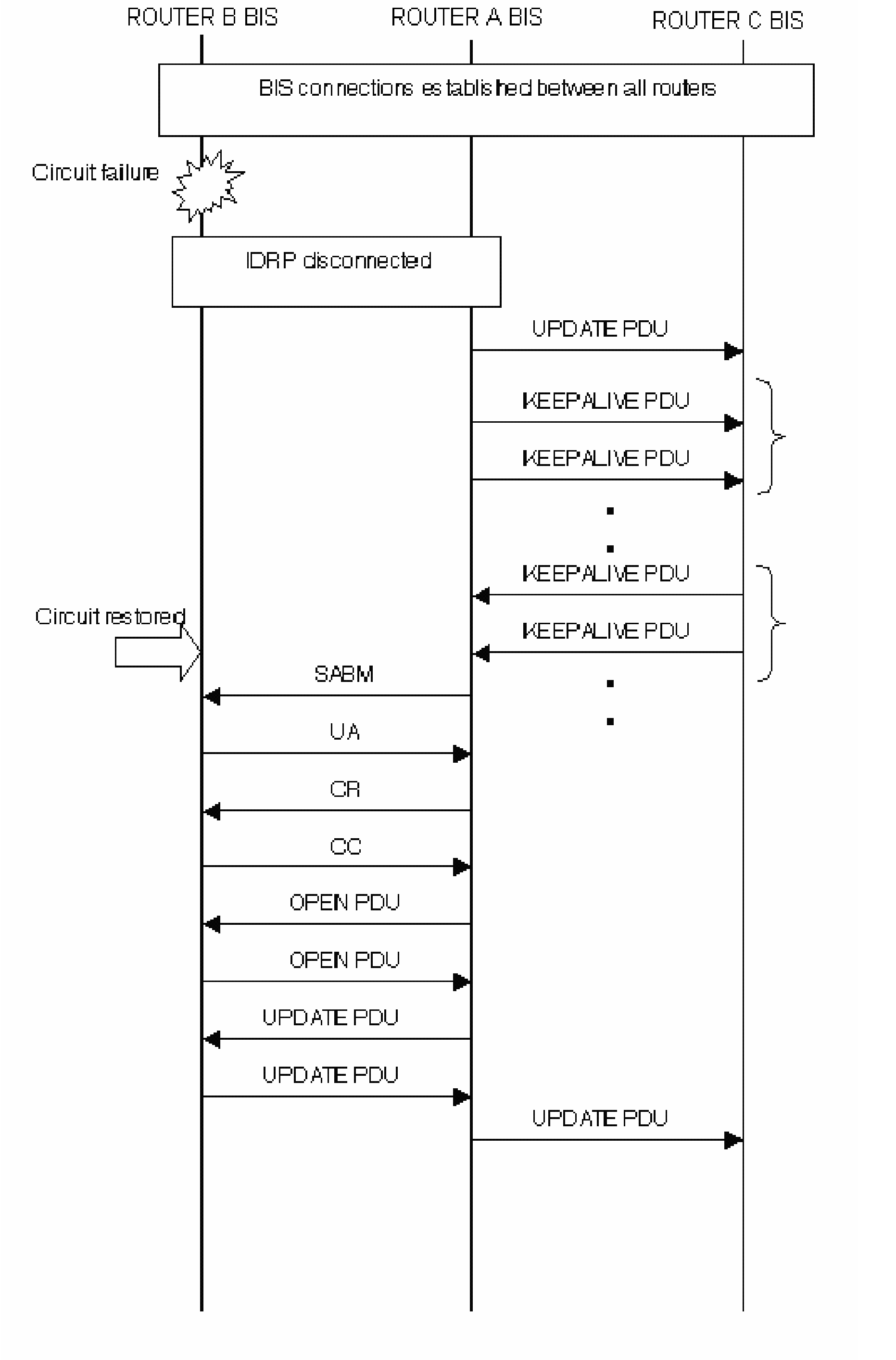


Figure 21 Sequence: Failure and recovery of ROUTER B-ROUTER A circuit

Test No.			Sequence Diagram
4	13	1	
4	13	2	
4	13	3	
4	14	1	
4	14	2	
4	14	3	
4	14	4	

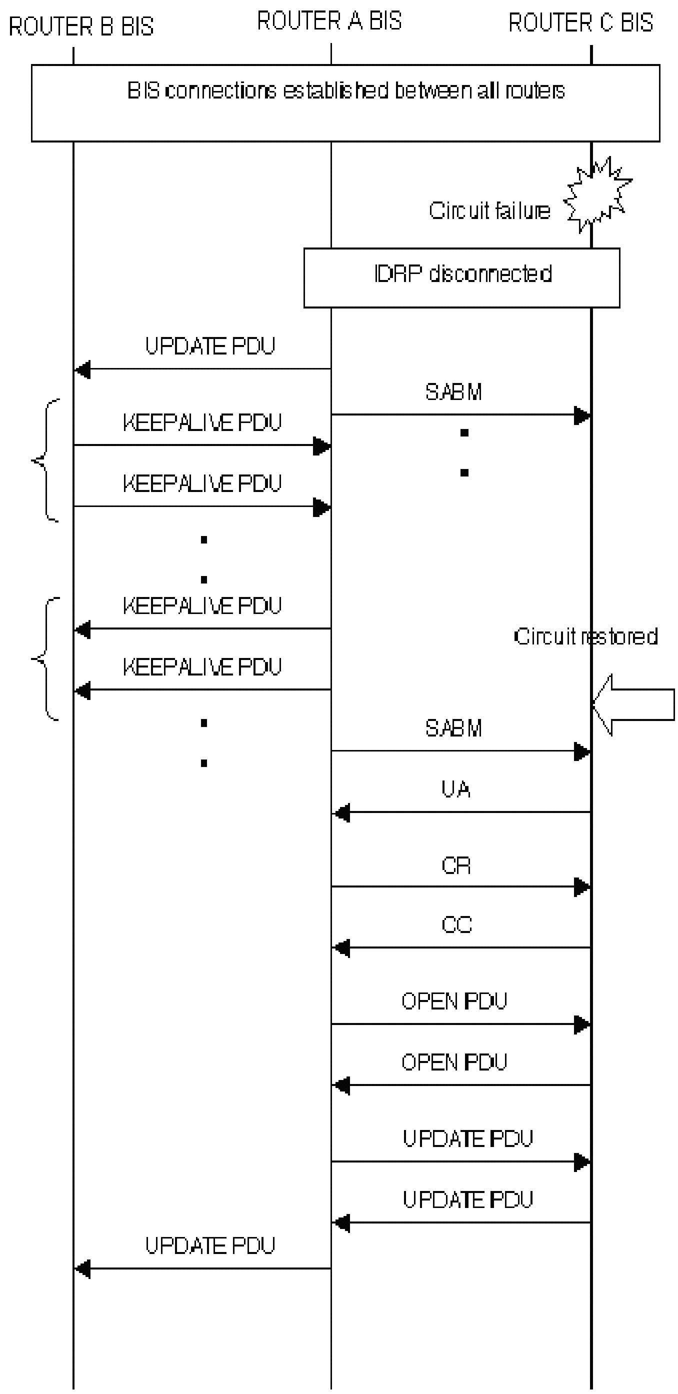


Figure 22 Sequence: Failure and recovery of ROUTER C-ROUTER A circuit

Table 12 Router Failure and Recovery Test Procedure

4. ATN Router Tests		**Test Item**	**Procedure**	**Result**	**Date/Time**
Failure and recovery of ROUTER C	Failure of ROUTER C	4-15-1	Simulate failure and recovery of ROUTER C by rebooting the router. At failure: ・ At ROUTER A, check that routing information for ROUTER C is deleted. ・ At ROUTER B, check that routing information for ROUTER C is deleted.	OK / NG	/ /
	Recovery of ROUTER C	4-15-2	Check that the ROUTER C-ROUTER A router connection is automatically re-established after ROUTER C recovers. After recovery: ・At ROUTER A, check that routing information for ROUTER C is added. ・At ROUTER B, check that routing information for ROUTER C is added.	OK / NG	/ /
Failure and recovery of ROUTER A	Failure of ROUTER A	4-16-1	Simulate failure and recovery of ROUTER A by forcing failover. At failure: ・At ROUTER B, check that routing information for ROUTER A and ROUTER C are deleted ・At ROUTER C, check that routing information for ROUTER A and ROUTER B are deleted.	OK / NG	/ /

4. ATN Router Tests		Test Item	Procedure	Result	Date/Time
	Recovery of ROUTER A	4-16-2	Check that the ROUTER C-ROUTER A and ROUTER A-ROUTER B router connections are automatically re-established after ROUTER A recovers. After recovery: ・At ROUTER A, check that routing information is added for ROUTER C and ROUTER B. ・At ROUTER B, check that routing information for ROUTER C and ROUTER A are added. ・At ROUTER C, check that routing information for ROUTER A and ROUTER B are added.	OK / NG	/ /
Failure and recovery of ROUTER B	Failure of ROUTER B	4-17-1	Simulate failure and recovery of ROUTER B by rebooting the router. At failure: ・ At ROUTER A, check that routing information for ROUTER B is deleted. ・ At ROUTER C, check that routing information for ROUTER B is deleted.	OK / NG	/ /
	Recovery of ROUTER B	4-17-2	Check that the ROUTER A-ROUTER B router connection is automatically re-established after ROUTER B recovers. After recovery: ・ At ROUTER A, check that routing information for ROUTER B is added. ・ At ROUTER C, check that routing information for ROUTER B is added. ・ At ROUTER B, check that routing information for ROUTER A and ROUTER C are added.	OK / NG	/ /

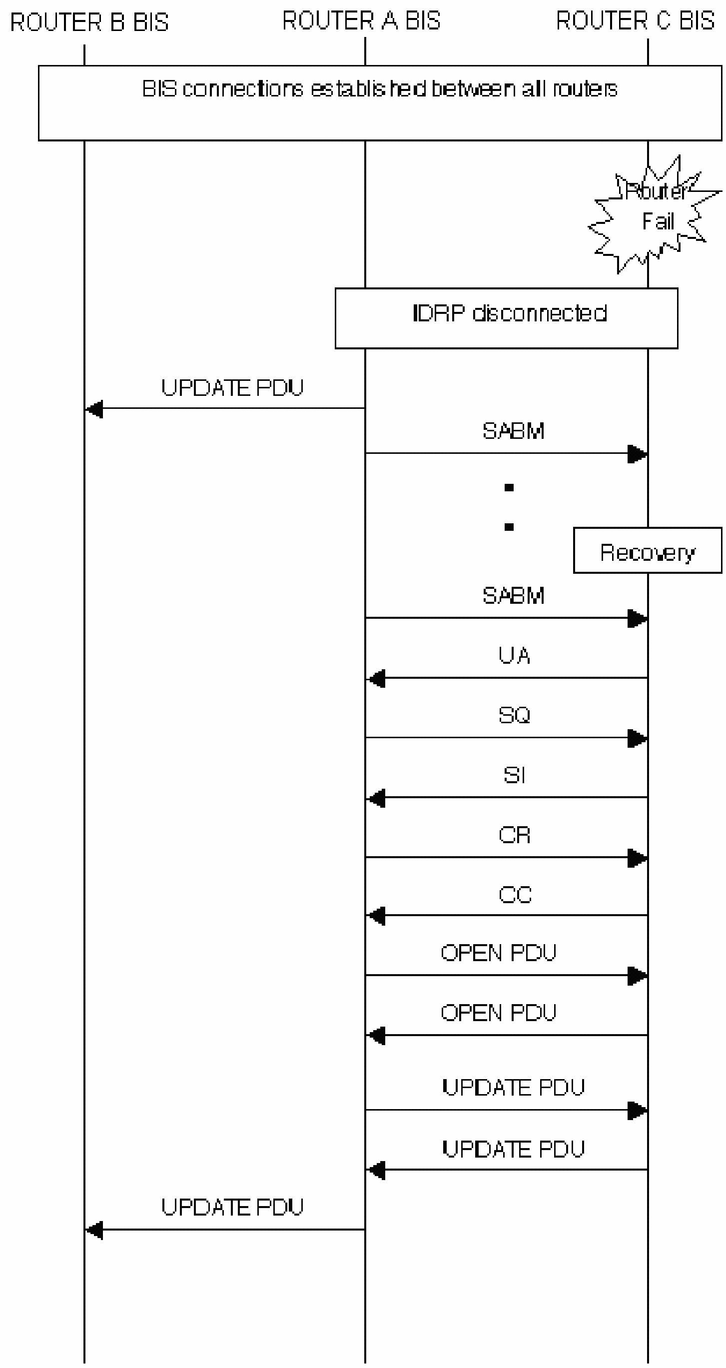
<table>
<tr><th colspan="3">Test No.</th><th>Sequence Diagram</th></tr>
<tr><td>4</td><td>15</td><td>1</td><td rowspan="2">
</td></tr>
<tr><td>4</td><td>15</td><td>2</td></tr>
</table>

Figure 23 Sequence: Failure and Recovery of ROUTER C

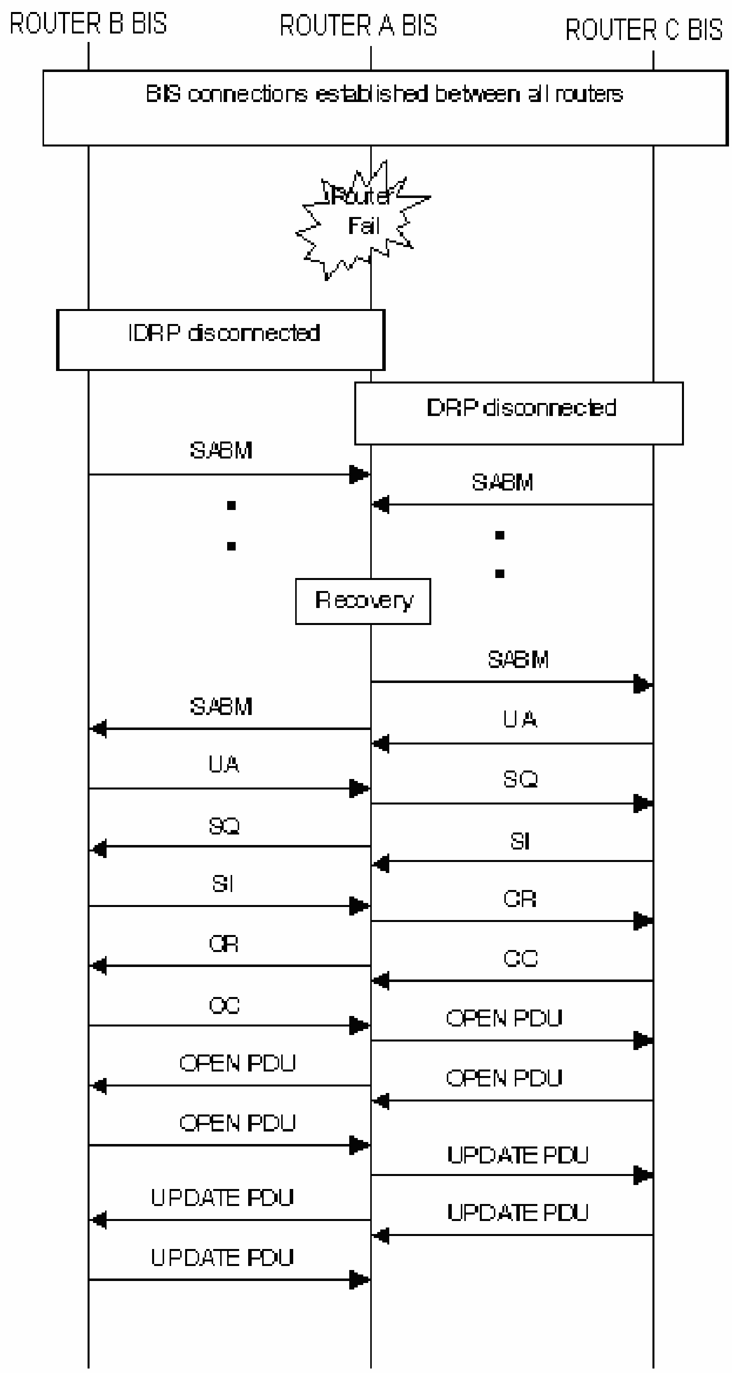
Test No.			Sequence Diagram
4	16	1	
4	16	2	

Figure 24 Sequence: Failure and Recovery of ROUTER A

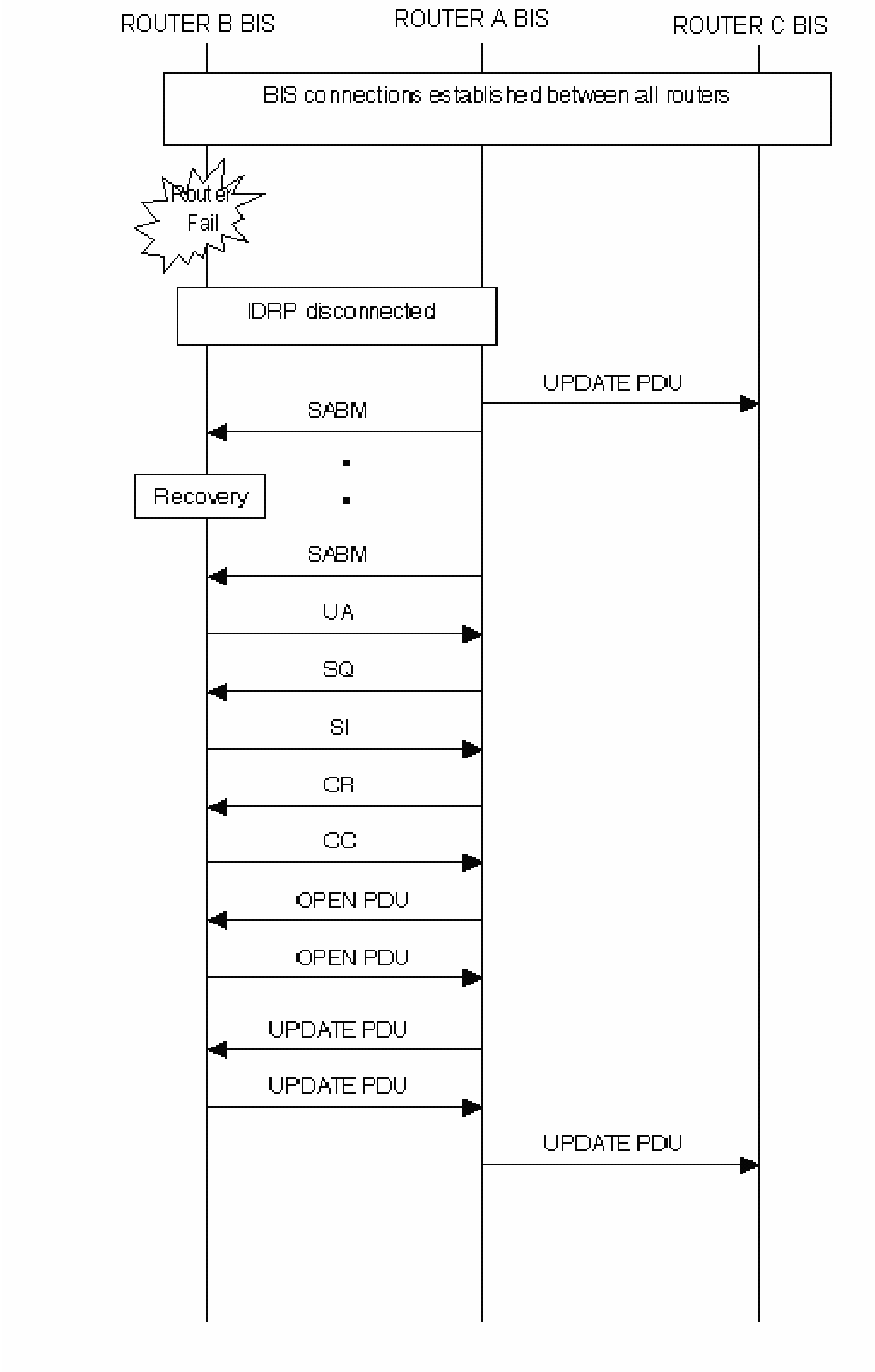
<table>
<tr><th colspan="3">Test No.</th><th>Sequence Diagram</th></tr>
<tr><td>4</td><td>17</td><td>1</td><td rowspan="2">
</td></tr>
<tr><td>4</td><td>17</td><td>2</td></tr>
</table>

Figure 25 Sequence: Failure and Recovery of ROUTER B

Table 13 End-to-End CLNP Echo Test Procedure

4. ATN Router Tests		**Test Item**	**Procedure**	**Result**	**Date/Time**
End-to-End CLNP Echo Test between end systems in ROUTER C domain and ROUTER B domain	ERQ transmission	4-18-1	Send ERQ PDU from ES in ROUTER C domain to ES in ROUTER B domain. Confirm receipt of ERQ PDU at ES in ROUTER B domain.	OK / NG	/ /
	ERP transmission	4-18-2	Send ERP PDU from ES in ROUTER B domain to ES in ROUTER C domain. Confirm receipt of ERP PDU at ES in ROUTER C domain.	OK / NG	/ /
	Continuous ERQ/ERP transmission	4-18-3	Repeat 4-18-1 to 4-18-2 ten times to confirm that there is no problem with ERQ/ERP transmission and relay through the ROUTER A.	OK / NG	/ /
	ERQ transmission	4-18-4	Send ERQ PDU from ES in ROUTER B domain to ES in ROUTER C domain. Confirm receipt of ERQ PDU at ES in ROUTER C domain.	OK / NG	/ /
	ERP transmission	4-18-5	Send ERP PDU from ES in ROUTER B domain to ES in ROUTER C domain. Confirm receipt of ERP PDU at ES in ROUTER C domain.	OK / NG	/ /
	Continuous ERQ/ERP transmission	4-18-6	Repeat 4-18-4 to 4-18-6 ten times to confirm that there is no problem with ERQ/ERP transmission and relay through the ROUTER A.	OK / NG	/ /

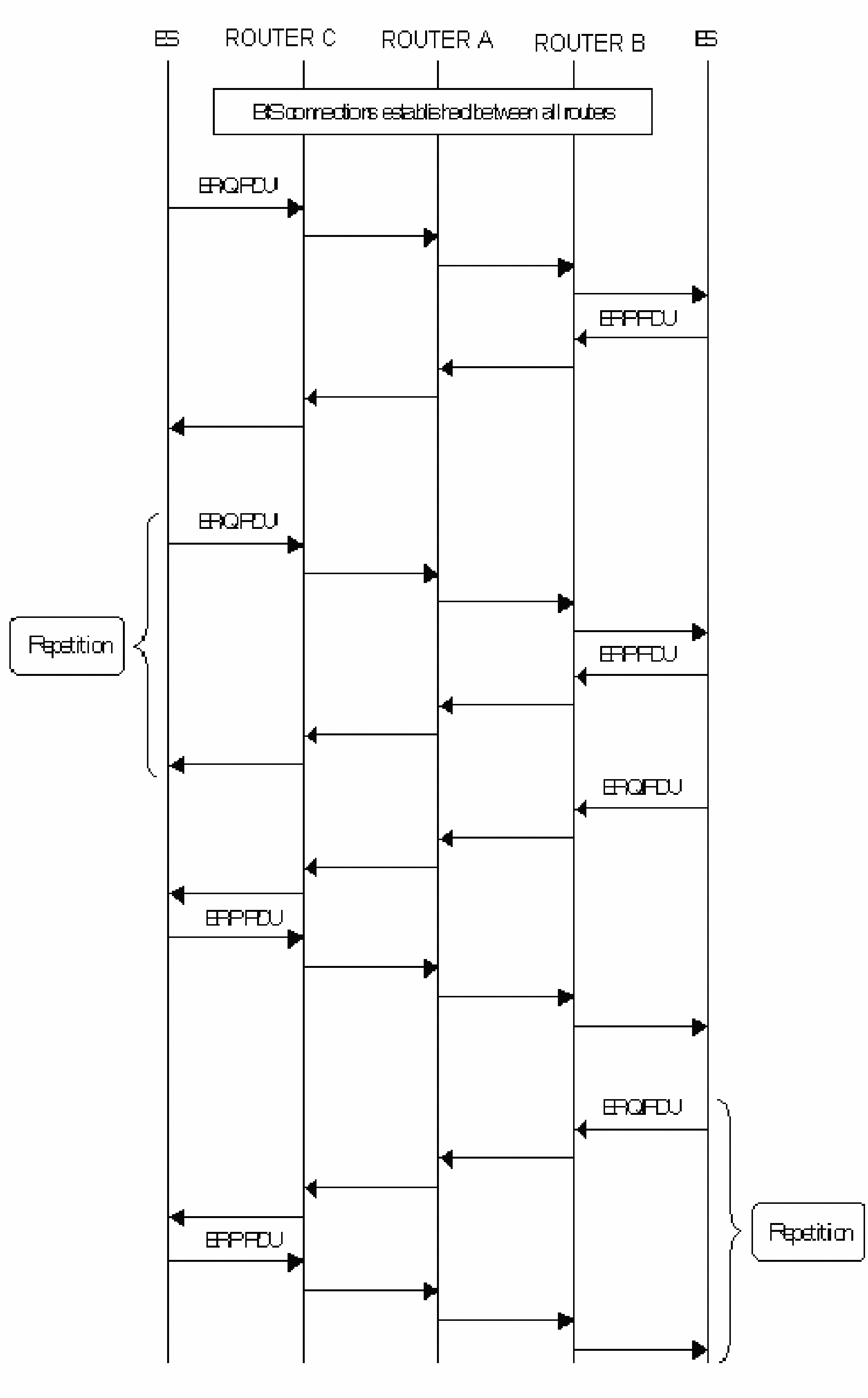
Test No.			Sequence Diagram
4	18	1	
4	18	2	
4	18	3	
4	18	4	
4	18	5	
4	18	6	

Figure 26 Sequence: End-to-End CLNP Echo Tests

Annex D

AMHS Testing Requirements

Annex D

To

AMHS Manual

Document Control Log

Edition	Date	Comments	Section/pages affected
1.0	22/06/2007	Creation of the document.	all

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1 Introduction

1.1 Purpose of the Document

The purpose of the document is to define the functional requirements for AMHS testing procedures.

1.2 Scope of the Document

Based on known principles of testing and general assumptions on an AMHS test scenario, the scope of testing for an "AMHS Conformance Test" is specified. Elements of the specifications are generic test groups and related test configurations. Special attention is given to the “provocation” of an AMHS implementation with incorrect protocol behavior (“negative testing”) to analyze its stability (robustness) in out-of-line situations.
Further requirements are specified in terms of configuration parameters (as number of ATS Message Servers and AMHS users represented by test equipment) and the components of AMHS and AFTN information objects to be handled.
In principle, these groups are also valid for interoperability tests. But especially the test groups dealing with “negative testing” cannot be performed by real systems due to the nature of an implementation to avoid such exception situations.

1.3 Document Structure

Chapter 2 is concerned with general aspects of conformance testing and identifies the principal differences to interoperability testing. Key elements of the envisaged test methodology are identified which form high-level requirements for an AMHS conformance testing equipment. References are made to ISO/IEC 9646 which provides a general concept of conformance testing and to deliverables of the ACCESS study concerning AMHS testing.

Chapter 3 deals with the scope of AMHS functions to be tested and identifies reference points at AMHS implementations which should be accessible for testing. In addition, the used transport service for AMHS communications is identified and the interface with AFTN at the implemented AFTN/AMHS Gateway is detailed.

Chapter 4 defines AMHS test groups for comprehensive conformance testing of AMHS native communications and gateway operations with the AFTN. Related test configurations are added with explanations on sequences of exchanged AMHS and AFTN information objects. In addition, principles for definitions of test cases are set up including the consideration of so-called “negative testing”.

Chapter 5 specifies the range of parameters values supported in test configurations which place quantitative requirements on the testing equipment as the number of represented adjacent ATS Message Servers and handled AMHS and AFTN users.

Finally, *chapter* 6 identifies the used AMHS and AFTN test data. In particular, the elements of AMHS information objects and their sub-components (as message and message transfer envelope) to be supported are specified in detail.

1.4 References

[1] ICAO DOC 9705-AN/956: The Manual of technical provisions for the ATN, Sub-volume III, Section 3.1 –Edition 3 (2002) – Referred to as AMHS SARPs

[2] ICAO Annex 10 – Aeronautical Telecommunications, Volume II: Communication Procedures

[3] ISO/IEC 10021-2 – Information technology, Text communication – Message-oriented Text Interchange Systems – Part 2: Overall architecture

[4] ISO/IEC 10021-4 – Information technology, Text communication – Message-oriented Text Interchange Systems – Part 4: Message Transfer System: Abstract service definition and procedures

[5] ISO/IEC 10021-7 – Information technology, Text communication – Message-oriented Text Interchange Systems – Part 7: Interpersonal Messaging System

[6] ISO/IEC ISP 10611-3 – International standardized profile AMH1n – Message Handling Systems – Common Messaging –AMH11: Message transfer (P1)

[7] ISO/IEC ISP 12062-2 – International standardized profile AMH2n – Message Handling Systems – Interpersonal Messaging –AMH21: IPM content

[8] ISO/IEC ISP 12062-3 – International standardized profile AMH2n – Message Handling Systems – Interpersonal Messaging –AMH22: IPM requirements for message transfer (P1)

[9] ISO/IEC 9646-1 – Conformance testing methodology and framework – Part 1: General concept (1994)

2 Conformance Testing

The chapter provides an introduction to general aspects of conformance testing and identifies the principal differences to interoperability testing. Elements of the envisaged test methodology are identified which form high-level requirements for an AMHS conformance testing equipment.
References are made to ISO/IEC 9646.

2.1 Objectives

Generally, conformance testing attempts to determine whether a given implementation matches a specification. The implementation to be tested is referred to as the *implementation under test (IUT).* A tester provides the IUT with defined inputs and observes the resulting outputs. – ISO/IEC 9646-1 provides a general concept of OSI conformance testing and definitions of related key terms.

Note. – According to ISO 9646-1, the term Implementation Under Test (IUT) refers to an implementation of one or more OSI protocols, being part of a real open system which is to be studied. The System Under Test (SUT) is the real open system in which the IUT resides. – In the following, the term IUT is used when referring to the AMHS implementation to be tested in consideration that only the AMHS aspects within an given (real) ATS communication system are addressed.

ISO/IEC 9646-1 distinguishes three types of standardised conformance testing:

- *Basic interconnection tests*, that is to determine whether or not there is sufficient conformance to the relevant protocols for interconnection to be possible without trying to perform thorough testing.

.

- *Capability tests*, which are used to verify the existence of one or more claimed capabilities of an IUT (*static* conformance requirements).

.

- *Behaviour tests* deal with *dynamic* conformance requirements, which specify the observable behaviour of an implementation. Behaviour tests include tests for valid behaviour of the IUT for both valid and invalid inputs by the tester.

The AMHS testing requirements specified in this document focus on *behaviour tests*, i.e. test exercises address implemented AMHS functions in a way as they should be used. *Basic interconnection tests* are an appropriate means to check the correctness of a test configuration before starting detailed test exercises.

The discussed AMHS conformance testing relates to that scope of functions which is typically implemented in an *International Communication Centre*, i.e.

1) AMHS message transfer,
2) AMHS submission and delivery operations with attached AMHS user terminals and
3) Intercommunication with the AFTN/X.25 by means of the AFTN/AMHS Gateway.

The interface to the AFTN (X.25) is only taken into account in the extent as specified in the AMHS SARPs. For example, the AMHS SARPs do not assume AFTN routing by the gateway. – The Basic ATS Message Handling Service is assumed as the service level supported by the IUT.

The conformance testing equipment acting as peer system of the AMHS IUT is referred to the *AMHS Test Tool*. The AMHS Test Tool provides the IUT with inputs, records and evaluates responses of the IUT.

The specified testing requirements refer to an initial functionality of the AMHS Test Tool. Potential future extensions are indicated in the context of the specified sub-items of the test tool.

2.2 Specific aspects of AMHS testing

The AMHS (MHS) functions to be tested reside in the *application layer* of the ISO/OSI reference model. The underlying layers provide supporting communication services, however, are not primary subject of testing.

The context of AMHS conformance testing:

(a) the testing of complete systems ("black boxes") and

(b) the testing of individual protocol layers, in particular the application layer.

In case (a) only external interfaces which are part of the IUT are used by the conformance testing equipment. In case (b), on the other hand, the IUT has to be "opened up", providing the layer to be tested. For this purpose special software modules have to be provided within the IUT for control and observation of the lower and upper service boundary at the layer under test (see ISO/IEC 9646-1).

Recommendations for AMHS conformance testing are:

- the individual components and protocol layers of the IUT not be visible to the conformance testing equipment;
- access to the IUT by the test equipment is only via standard interfaces; and
- human readable terminal interfaces (as the Control Position of an AMHS gateway) are not accessed by the test equipment.

This recommended testing approach forms the baseline for the functional requirements placed on the AMHS Test Tool, as follows:

- The AMHS Test Tool will be interconnected with the IUT's external interfaces as far as they are standardised by the AMHS SARPs. Such standardised interfaces are the *AMHS transfer ports* and the *AFTN/X.25 interface*. The IUT is treated as a *black box*.
- Originations and receptions at user terminals have to be performed and observed by an operator who is familiar with the implemented HMI. From that follows that conformance testing needs certain operator assistance at the IUT. (The made assumptions on interfaces which are available at individual IUTs will be outlined by means of an IUT model.)

3 Assumed Test Scenario

3.1 AMHS Functionality of the IUT

3.1.1 AMHS SARPs provisions

The assumption is made that the IUT to be tested provides completely or partially the AMHS functionality as specified by the SARPs in support of the *Basic* ATS Message Handling Service. Figure 1 identifies the key elements of the AMHS which are addressed by SARPs. The figure shall also indicate that the majority of the AMHS functionality is specified by references to the MHS standard series ISO/IEC 10021 and the related profile documentation ISO/IEC ISP 10611 (Common Messaging) and ISP 12063 (Interpersonal Messaging).

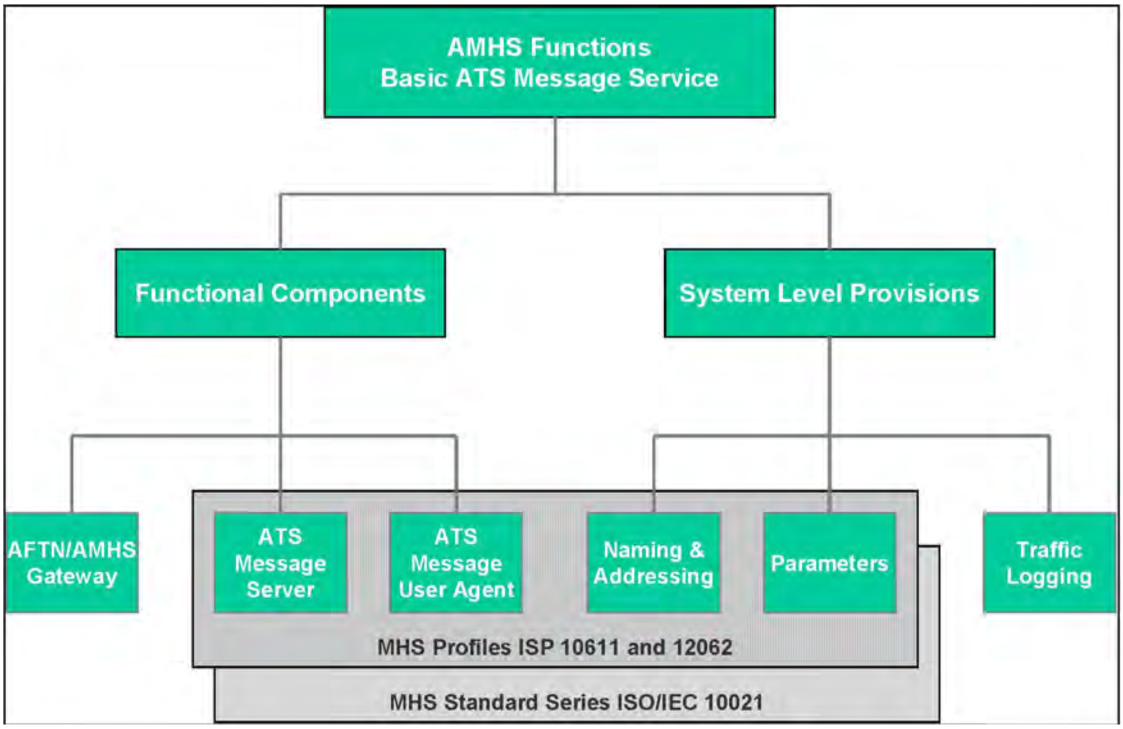

Figure 1: AMHS functionality specified by SARPs

The nucleus of the AMHS is formed by its three functional components:

- *ATS Message Server* performing *transfer* operations with adjacent ATS Message Servers (and AMHS gateways) by means of its inherent (MHS) Message Transfer Agent (MTA). In addition, *submission* and *delivery* operations are performed with one or more attached ATS Message User Agents. Optional (MHS) Message Stores (MS) may provide retrieval services for ATS Message User Agents in connection with message delivery.

- *ATS Message User Agents* each including a (MHS) User Agent (UA) as key component. An ATS Message User Agent interacts on one side with a (local) AMHS user interface and accesses on the other side the transfer level of the AMHS by performing *submission* and *delivery* operations with the superordinated ATS Message Server. Communications between ATS Message User Agents (via ATS Message Servers) are end-to-end and have to comply with the IPM content as specified for the (MHS) Interpersonal Messaging System (IPMS).

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- *AFTN/AMHS Gateway* supporting interworking between users of the AMHS and AFTN. The gateway includes for operations with the transfer level of the AMHS and MTA. The mapping functions of the gateway reside in the Message Transfer and Control Unit (MTCU). The operations with AFTN are performed with the AFTN components. Exception handling which needs operator assistance is moved to the Control Position.

The above listed functional components are typically implemented in International Communication Centres performing AMHS message transfers, AMHS message submission and delivery operations with attached AMHS user terminals and intercommunications with the AFTN. However, an AFTN/AMHS Gateway may be also implemented as stand-alone facility allowing existing AFTN communication facilities access to the AMHS.
In addition, the AMHS SARPs address some aspects relating to the system level of an AMHS environment. The key ingredients at the system level of the AMHS are:

- *Naming and addressing* relating to the unambiguously identification of AMHS users and entities at upper layers protocols as needed for communications between AMHS systems. The specifications are based on MHS O/R addressing and ISO/OSI upper layer conventions. Examples are: the Common AMHS Addressing Scheme, Application Process Titles and Transport/Session/Presentation addresses.

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- *Parameters* define specific AMHS conventions in the framework of the MHS standard. Examples are: The limitation of Receipt Notifications for IPMs with the *importance* value "high" and the definition of the ATS-Message-Header in the IPM body part.

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- *Traffic logging* in functional components in support of message tracking across the AMHS.

The manner of implementation of the above identified AMHS functionality in the IUT is irrelevant for testing (*black-box* view). The above functional outline is used just as reference for the scope of conformance testing to be supported by the AMHS Test Tool.

3.1.2 Implementation specific AMHS features

Typically, an AMHS implementation includes features which are either beyond the scope of the SARPs or seen as local issue. Examples are: User interfaces (HMI) for local submissions and deliveries, proprietary MTS access protocol and provisions for systems management (including statistics and diagnostic means).
Such features will not be subject of conformance testing, however, may be used in support of conformance testing. Example: IPM submission at local user terminals for verification of correct generation of the related P1 message.

3.2 Modelling of the test environment

Figure 2 illustrates the intended operational environment of the IUT at the level of messaging: Via Transfer Ports of the IUT (logical) connections are established to *n* adjacent ATS Message Servers which in turn provide connectivity to *m* distant ATS Message User Agents. Local access to the AMHS is offered by *p* AMHS User Terminals attached to the IUT. Via the AFTN/AMHS Gateway there is a connection to an adjacent AFTN Communication Centre which in turn provides connectivity to *s* AFTN stations. – The figures *m*, *n*, *p* and *s* are seen as configuration parameters of the test configuration (see Section 5).

Note 1. – The specification of the AFTN/AMHS Gateway assumes an AFTN link to only one adjacent AFTN centre to minimise the AFTN functionality in the gateway. However, in typical implementations, the AFTN/AMHS Gateway is collocated with AFTN centre functions supporting connections to a number of adjacent centres. This aspect of multiple AFTN connections is not considered for conformance testing against the AMHS SARPs.

Note 2. – In the AISAPAC Region, AFTN communications make use of the X.25 transport service. This is taken into account for conformance testing, however, with the limitation, that only one X.25/AFTN link is established between the test tool and the IUT (see Figure 2).

Note 3. – In-depth testing of AFTN and X.25 capabilities of the IUT is not seen as subject of AMHS conformance testing.

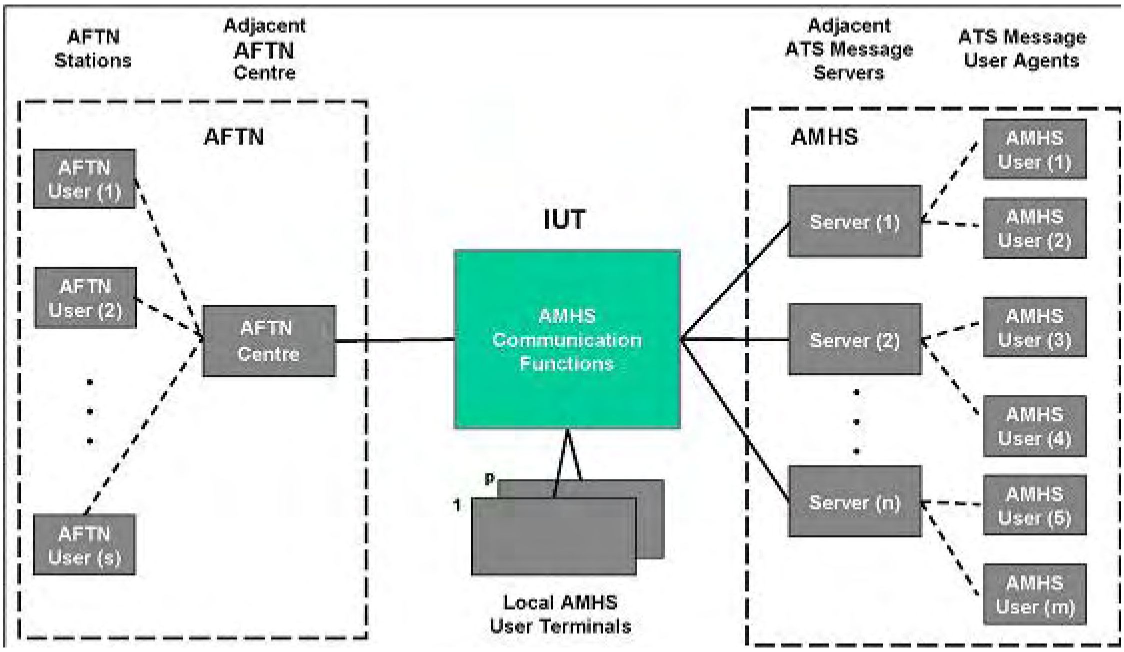


Figure 2: Assumed operational environment of the IUT

The AMHS Test Tool simulates an operational environment for the IUT as depicted in Figure 2. Figure 3 shows the corresponding model of the test configuration. The *COM Interfaces* of the test tool include *n* MTA instances representing the *n* adjacent ATS Message Servers of the IUT and an AFTN/X.25 source/sink representing the AFTN/X.25 environment. Other major functional components of the test tool are the *Test Repository* (containing predefined test scripts and associated test data), *Test Script Editor* (providing an HMI for specifications of test scripts and test data), *Test Log* (containing all the exchanged information objects) and *Test Evaluation* (performing test evaluations based on the test log against various criteria). The *Test Driver* controls the execution of test scripts and enters exchanged information objects in the test log. Finally, the component *Test Management* is tasked with the overall management and administration of the test tool.

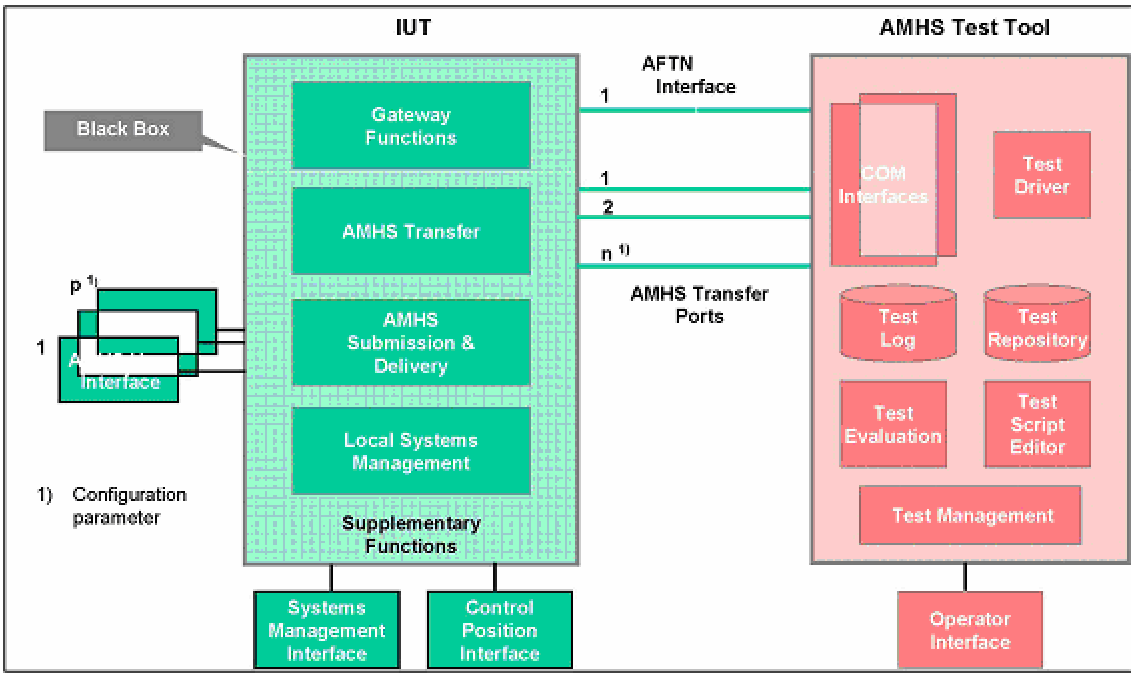


Figure 3: Model of the test environment

The IUT is represented in the modelled test configuration (*Figure 3*) by its functional components which will be subject of testing, i.e. AMHS transfer, AMHS submission/delivery and AMHS gateway functions (cf. Section 3.1). The inclusion of other indicated components of the IUT (as Systems Management Interface) will be addressed in subsequent sections.

The *n* MTA names, the addresses of the *m* ATS Message User Agents, *s* AFTN stations and *p* AMHS User Terminals are considered as configuration parameters which are jointly set up in the IUT and AMHS Test Tool.

Note. – The above outlined functional model includes an abstract, logical view on the AMHS Test Tool for the purpose of understanding the intended testing approach. The real design of the test tool is subject of separate documentation.

3.3 Used Transport Service for AMHS

According to the AMHS SARPs AMHS communications make use of the *ATN Internet Communications Service* (Layer 4). The ISO Transport Service of the class TP0 will be provided over a TCP/IP stack by using the convergence function defined with RFC 1006. The AMHS communications in the test configuration follow this approach.

Note. – Further extensions of the AMHS Test Tool may also support the ATN internet communications Service (aspect of inter-Regional or boundary centres) and TP0 over X.25.

3.4 Communication with the AFTN

The AMHS SARPs specify for the AFTN/AMHS Gateway an AFTN interface by referring to Annex 10, Volume II, i.e. the (asynchronous) *AFTN Teletypewriter Procedures* apply.

Note. – Extensions of the AMHS Test Tool may also support AFTN asynchronous communications and/or AFTN over X.25.

3.5 Points of Reference for testing

With the black-box view at the IUT, the verification of implemented functionality is limited to test inputs and examinations of resulting responses at external (open) interfaces of the IUT. Standardised interfaces of the IUT are directly interfaced by the AMHS Test Tool. At nonstandardised (proprietary) user interfaces of the IUT observations of operator inputs and displayed information are needed. Example: Origination of IPMs to be submitted or presentations of delivered IPMs at local AMHS user interfaces.
Such interfaces of the IUT which are used for conformance testing are referred to as *points of reference*. In the following, these points of reference will be detailed with reference to Figure 3.

3.5.1 Standardised points of reference

3.5.1.1 AMHS Communications

The IUT shall offer *Transfer Ports* for P1 communication with *n* adjacent ATS Message Servers. The lower protocol layers (layers 1 to 4) shall be configured as indicated below:

Layer 4	Layer 3	Layer 2	Layer 1
ISO TP0 RFC 1006 TCP	IPv4	ISO LLC1	10/100 Base T (Ethernet)

Table 1: Lower protocol layers (AMHS communications)

The Transfer Ports of the IUT and AMHS Test Tool shall be physically interconnected via a LAN (Ethernet).

3.5.1.2 AFTN/X.25 Communications

The IUT should offer a X.25/AFTN interface. That means, the IUT conveys AFTN-formatted messages by using the X.25 transport service.
Note. – If the IUT supports only AFTN asynchronous communications or AFTN over X.25 the "Extensions" of the AMHS Test Tool has to be used. The conformance testing is independent from the physical connection used.

3.5.2 Proprietary points of reference

The scope of conformance testing includes submission and delivery operations with local *AMHS user interfaces* of the IUT. Notifications for specified out-of-line situations shall be sent to the *Control Position* of the AFTN/AMHS Gateway. Further, traffic logs generated by the IUT during test exercises have to be verified against the AMHS SARPs by means of retrieval services provided at the IUT's *Operator Positions*.
The style of input and presentation of test data at the above identified three working positions is seen as a local implementation matter and is, therefore, out of scope of conformance testing. The inclusion of these working positions in testing is limited to observation and interpretation of test data.

Next, the handling of the three types of working positions will be discussed in more detail.

3.5.2.1 AMHS user interface

AMHS user interfaces provided at the IUT allow submission of IPMs and Probes and in the opposite direction delivered IPMs, IPNs and Reports have to be brought to the attention of AMHS users. The style of origination and presentation of the mentioned AMHS information objects is seen as subject of implementation. The inclusion of submission and delivery operations in conformance testing requires observations of operator interaction during test exercises.

Note. – Although the MTS access is seen as an implementation matter when supporting only the Basic ATS Message Handling Service, conformance testing shall verify the correct mapping of originated information objects onto P1 information objects; vice versa delivery operations have to map P1 information objects onto displayed objects in a correct manner.

3.5.2.2 Control Position

There is an AMHS SARPs requirement to notify the Control Position of the AFTN/AMHS gateway on specified deviations from the gateway's normal operations. Notifications may be issued for the operator information only or may require operator assistance for recovery from an occurred communication problem. How the Control Position is implemented is out of scope of the AMHS SARPs. However, the correct presentation of notifications at the IUT's Control Position is seen as subject of conformance testing. Appropriate observations have to accompany certain exercises.

3.5.2.3 Access to systems management functions

Access to IUT's systems management functions by means of a related working position shall be possible for:

- Preparation of the IUT for the test configuration, and • verification of traffic logs generated by the IUT during test exercises.

4 Supported Scope of Conformance Testing

4.1 General aspects

The scope of testing covers the (native) AMHS communications and interoperations with the AFTN/X.25 by means of the AFTN/AMHS Gateway. The AFTN/X.25 interface is tested for verification of the gateway's capability to intercommunicate with AFTN/X.25, however, is not subject of dedicated conformance testing.
Communication services at lower communication layers (as TCP/IP, X.25, LAN) support the interconnection between the AMHS system and the AMHS Test Tool. In this way, lower communication layers will be included in the test tool, however, there is no intention performing lower layer protocol testing.

The following aspects of conformance testing shall be taken into account:

- *Protocol testing*, encompassing intra-AMHS communications (MTS, IPMS) and AMHS to AFTN/X.25 mappings (and vice versa).

- *Functionality testing*, to ensure the appropriate implementation of AMHS functionality and services (as message submission, transfer, delivery) including the correct mappings between AMHS information objects and user data made visible at users' working positions.

- *Resilience testing*, particularly with regard to the stability of an AMHS implementation against external communication failures.

The reference specification for AMHS testing is the *Basic ATS Message Handling Service* as specified in the AMHS SARPs.

Note. – The incorporation of the Extended ATS Message Handling Service shall be conceptually taken into account in a later extension of the AMHS testing requirements.
Below, the scope of conformance testing will be specified by definitions of generic *test groups* and related *test cases*. These definitions should be seen as a base (minimum) set which do not exclude testing using other equivalent or extended test arrangements.

4.2 Generic test configuration

The scope of AMHS functions expected from the IUT is defined firstly by the implemented AMHS *functional components*, i.e. ATS Message Server, AFTN/AMHS Gateway and ATS Message User Agent and secondly by supplementing *system level provisions* as AMHS naming/addressing, AMHS parameters and AMHS traffic logging (see Section 3.1).
Figure 4 places the above three functional components in a fictitious AMHS communication scenario with flows of AMHS information objects between two (*direct*) AMHS users. In addition, an AFTN/AMHS Gateway supports intercommunications with AFTN users (i.e. *indirect* users of the AMHS). The position of the gateway in Figure 4 should be seen just as an example.

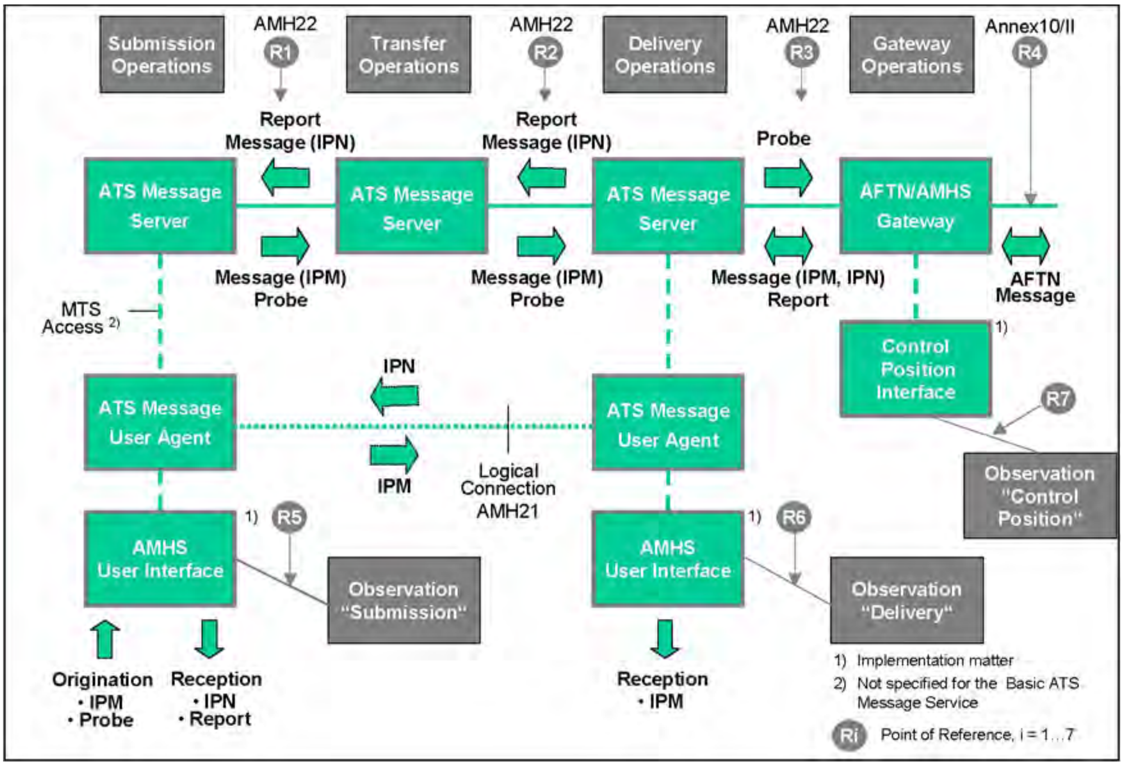


Figure 4: Generic AMHS communication scenario and used Points of Reference for conformance testing

The points of references *R1* to *R7* (in Figure 4) are allocated to the communication scenario according to the principles which have been stated in Section 3.5. The points *R1* to *R3* correspond to communication interfaces which are addressed by the MHS profiles AMH11 or AMH22, respectively [6], [8]. The exchange of IPMs and IPNs between the pair of ATS Message User Agents is subject of the MHS profile AMH21 [7]. Communications at the point *R4* follow the procedures laid down in Annex 10, Volume II, as far as applicable for the AFTN/AMHS Gateway.

The IUT is required to provide the communication functions of the ATS Message Server, ATS Message User Agent and AFTN/AMHS Gateway in any of their positions indicated in Figure 4. For related conformance testing the IUT is placed in various positions of the communication scenario (Figure 4) and the AMHS Test Tool performs the functions of the corresponding AMHS peer entity (entities). The resulting generic test configuration is depicted in Figure 5. The allocated points of reference *R1* to *R7* correspond to them of Figure 4. The reference point R8 is added for identification of the IUT's systems management interface (see Section 3.5.2.3).

Note. – In consideration of testing implementations of the Basic ATS Message Handling Service no point of reference is allocated to the MTS access.

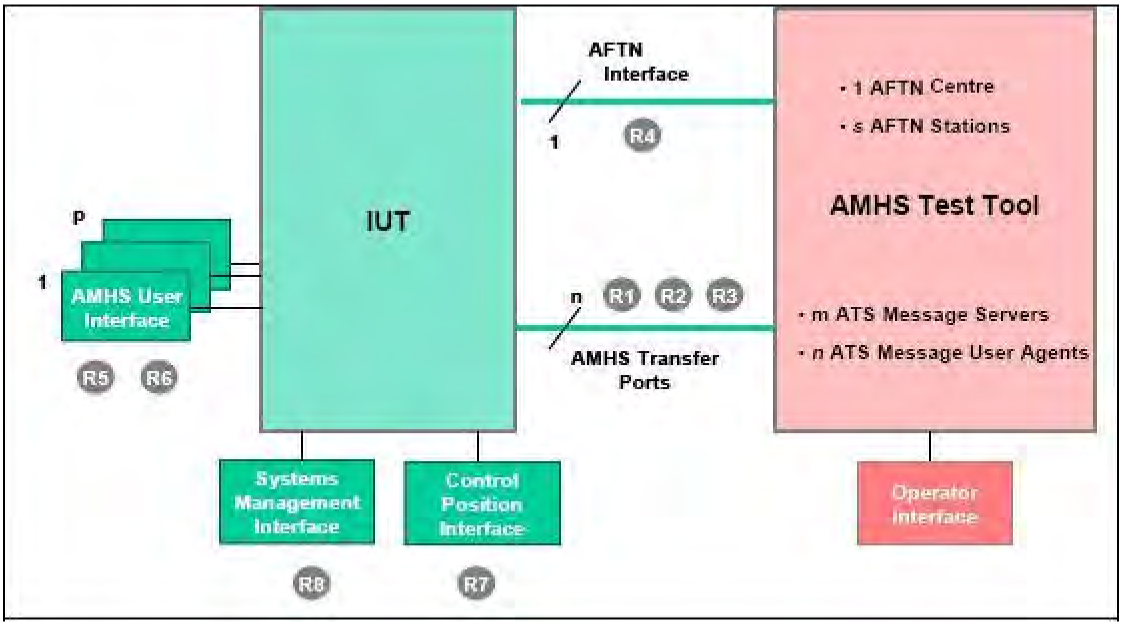


Figure 5: Generic test configuration with points of reference

Note. – In Figure 5 no AFTN user interface is forming part of the IUT. Such interfaces are outside of the scope of the specified AMHS functionality and are placed, therefore, in the IUT's test environment surrounding the IUT (see Figure 2). When testing AFTN/AMHS Gateway functions of the IUT the AFTN peer entities are always represented by the AMHS Test Tool. The AFTN related user actions should be performed by the AMHS Test Tool itself.

4.3 Definition of test groups

Generally, *test groups* provide a logical high-level ordering in test specifications (ISO 96462). Typically, a single test group addresses a particular functional area for which an IUT claims conformance. In the following, AMHS test groups are defined for the purpose of specification of high-level requirements placed on an AMHS Test Tool.

Figure 4 identifies four types of AMHS functional areas to be supported by the IUT: *Submission*, *Transfer*, *Delivery* and *Gateway* Operations. These types of AMHS operations will be constitute a first set of test groups. A second set of test groups is formed by the provisions at the AMHS system level as referred to in Section 3.1.1, i.e. *Naming & Addressing*, *Parameters* and *Traffic Logging*.

The defined test groups reflect the external view at the IUT's functionality and are independent of the chosen implementation model. Below, the defined test groups are handled in detail.

For each of the handled test groups the correspondent test configuration is indicated. These test configurations are of generic nature. In practice, test configurations may be combined for study of local interworking between functional areas in an IUT. Example: Combined test exercises for message submission and local gateway functions.

4.3.1 Submission operations

Subject of the test group *Submission* operations is the origination of *IPMs* and *Probes* at AMHS user interfaces at the IUT and the related generation of *P1 information objects* for transfer to adjacent ATS Message Servers; returned *Reports* and *IPNs* have to be displayed at the IUT in an appropriate manner (see Figure 4).

Figure 6 depicts the test configuration for verification of the *Submission* operations. The test configuration follows from Figure 4 and Figure 5.

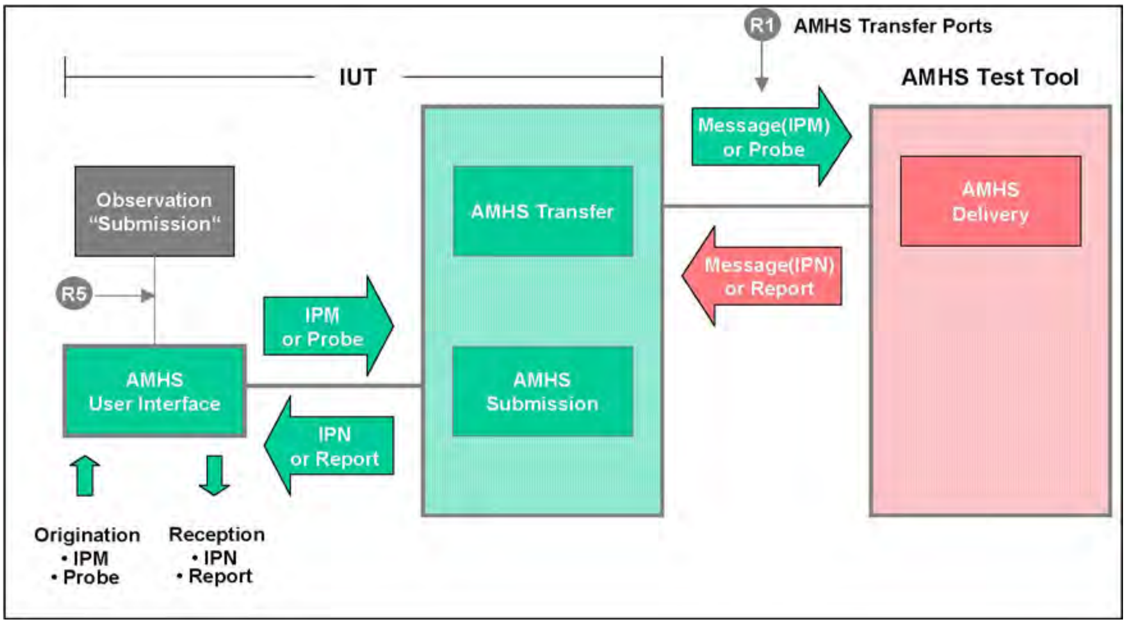


Figure 6: Test configuration "Submission"

For testing of the *Submission* operations the following actions may be performed:

- At an AMHS user interface of the IUT (reference point *R5* in Figure 6) predefined IPMs and Probes are originated for intended recipients. The AMHS Test Tool at the transfer ports of the IUT (*R1*) verifies the correct generation of the related Messages (IPMs) and Probes.

- In the opposite direction, the AMHS Test Tool responds at the transfer ports of the IUT (*R1*) with valid and invalid Messages containing IPNs (upon IPMs) and Reports (upon IPMs and Probes). The presentation of valid IPNs and Reports is observed at the originator's AMHS user interface (*R5*). Invalid responses may effect error notifications at an operator position of the IUT (fault management).

Note. – The local rejection of erroneous originations of IPMs and Probes at IUT's user interfaces is seen as a local implementation matter and is, therefore, out of the scope of conformance testing.

4.3.2 Transfer operations

Subject of the test group *Transfer* operations is the transfer of P1 information objects (i.e. Message, Report, Probe) by the IUT. Rejected transfers of messages and probes have to be indicated by returning of Non-Delivery Reports (NDR). The test group includes handling of multiple recipient addresses (multiple dissemination) and the expansion of Distribution Lists (DLs).

Figure 7 depicts the test configuration for verification of the *Transfer* operations. The test configuration follows from Figure 4 and Figure 5.

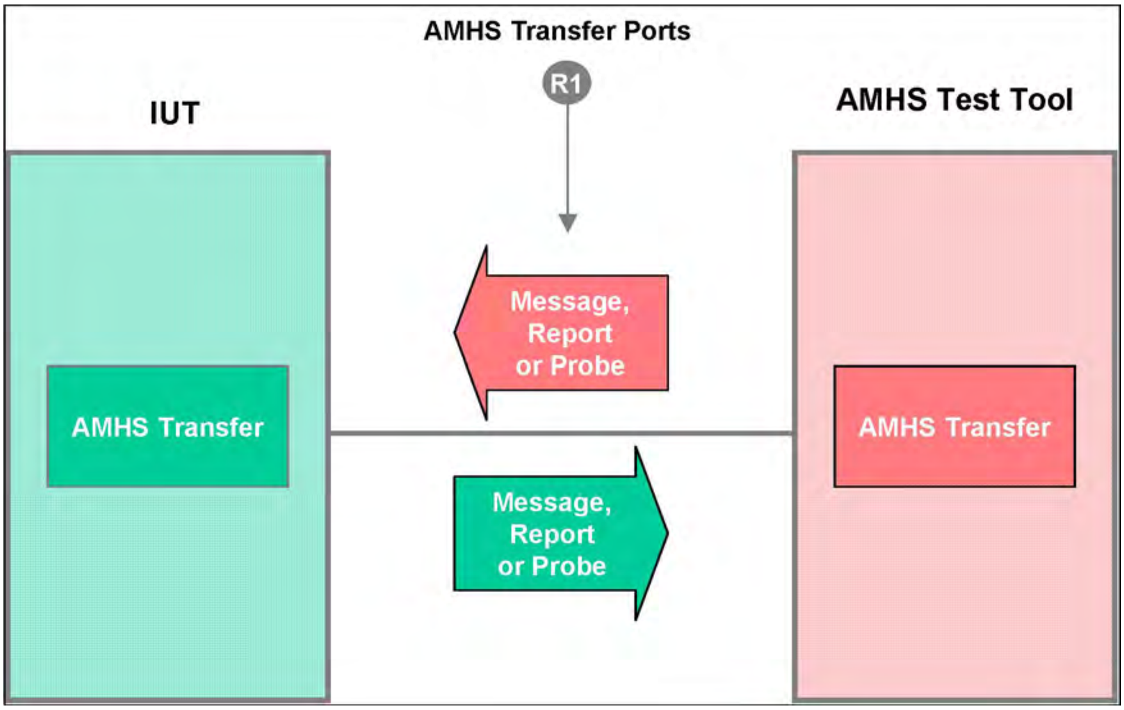


Figure 7: Test configuration "Transfer"

For testing of the *Transfer* operations the following actions may be performed:

- The AMHS Test Tool provides the IUT at its transfer ports (reference point *R1* in Figure 7) with valid and invalid Messages (containing IPMs or IPNs), Reports and Probes with recipient addresses which are *not* local to the IUT.

- The IUT responds at its transfer ports (*R1*) with the output of one or more Messages, (due multiple dissemination and/or DL resolution), one or more Probes (multiple dissemination) or just the received Reports. The AMHS Test Tool verifies the expected IUT behaviour. Invalid information objects generated by the AMHS Test Tool may effect error notifications at an operator position of the IUT (fault management).

4.3.3 Delivery operations

Subject of the test group *Delivery* operations is the display of received Messages (IPMs) at AMHS user interfaces of the IUT. In addition, the IUT shall generate Reports (DR, NDR) and/or IPNs (RN, NRN) according to the requests contained in the received Messages and Probes.

Figure 8 depicts the test configuration for verification of the *delivery* operations. The test configuration follows from Figure 4 and Figure 5.

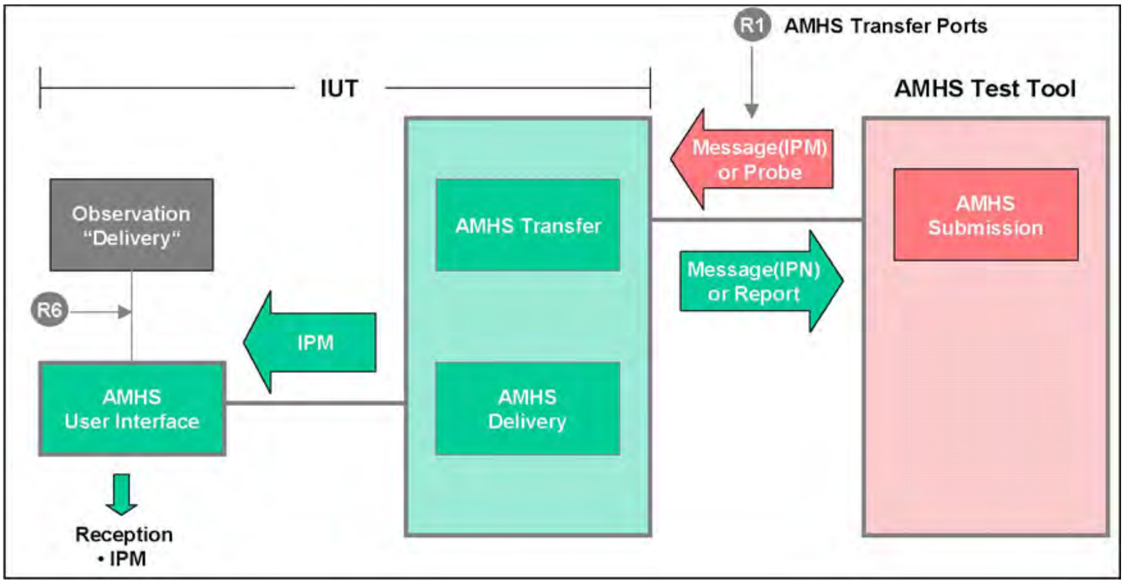


Figure 8: Test configuration "Delivery"

For testing of the *Delivery* operations the following actions may be performed:

- The AMHS Test Tool provides the IUT at its transfer ports (reference point *R1* in Figure 8) with valid and invalid Messages (containing IPMs) and Probes, both with recipient addresses which are local to the IUT.

- The IUT may respond with one or more of the following actions:

  - Display the received IPM at the appropriate AMHS user interface (*R6*),
  - Returning a Message (IPN) at its transfer Port (*R1*) according to the given *receipt notification request* in the subject IPM,
  - Returning a Report (DR or NDR) at its transfer ports (*R1*) according to the given *report request* in the subject Message or Probe.

4.3.4 Gateway operations

Subject of the test group *Gateway* operations is the bi-directional conversion between AMHS and AFTN user messages and the handling of accompanying service information, i.e. AFTN service messages (SVC), AFTN SS acknowledgements (SS ACK), AMHS Reports and AMHS Receipt Notifications. – Cf. AMHS SARPs [1] para. 3.1.2.3.2.1.4.
Considering the functional complexity of the AFTN/AMHS Gateway, the test group is logically subdivided in three sub-groups: 1) Flow of user message from AMHS to AFTN, 2) Flow of user message from AFTN to AMHS and 3) Handling of Probes. The sub-groups 1) and 2) include the handling of accompanying service information.

4.3.4.1 User Message from AMHS to AFTN

Figure 9 depicts the test configuration for verification of the *Gateway* operations for the flow of a user message from AMHS to AFTN. The test configuration follows from the Figure 4 and Figure 5.

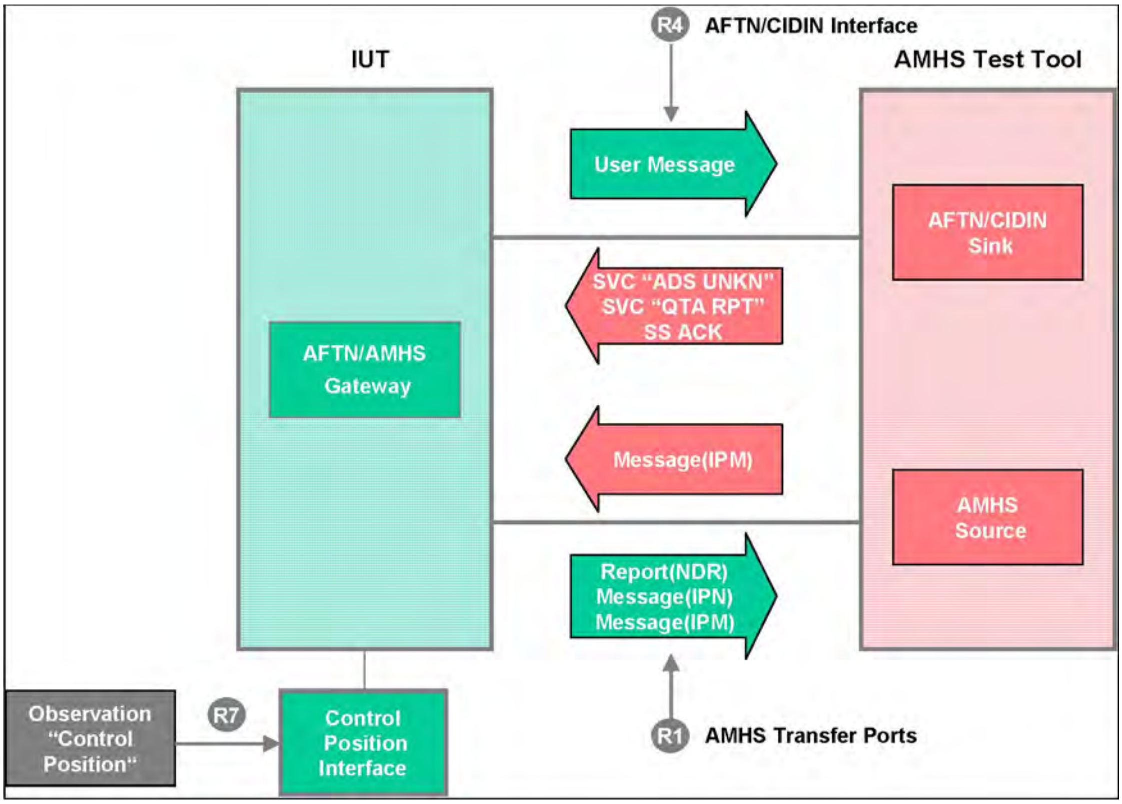


Figure 9: Test configuration "Gateway" – User message from AMHS to AFTN

The following actions may be performed with the Gateway test configuration depicted in Figure 9:

- The AMHS Test Tool provides the IUT at its transfer ports (reference point *R1* in Figure 9) with valid and invalid AMHS Messages containing IPMs. The IUT converts valid AMHS Messages in AFTN user messages which leave the IUT at its AFTN/X.25 interface (*R4*), invalid AMHS Messages are rejected by the IUT with Non-Delivery Reports (NDR) which are returned to the AMHS Test Tool using the IUT's transfer ports (*R1*).

- The AMHS Test Tool provides the IUT at its AFTN/X.25 interface (*R4*) with an AFTN SVC "ADS UNKNOWN" simulating the detection of an unknown destination address within the AFTN. The IUT converts the SVC "ADS UNKNOWN" in a Non-Delivery Report (NDR). In exceptional situation, the SVC "ADS UNKNOWN" is encapsulated by the IUT in an IPM. The NDR or IPM, respectively, is forwarded to the AMHS Test Tool via the IUT's transfer ports (*R1*).

- The AMHS Test Tool provides the IUT at its AFTN/X.25 interface (*R4*) with an SS ACK. The IUT converts the SS ACK in an IPN of the type Receipt Notification (RN). In exceptional situation, the SS ACK is encapsulated by the IUT in an IPM. The IPN or IPM, respectively, is forwarded to the AMHS Test Tool via the IUT's transfer ports (*R1*).

- The AMHS Test Tool provides the IUT at its AFTN/X.25 interface (*R4*) with an SVC "QTA RPT" requesting the repetition of an AFTN message sent before to a specified AFTN addressee. The IUT retransmits the respective AFTN message via its AFTN/AMHS interface (*R4*).

For certain out-of-line situations, which may occur during conversions in the AFTN/AMHS Gateway, the AMHS SARPs [1] specify error notifications to be forwarded to the gateway's Control Position. Such notifications have to be observed during test exercises at the reference point *R7* in Figure 9.

4.3.4.2 User message from AFTN to AMHS

Figure 10 depicts the test configuration for verification of the Gateway operations for the flow of a user message from AFTN to AMHS. The test configuration follows from Figure 4 and Figure 5.

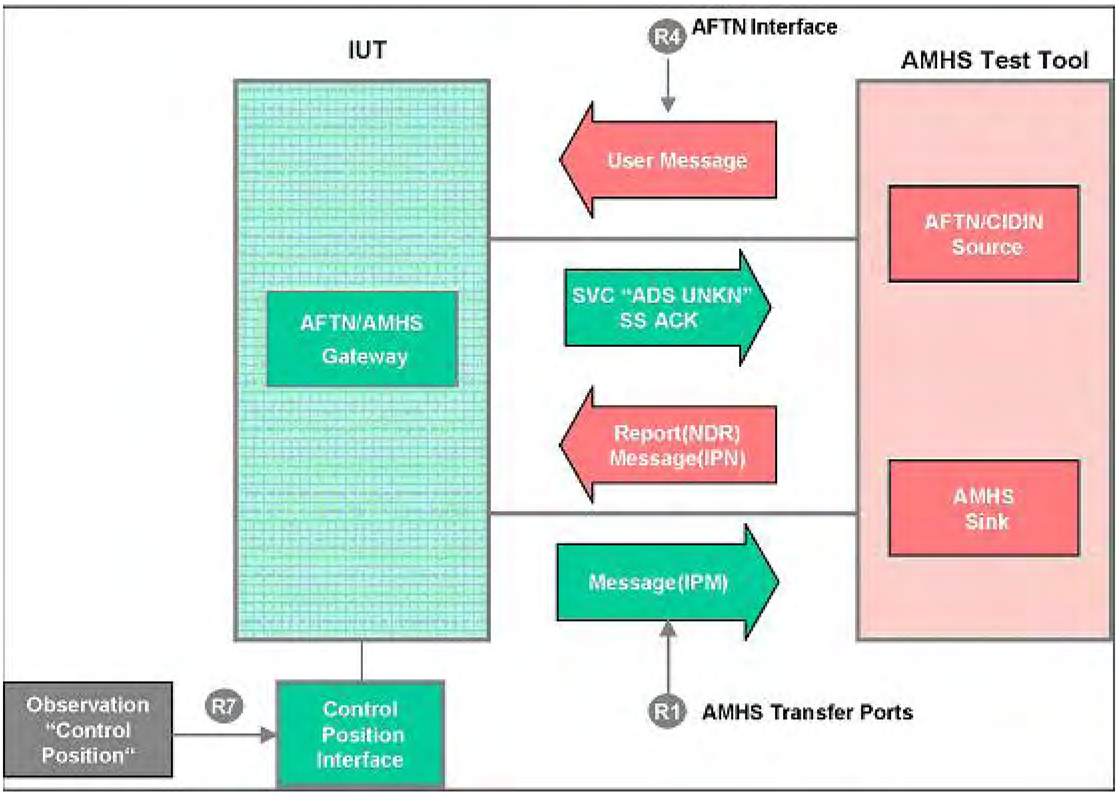


Figure 10: Test configuration "Gateway" – User message from AFTN to AMHS

The following actions may be performed with the Gateway test configuration depicted in Figure 10:

- The AMHS Test Tool provides the IUT at its AFTN/X.25 interface (reference point *R4* in Figure 10) with valid and invalid AFTN user messages. The IUT converts valid AFTN user messages in AMHS messages containing IPMs which leave the IUT at its transfer ports (*R1*), invalid AFTN user messages are handled according to locally implemented procedures. When the conversion of AFTN addressee indictors fails, the IUT returns AFTN service messages of the type SVC "ADS UNKNOWN" to the AFTN (AMHS Test Tool) via its AFTN/X.25 interface (R4).

- The AMHS Test Tool provides the IUT at its transfer ports (*R1*) with a Non-Delivery Report (NDR) simulating the detection of an unknown recipient address within the AMHS. The IUT converts the NDR in an AFTN service message of the type SVC "ADS UNKNOWN" which leaves the IUT via its AFTN/X.25 interface (*R4*).

- The AMHS Test Tool provides the IUT at its transfer ports (*R1*) with an AMHS message containing a Receipt Notification (RN) indicating the reception of a SS-priority message at a specified AMHS recipient. The IUT converts the RN in a SS ACK which leaves the IUT via its AFTN/X.25 interface (R4).

For certain out-of-line situations which may occur during conversions in the AFTN/AMHS Gateway, the AMHS SARPs [1] specify error notifications to be forwarded to the gateway's Control Position. Such notifications have to be observed during test exercises at the reference point *R7* in Figure 10.

4.3.4.3 Handling of Probes

Figure 11 depicts the test configuration for verification of the Gateway operations when receiving a Probe. The test configuration follows from Figure 4 and Figure 5.

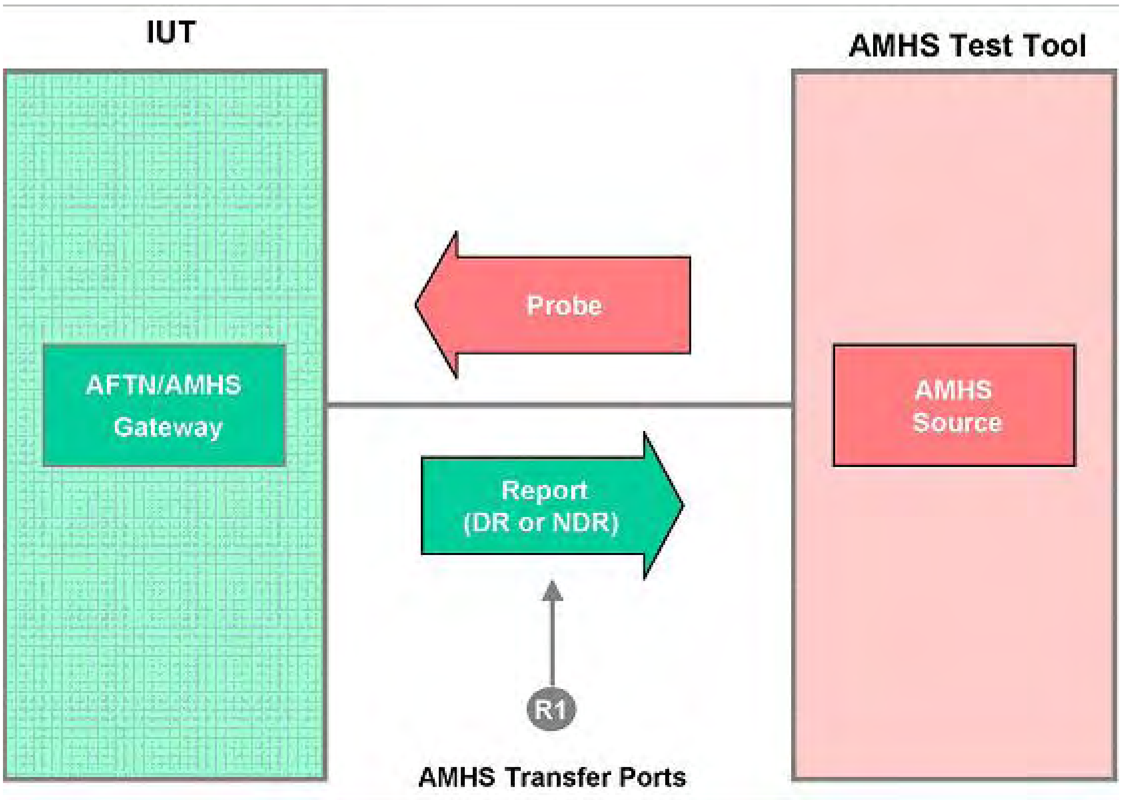


Figure 11: Test configuration "Gateway" – Handling of Probes

The following actions may be performed with the Gateway test configuration depicted in Figure 11:

- The AMHS Test Tool provides the IUT at its transfer ports (reference point *R1* in Figure 11) with valid and invalid Probes.

- The IUT verifies whether it could have effected translation in an AFTN user message by comparing certain parameters in the Probe with the capability of its gateway function. The IUT generates in dependence on the result of the verification either a Delivery Report (DR) or a Non-Delivery Report (NDR) which is returned to the AMHS Test Tool via a transfer port (R1).

4.3.5 Naming and addressing

Naming and addressing in the AMHS context relates to the unambiguously identification of 1) users to a global AMHS and 2) communication entities residing in the upper layers of the AMHS communication stack. Focus of conformance testing is the IUT's capability to handle AMHS addressing schemes for identification of users. The second aspect is covered by setting up of configuration parameters in the test configuration (see Section 5).

The AMHS SARPs specify two user addressing schemes which are collectively referred to as MF-addressing schemes: the *XF-addressing scheme* and the *Common AMHS Addressing Scheme (CAAS)*. Preference should be given to the latter. In addition, the SARPs allow to implement within an AMHS Management Domain *locally defined* schemes. The AMHS Test Tool supports the XF-addressing scheme and the CAAS. (Support of other addressing schemes may be subject of further extensions.)

The use of *directory names* is seen as a local matter when supporting the *Basic* ATS Message Handling Service (AMHS SARPs). Their support by the AMHS Test Tool may be subject of further extensions meeting the requirements of the *Extended* ATS Message Handling Service.

An IUT's capability to handle MF-addressing schemes is already implicitly verified with the operations related test groups as defined in Sections 4.3.1 to 4.3.4. However, for in-depth testing of implemented addressing features the establishment of a dedicated test group may be a suitable approach. Depending on the test purpose an appropriate test configuration may be selected from them depicted in Figure 6 to Figure 10.

Note. – The aspect of a dedicated test groups for in-depth testing of system level provisions applies also to the two remaining test groups defined below.

4.3.6 AMHS parameters

The AMHS SARPs [1] 3.1.2.2.3 specify a number of operational conventions which have the nature of parameters from the MHS point of view. These parameters relate to:

- Use of MF-addresses (see Section 4.3.5)
- User data conventions
    - Only single body part in IPMs
    - Ia-5 text body (Basic ATS Message Handling Service)
- Use of ATS-Message-Header in the body part of IPMs (Basic ATS Message Handling Service)
- Restriction of Notification Requests (IPMS) for SS-priority messages. In-depth testing of the AMHS parameters may be performed by means of a dedicated test group. Depending on the test purpose an appropriate test configuration may be selected from them depicted in Figure 6 to Figure 10.

4.3.7 Traffic logging

The AMHS SARPs specify long-term (30 days) logging requirements for the various types of functional components of the AMHS. The requirements make it possible to perform message tracing through the AMHS, in particular when an investigation is needed. The query of the logged information is seen as a local implementation detail.

Logging requirements are placed on the following functional components of the AMHS:

- ATS Message User Agent
- ATS Message Server
- AFTN/AMHS Gateway concerning its sub-components

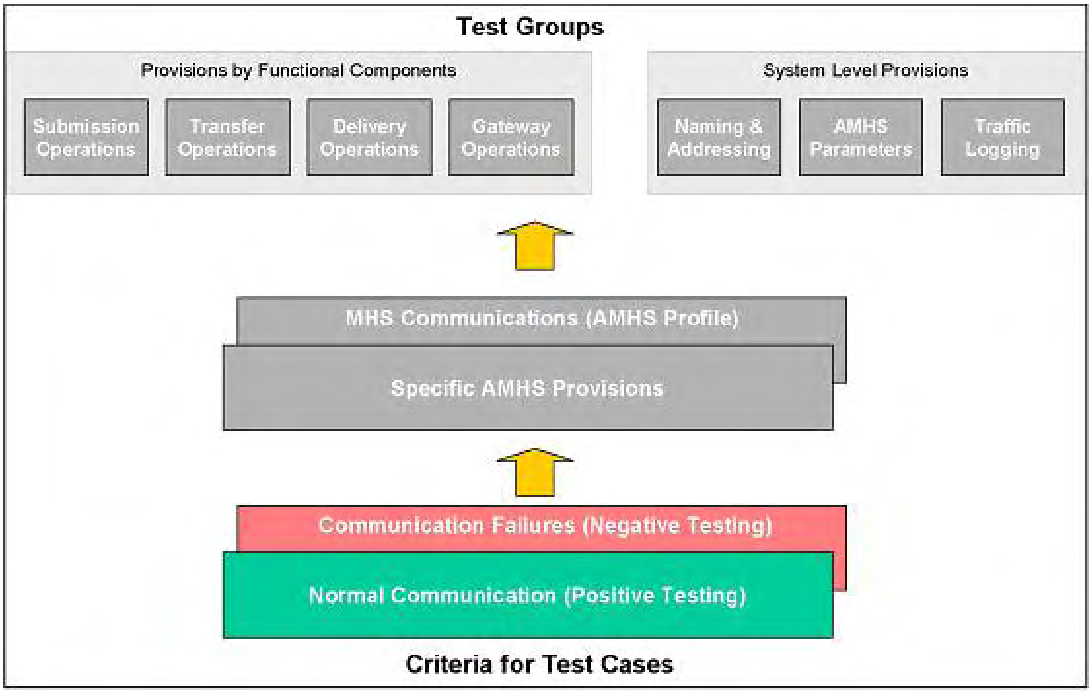
  - ATN component – [1] Section 3.1.2.3.2.2.6
  - Message Transfer and Control Unit (MTCU) – [1] Section 3.1.2.3.3.1
  - AFTN component – [1] Section 3.1.2.3.21.8-11.

In-depth testing of the traffic logging may be performed by means of a dedicated test group. Depending on the test purpose an appropriate test configuration may be selected from them depicted in Figure 6 to Figure 10. Verification of the logged information will make use of the local query and tracing provisions. Access is typically provided at the system management interface of the IUT (cf. reference point *R8* in Figure 5).

4.4 Definition of test cases

According to ISO 9646-2 a *test case* comprises the actions to achieve a specific test purpose. Each test case normally has a single test purpose, such as that of verifying that the IUT has a certain required capability (e.g. the capability to support certain message lengths) or exhibits a certain required behaviour when a particular event occurs (e.g. transfer of submitted messages). Typically, a set of test cases aiming at a common functional area of an IUT are arranged to a *test group* (see Section 4.3).

There may be many criteria for methodical definitions of test cases (within a test group) to achieve an envisaged confidence in a particular functional area of the IUT. Figure 12 depicts proposed two levels of high-order criteria for definitions of AMHS related test cases. The AMHS Test Tool should support conformance testing in a scope as outlined in Figure 12.



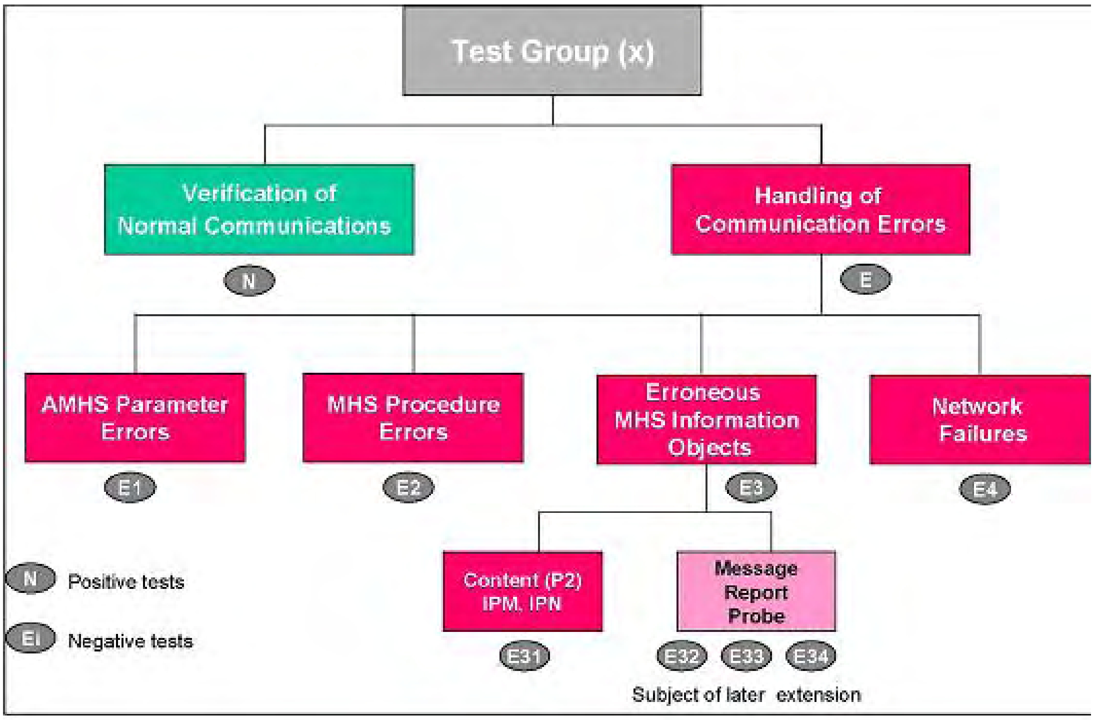
Fi
gure 12 : Approach for definition of Test Cases

In Figure 12 a distinction is made between communication requirements which are of general nature in MHS environments and such which are specific to AMHS. The first category of requirements is addressed in the AMHS SARPs just by references to the MHS standard (ISO/IEC 10021) and related profile documentation (ISPs). No further details of MHS procedures are provided with the AMHS SARPs .

In addition, the AMHS SARPs include a number of provisions which are specific for AMHS. Such provisions may relate to supplementary functional components (as AMHS gateways) or specify conventions for which MHS implementations are transparent (e.g. limited use of notification requests). The AMHS SARPs specify the AMHS specific provisions in a “standalone” manner.

Note. – An example of the above made distinction between specific AMHS requirements and underlying MHS features are the AMHS traffic logging requirements: The traffic logging requirements at an ATS Message Server refer to the last element of the trace-information (AMHS SARPs). The trace-information itself (forming part of the message-transfer-envelope) is specified in ISO/IEC 10021-4, 12.3.1. – It is up to the organisation which will operate an AMHS system to limit conformance testing to the SARPs specific elements or to extend testing to the referenced trace-information as defined with the MHS standard.

As second level criteria for definition of test cases a distinction is made between normal MHS/AMHS communications (*positive* testing) and enforcing fault situations (*negative* testing). Figure 13 details this further logical ordering of testing.



Fi

gure 13: Classes of "Negative Tests"

The test categories indicated in Figure 13 are based on the following definitions:

Normal communications (N). – The AMHS Test Tool provides the IUT with correct inputs and the related responses (behaviour) of the IUT should be in compliance with the AMHS SARPs. It should be noted that a correct response of the IUT not always equals to a successful transmission of an AMHS information object. Example: If the service element *DL-expansion-prohibited* has been set then a DL expansion will not occur.

Erroneous AMHS parameters (E1). – The AMHS SARPs, Parameters, specify a number of specific AMHS conventions as use of MF-addresses, ATS-Message-Header, notification requests and single body part IPMs. It should be noted that violations of such AMHS conventions are not equal with faults in the MHS communication.

MHS procedural errors (E2). – The AMHS Test Tool does not act in compliance with the MHS procedures or the arrangements made in the test configuration. Examples:

1) The IUT is requested to send a message with a Report request, however, the AMHS Test Tool does not return any Report.
2) 2) The AMHS Test Tool uses a recipient address which is unknown in the test configuration.

Erroneous MHS information objects (E3). – That means arguments have not allowed values or information objects are corrupted. A distinction is made between the levels of IPMS and MTS:

- IPMS (E31). – IPMs and IPNs sent to the IUT are not correctly encoded (syntax or semantic errors). Example: Mandatory arguments in the IPM heading are missing or there is no IPM body attached to the IPM heading.

- MTS (E32), (E33), (E34). – Messages, Reports and Probes sent to the IUT are not correctly encoded. Example: In a Report the *Report Transfer Content* is missing.

Network failures (E4). – Transient interruptions of network connections during transmission of AMHS information objects. The AMHS Test Tool supports negative testing of the categories E1, E2 and E31 and E4 (Figure 13).

Note. – Negative testing of the categories E32, E33 and E34 may be subject of further extensions of the testing requirements if experience leads to this need.

A given test group may be transparent for one or more classes of “negative tests”. For example, transfer operations are transparent for AMHS parameter errors (E1) and Content (IPMS) failures (E31). Table 3 indicates in a form of a matrix the valid interrelations between defined test groups and classes of negative tests. Such a testing matrix may be helpful to demonstrate the reached coverage of testing for a given set of test cases.

	Submission Ops	**Transfer Ops**	**Delivery Ops**	**Gateway Ops**	**Naming & Addressing**	**AMHS Parameters**	**Traffic Logging**
N	X	X	X	X	X	X	X
E1	X	n/a	X	X	X	X	n/a
E2	X	X	X	X	n/a	n/a	n/a
E31	X	n/a	X	X	n/a	n/a	n/a
E32-E34	X	X	X	X	n/a	n/a	n/a
E4	X	X	X	X	n/a	n/a	n/a

X = valid interrelation; n/a = not applicable

Table 3: Applicability of negative testing for test groups (testing matrix)

5 Configuration Parameters

5.1 The generic test configuration depicted in Figure 5 needs a number of quantitative adjustments before AMHS Test Tool and IUT are in a position to communicate with each other. The subjects of such adjustments are the values of *configuration parameters* which are inherent in the test configuration. Configuration parameters relate to the number of established communication links, number of simulated AMHS and AFTN users as well as to addresses associated with the various layers of communications. Below the configuration parameters are specified in the categories of AMHS and X.25/AFTN communications.

5.2 AMHS communication

5.3

5.3.1 AMHS application

- Number of transfer ports: 3
- Number of AMHS users: 30

Reference: Section 3.2, Figure 2 and Figure 3.

5.4 Layer addresses

No.	Address Type	AMHS SARPs	Value	
			IUT	AMHS Test Tool
1	Application Process Title	3.1.2.1.5.2.1 4.3.2.2		
2	AE-Qualifier	3.1.2.1.5.2.2	ATS Message Server: AMS(7) AFTN/AMHS Gateway: GWB(8)	
3	Presentation Selector	3.1.2.1.5.2.3	tbd	tbd
4	Session Selector	3.1.2.1.5.2.3	tbd	tbd
5	TSAP	3.1.2.1.5.2.3	tbd	tbd
6	TCP Port	n/a	102	
7	IP Address	n/a	tbd	MTA(1): tbd MTA(2): tbd

No.	Address Type	AMHS SARPs	Value	
			IUT	AMHS Test Tool
				MTA(3): tbd
8	MAC Address	n/a	tbd	MTA(1): tbd MTA(2): tbd MTA(3): tbd

Reference: Sections 3.3 and 3.5.1.1.

Table 4: Layer addresses (AMHS communications) AFTN/X.25 communication

5.4.1 AFTN application

- Number of links: 1
- Number of AFTN users: 30

Reference: Section 3.2, Figure 2 and Figure 3.

5.5 Layer addresses

No.	Address Type	Reference	Value	
			IUT	AMHS Test Tool
1	X.25 Entry (Ae)	[3] 6.1.2.1.4.5	*tbd*	*tbd*
	X.25 Exit (Ax)	[3] 5.1.2.7	*tbd*	*tbd*
2	X.25 DTE	[3] 4.2.1.7	*tbd*	*tbd*

Reference: Sections 3.4 and 3.5.1.2.

Table 5: Layer addresses (X.25 communications)

5.6 Test Data

The test data generated and evaluated in conformance testing environments with the AMHS Test Tool comprise (cf. Figure 5):

(1) AMHS and AFTN information objects exchanged between the AMHS Test Tool and IUT. These information objects are well defined by the AMHS SARPs and Annex 10, Vol. II [2], respectively.

(2) AMHS information objects entered and presented at AMHS user interfaces of the IUT. Even if these information objects are substantially specified by the AMHS SARPs their appearance at AMHS user interfaces is specific to a given IUT. In addition, when entering AMHS information objects certain parameters may be handled by the IUT as defaults and do not appear at user interfaces at all.

(3) The AMHS SARPs specify events to be reported to the Control Position of an AFTN/AMHS Gateway. However, the style of reporting is an implementation matter.

(4) Traffic log data to be maintained by the IUT are specified in the AMHS SARPs , however, their handling and presentation is specific for each IUT.

Note :
The correct interpretation of test data of the types (2) to (4) needs insight into the IUT's User Manual.

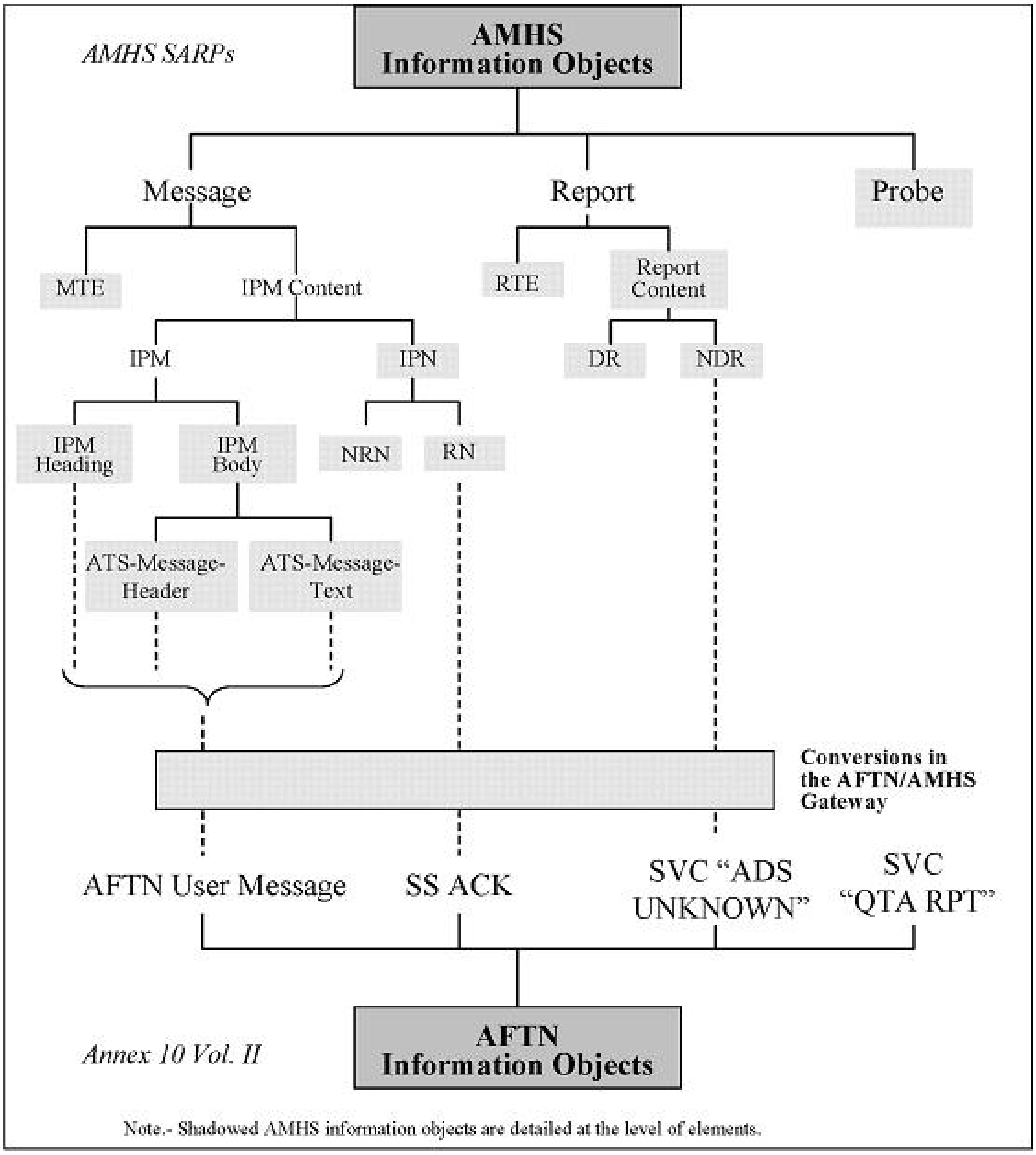


Figure 14: Information objects supported by the AMHS Test Tool

6 Recommended default values for international MTA names and passwords

6.1 Introduction

6.1.1 AMHS implementation requires the setting of the MTA names and passwords for each communication partner (MTA) connected. In a future fully meshed AMHS Network, unique identification of the MTAs would be required. Additionally, the naming should respect the knowledge and experiences of the operator staff, in order to avoid any unnecessary complications in the transition to AMHS.

6.1.2 One way to achieve this is to use a scheme, in which MTA names and passwords contain keywords which uniquely identify the MTA and facilitate recognition.

6.2 Default values for international MTA names

6.2.1 The recommended scheme of MTA names consists of:

- the term "MTA"
- the Location Indicator of the MTA location and
- a number (for future extensions if required)

6.2.2 All items are separated by a hyphen (hexadecimal 2D). The result is a printable string which can be exchanged in a message without difficulties.

Example: In accordance with this scheme the name of the MTA in Singapore, should be: MTA-WSSS -1.

6.2.3 This scheme could be used for the national MTA naming as well.

6.3 Default values for international MTA passwords

6.3.1 Password complications arise because manufacturers deviate in the interpretation of an "empty" password. Some implementations await "nothing", some hexadecimal 00, others a single "space" character. To avoid misinterpretations during establishment of association(s) all tests could be performed with a common (known) password. Individual secure passwords could be established later, in order to ensure the necessary security of operational AMHS facilities.

6.3.2 The recommended scheme of the default password consists of:

- the term "ICAO"
- the Location Indicator of the MTA location and
- the specific number of the MTA

6.3.3 All items are separated by a hyphen (hexadecimal 2D). The result is a printable string which can be exchanged in a message without difficulties.

Example: In accordance with this scheme the default password of the MTA in Singapore should be: ICAO-WSSS-1.

6.3.4 By following this scheme, the default passwords of future MTAs can be determined at any time. If there are no other security requirements such a scheme can simplify the integration of new MTAs in a fully meshed AMHS Network topology.

END

TABLE CNS -1E

**ATS INTER-FACILITY DATA COMMUNICATION (AIDC)
IMPLEMENTATION PLAN**

Explanation of the Table

Column

1 State/Administration – the name of the State/Administration;

2 Location of AIDC end system – the location of the AIDC end system under the supervision of State/Administration identified in column 1;

3 AIDC Pair – the correspondent AIDC end system;

Location – location of the correspondent AIDC end system

State/Administration – the name of the State/Administration responsible for management of the correspondent AIDC end system

4 AIDC standard used – the AIDC standard adopted for the AIDC connection between the corresponding AIDC pair, AFTN, AFTN/AMHS or ATN;

5 Target Date of Implementation – date of implementation of the AIDC end system;

6 Remarks – any additional information describing the AIDC end system or the AIDC service between the corresponding AIDC pair.

TABLE CNS-1E
ATS INTERFACILITY DATA COMMUNICATION (AIDC) ROUTING PLAN

State/Administration	Location of AIDC end system	AIDC Pair		AIDC standard used	Target date of Implementation	Remarks
		Correspondent location	Correspondent State/Administration			
1	2	3		4	5	6
AUSTRALIA	Brisbane ACC	Oakland ARTCC	USA	AFTN	Implemented	ICD V.1.0
				AFTN/AMHS	2008	
		Auckland ACC	New Zealand	AFTN	Implemented	ICD V.1.0
				AFTN/AMHS	2008-2009	
		Melbourne	Australia	AFTN	Implemented	ICD V.1.0
				AFTN/AMHS	2007	
		Makassar ACC	Indonesia	AFTN	2010	ICD V.1.0
				AFTN/AMHS	TBD	
		Nadi ACC	Fiji	AFTN	Implemented	ICD V.1.0
				AFTN/AMHS	2008	
	Melbourne ACC	Brisbane ACC	Australia	AFTN	Implemented	ICD V.1.0
				AFTN/AMHS	2007	
		Jakarta ACC	Indonesia	AFTN	2010	ICD V.1.0
				AFTN/AMHS	TBD	
		Mauritius ACC	Mauritius	AFTN	Implemented	ICD V.1.0
				AFTN/AMHS		
BANGLADESH	Dhaka ACC	Kolkata ACC	India	AFTN	2008	
		Yangon ACC	Myanmar	AFTN	2008	Subject to concurrence with Myanmar
BHUTAN						
BRUNEI DARUSSALAM			Not Required			
CAMBODIA	Phnom Penh ACC	Bangkok ACC	Thailand	AFTN	2010	
CHINA	Beijing ACC	Incheon ACC	Republic of Korea	AFTN	2008	
	Sanya ACC	Hong Kong ACC	Hong Kong, China	AFTN	Implemented	
		Ho Chi Minh ACC	Vietnam	AFTN	2007	
	Guangzhou ACC	Hong Kong ACC	Hong Kong, China	AFTN	2008	
	Taibei ACC	Hong Kong ACC	China	TBD	2012	

TABLE CNS-1E
ATS INTERFACILITY DATA COMMUNICATION (AIDC) ROUTING PLAN

State/Administration	Location of AIDC end system	AIDC Pair		AIDC standard used	Target date of Implementation	Remarks
		Correspondent location	Correspondent State/Administration			
1	2	3		4	5	6
HONG KONG, CHINA	Hong Kong ACC	Guangzhou ACC	China	AFTN	2008	
		Sanya ACC	China	AFTN	Implemented	
		Manila ACC	Philippines	AMHS	2008	
		Taibei ACC	China	TBD	2012	
MACAO, CHINA						
COOK ISLANDS						
DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA						
FIJI	Nadi ACC	Auckland ACC	New Zealand	AFTN	Implemented	ICD V.1.0
				AFTN/AMHS	2008	
		Brisbane ACC	Australia	AFTN	Implemented	ICD V. 1.0
				AFTN/AMHS	2008	
		Oakland ARTCC	USA	AFTN	Implemented	ICD V.1.0
				AFTN/AMHS	2008	
FRANCE						
FRENCH POLYNESIA	Papeete ACC	Auckland ACC	New Zealand	AFTN	Implemented	ICD V. 2.0
NEW CALEDONIA						
INDIA	Kolkata ACC	Dhaka ACC	Bangladesh	AFTN	2008	
	Mumbai ACC	Karachi ACC	Pakistan	AFTN	2007	Subject to co-ordination between Administrations
				AFTN/AMHS	2008	

TABLE CNS-1E
ATS INTERFACILITY DATA COMMUNICATION (AIDC) ROUTING PLAN

State/Administration	Location of AIDC end system	AIDC Pair		AIDC standard used	Target date of Implementation	Remarks
		Correspondent location	Correspondent State/Administration			
1	2	3		4	5	6
INDONESIA	Jakarta ACC	Melbourne	Australia	AFTN/AMHS	TBD	
	Makassar ACC	Brisbane ACC	Australia	AFTN	2008	ICD V.1.0
				AFTN/AMHS	TBD	
JAPAN	Fukuoka ATMC	Anchorage ACC	USA	AFTN	Implemented	ICD V.1.0
		Incheon ACC	Republic of Korea	AFTN	2008	
		Oakland ARTCC	USA	AFTN	Implemented	
KIRIBATI						
LAO PEOPLE'S DEMOCRATIC REPUBLIC	Vientiane ACC	Bangkok ACC	Thailand	AFTN	2010	
MALAYSIA	Kuala Lumpur ACC	Bangkok ACC	Thailand	AFTN	2010	TBD
MALDIVES	Male ACC	Colombo ACC	Sri Lanka	AFTN	2008	
MARSHALL ISLANDS						
MICRONESIA (FEDERATED STATE OF)						
MONGOLIA						
MYANMAR	Yangon ACC	Bangkok ACC	Thailand	AFTN	2010	ICD V.1.0
		Dhaka ACC	Bangladesh	AFTN	2008	
NAURU	Brisbane ACC	Oakland ARTCC	USA	AFTN	Implemented	ICD V.1.0
				AFTN/AMHS	TBD	
		Nadi ACC	Fiji	AFTN	Implemented	ICD V.1.0
				AFTN/AMHS	2008	

TABLE CNS-1E
ATS INTERFACILITY DATA COMMUNICATION (AIDC) ROUTING PLAN

State/Administration	Location of AIDC end system	AIDC Pair		AIDC standard used	Target date of Implementation	Remarks
		Correspondent location	Correspondent State/Administration			
1	2	3		4	5	6
NEW ZEALAND	Auckland ACC	Brisbane ACC	Australia	AFTN	Implemented	ICD V.1.0
				AFTN/AMHS	2008/2009	
		Nadi ACC	Fiji	AFTN	Implemented	ICD V.1.0
				AFTN/AMHS	2008/2009	
		Oaekland ARTCC	USA	AFTN	Implemented	ICD V.1.0
				AFTN/AMHS	2008/2009	
		Papeete ACC	French Polynesia	AFTN	Implemented	ICD V.1.0
				AFTN/AMHS	2008/2009	
PAKISTAN	Karachi	Kuwait	Kuwait	AFTN	2008	Subject to concurrence of Kuwait
				AFTN/AMHS	TBD	
		Mumbai	India	AFTN	2007	
				AFTN/AMHS	2008	
PALAU						
PAPUA NEW GUINEA						
PHILIPPINES	Manila ACC	Hong Kong ACC	Hong Kong, China	AMHS	2008	
		Singapore ACC	Singapore	AMHS	2011	
		Taibei	Taibei, China	AMHS	2011	
		Makassar A CC	Indonesia	TBD	2011	
		Ho Chi Minh ACC	Viet Nam	TBD	2011	
		Fukuoka ATMC	Japan	AMHS	2011	
		Oakland ARTCC	USA	TBD	2011	
REPUBLIC OF KOREA	Incheon ACC	Fukoka ATMC	Japan	AFTN	2008	
		Beijing	China	AFTN	2008	

TABLE CNS-1E
ATS INTERFACILITY DATA COMMUNICATION (AIDC) ROUTING PLAN

State/Administration	Location of AIDC end system	AIDC Pair		AIDC standard used	Target date of Implementation	Remarks
		Correspondent location	Correspondent State/Administration			
1	2	3		4	5	6
SAMOA						
SINGAPORE						ATN AIDC 2009/2010
SOLOM ISLANDS						
SRI LANKA	Colombo ACC	Male ACC	Maldives	AFTN	2008	
TIMOR LASTE						
THAILAND	Bangkok ACC	Hochiminh ACC	Viet Nam	AFTN	2010	
		Kuala Lumpur ACC	Malaysia	AFTN	2010	
		Phnom Penh ACC	Cambodia	AFTN	2010	
		Vientiane ACC	Lao PDR	AFTN	2010	
		Yangon ACC	Myanmar	AFTN	2010	
TONGA						
UNITED STATES	Oakland ARTCC	Auckland ACC	New Zealand	AFTN	Implemented	ICD V.2.0
		Fukuoka ATMC	Japan	AFTN	Implemented	ICD V.1.0
		Nadi ACC	Fiji	AFTN	Implemented	ICD V.1.0
		Brisbane ACC	Australia	AFTN	Implemented	ICD V.1.0
	Anchorage ARTCC	Fukuoka ATMC	Japan	AFTN	Implemented	ICD V.1.0
		Sanya ACC	China	AFTN	2007	
				AFTN/AMHS	2008-2009	

TABLE CNS-1E
ATS INTERFACILITY DATA COMMUNICATION (AIDC) ROUTING PLAN

State/Administration	Location of AIDC end system	AIDC Pair		AIDC standard used	Target date of Implementation	Remarks
		Correspondent location	Correspondent State/Administration			
1	2	3		4	5	6
VIET NAM	Ho Chi Minh ACC	Pnom Penh ACC	Cambodia	AFTN/AMHS	2008	Subject to Concurrence from Cambodia
		Vientiane ACC	Lao PDR	AFTN/AMHS	2008	Subject to Concurrence from Lao PDR
VIETNAM	Ho Chi Minh ACC	Singapore ACC	Singapore	AFTN/AMHS	2008-2009	Subject to concurrence from Singapore
		Manila	Philippines	TBD	2011	Subject to concurrence from Philippines
		Bangkok ACC	Thailand	AFTN	2010	

Amendment to

Asia/Pacific Regional

INTERFACE CONTROL DOCUMENT (ICD)

FOR

ATS Message Handling System (AMHS)

Version ~~1.0~~2.0

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DOCUMENT CONTROL LOG

Version	Revised contents	Date
1.0	Version 1.0 as endorsed by the APANPIRG/13	13 September 2002
2.0		

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2. AMHS Specifications

   2.1 Guidance for Optional Parameters
   2.2 AMHS Specifications
   2.3 Upper Layer Specifications
   2.4 Lower Layer Specifications

Appendix: PICS of AMHS

<References>

1) ICAO Doc 9705/AN-956, "MANUAL OF TECHNICAL PROVISIONS FOR THE AERONAUTICAL TELECOMMUNICATION NETWORK (ATN)", SECOND EDITION (Effective 10 December 1999)
   a) Sub-Volume I : 1.1 "DEFINITIONS AND REFERENCES"
   b) Sub-Volume III : 3.1 "ATS Message Handling Services (ATSMHS)
   c) Sub-Volume V : "Internet Communication Service"

2) ICAO Doc 9739/AN-961 Comprehensive ATN Manual (Edition 1)

3) ICAO Annex 10, Vol. II, Fifth edition (July 1995)

NOTE 1: This ICD does not include the additional features such as CIDIN/AMHS Gateway, Security and Directory Service which are added in ICAO Doc 9705/AN-965, THIRD EDITION. This ICD may be enhanced to include such additional features in the future.

NOTE 2: This ICD includes supporting CAAS

1. Guidance for AMHS specification

1.1 Introduction

1.1.1 This document is the Interface Control Document (ICD) based on which the AMHS is to be implemented in the Asia/Pacific Region. It is essential that the implementation of the AMHS be fully compliant with ICAO ATN SARPs (Doc9705) as well as this ICD, in order to preserve interoperability between States and ensure that future ATN applications are accommodated. To assist the reader, the following clauses serve as an overview of the AMHS and its underlying network protocols.

1.2 AMHS Functions

1.2.1 The AMHS defines two End Systems, these being an AFTN/AMHS Gateway and an ATS Message Server (with ATS Message User Agent). It is expected that early implementations of AMHS will require the use of an AFTN/AMHS Gateway as during the transitional process to full AMHS AFTN may need to operate concurrently with AMHS either within or between outside States. However, it is also possible to replace AFTN with ATS Message Server (with User Agent) all at once, in this situation there will be no need for AFTN/AMHS Gateways as AFTN will not be required to coexist with AMHS.

NOTE: ATN Pass-Through Service (AFTN/ATN Type A Gateway) should not be implemented since it cannot be connected with AFTN/AMHS Gateway nor ATS Message Server. The description concerning the ATN Pass-Through Service has been deleted in the Third Edition of ICAO ATN SARPs. In addition, CIDIN/AMHS Gateway has been added as a new End System of AMHS in the Third Edition SARPs.

1.2.2 Even in the case that all the AFTN connections within States (i.e. domestic communication) are replaced with X.400 (MHS and NOT AMHS) connections, the connections outside State (i.e. international communication using ATN Routers) are to be complied with ICAO ATN SARPs and this ICD. When the domestic communication is implemented prior to the international communication, the domestic MHS Server may be so modified as to comply with ATN.

1.3 Network Configuration

1.3.1 The network configuration will grow according to the level of implementation of AMHS. The followings are the typical phases of AMHS implementation. The network configuration of each phase is shown in Figure 1.

1) Phase-1
AFTN connections are currently used for both all the domestic communication within State and all the international communication with other States.

2) Phase-2
AFTN/AMHS Gateways and ATN Routers are implemented for the international communication between at least two States.

3) Phase-3
Domestic AFTN connections are replaced with AMHS connections within State. AFTN/AMHS Gateway is enhanced to ATS Message Server. However, AFTN/AMHS Gateway System/Function remains for the AFTN connections (like State C in Figure). There may be AMHS-AMHS direct international communication (via ATN Routers) with the other States.

NOTE: It is a local matter whether to implement ATS Message Server and AFTN/AMHS Gateway in separated computer systems or in one computer system.

4) Phase-4
All the States in the Region implement either ATS Message Server or AFTN/AMHS Gateway and all the international communications are done by AMHS. There may be AMHS-AMHS direct international communication (via ATN Routers) with the other States.

5) Phase-5
AMHS connections are fully applied to both the domestic communication within States and the international communication with all the neighbor States.

6) Phase-6
Full ATN connection is applied within the Region. All the data of ATN applications including AMHS are exchanged through ATN Routers.

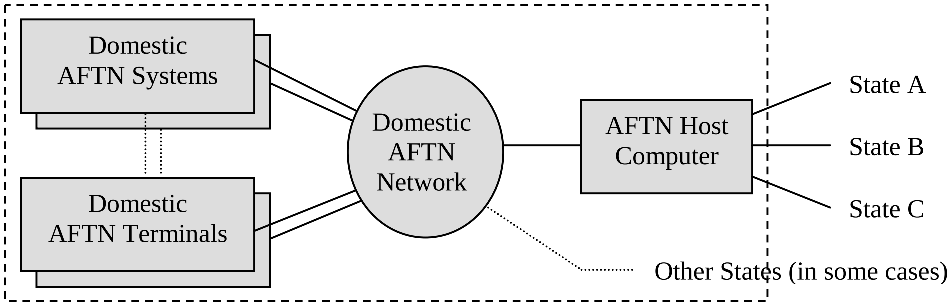
1.3.2 The systems in Figure 1 are as follows;

AMHS Gateway : AFTN/AMHS Gateway

AMHS Server : ATS Message Server (enhanced from AFTN/AMHS Gateway)

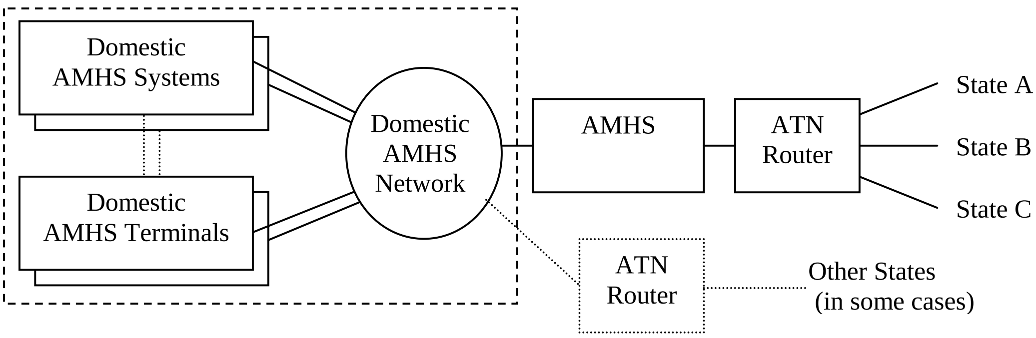
End Systems of ATN Applications
: End Systems of ATN applications including Air/Ground applications such as CM (Context Management), ADS (Automatic Dependent Surveillance), CPDLC (Controller and Pilot Data Link Communication) or FIS (Flight Information Service), whose ground to ground data is forwarded through the same ground network using ATN routers. The system may consist of computer(s) and/or equipment for ATN application for communication, ATM application, Human Machine Interface and maintenance.

AFTN System : AFTN host computer, domestic AFTN network and distributed AFTN systems/terminals (as shown below for an example)

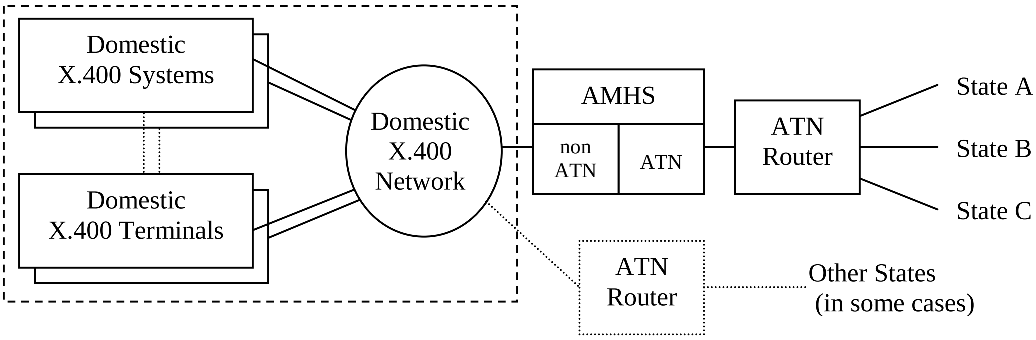


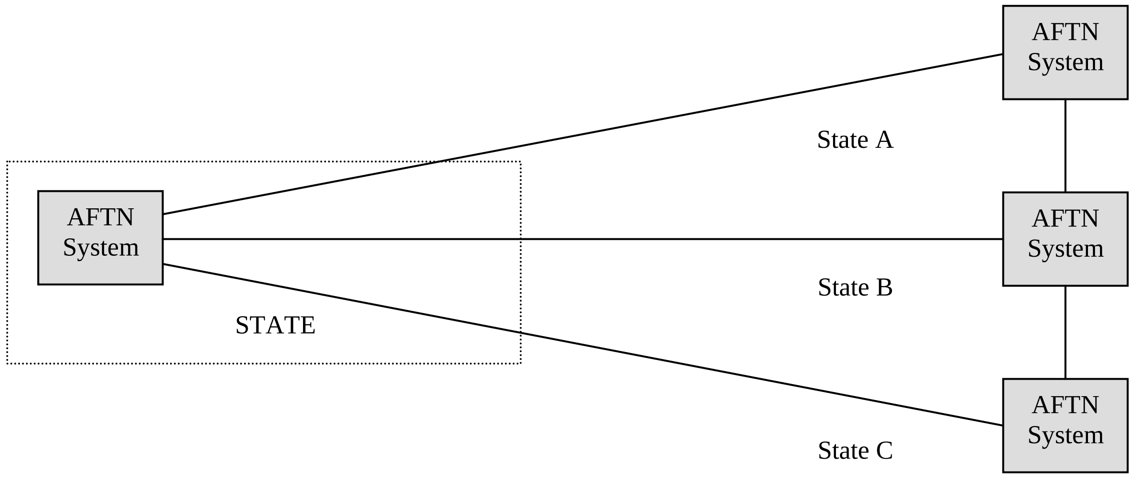
AMHS System : domestic AMHS (or X.400 MHS) network, distributed AMHS (or X.400 MHS) systems/terminals (User Agents) and AMHS (or X.400 MHS) local servers if necessary (as shown below for an example)

<u>AMHS domestic connections</u>

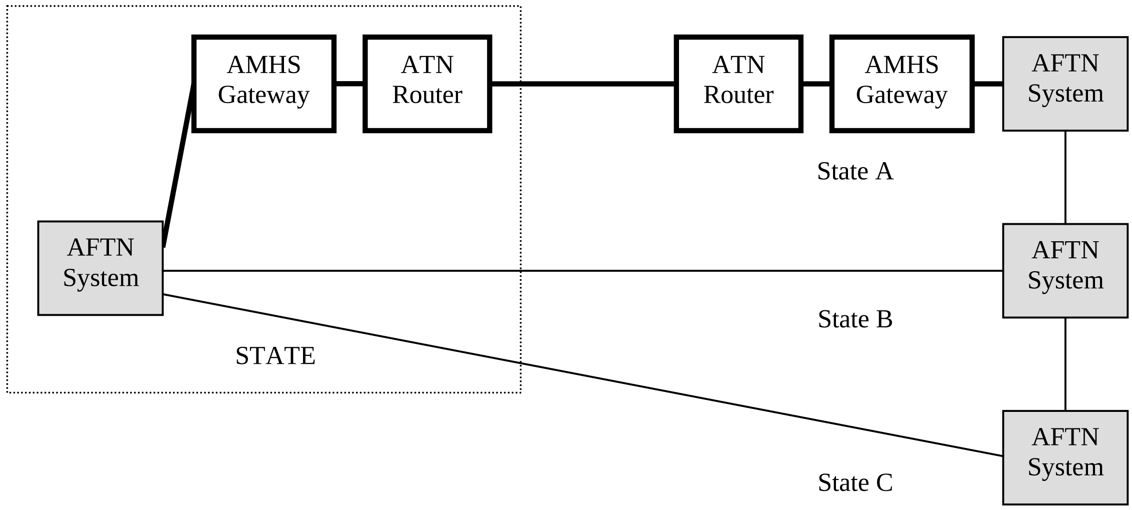


<u>X.400 MHS domestic connections</u>



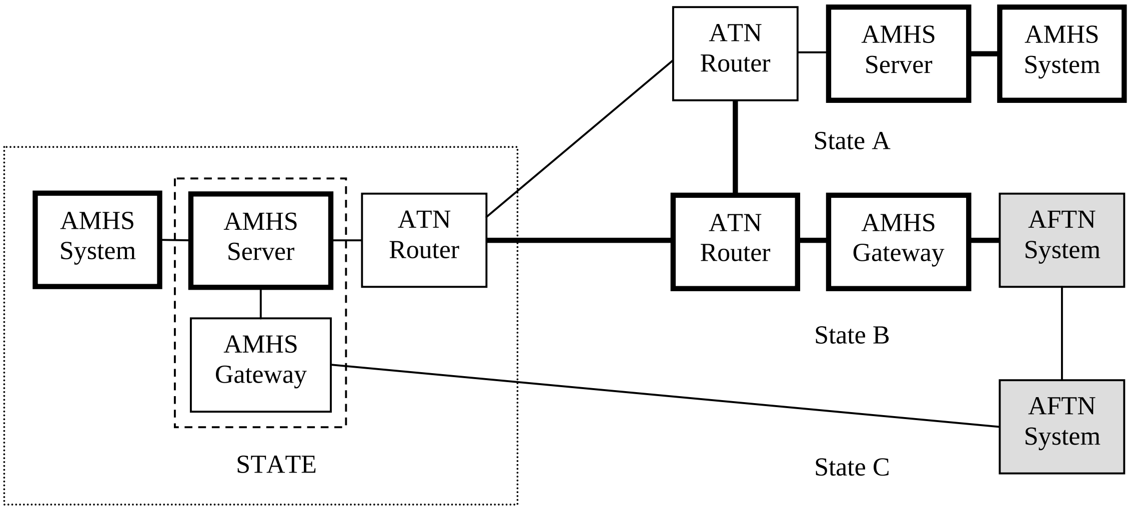


(1) Phase-1
Current AFTN connections

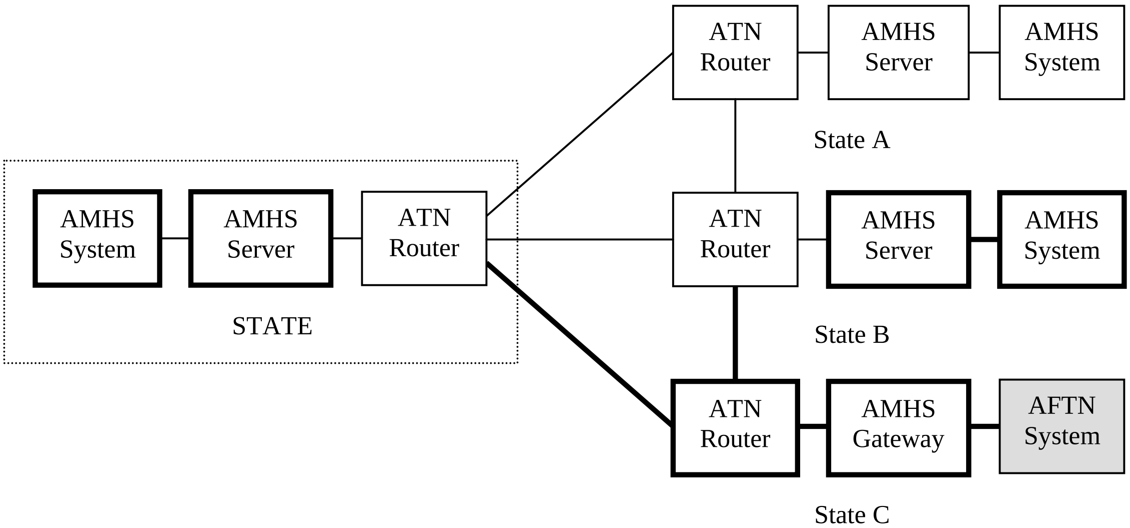


(2) Phase-2
Implementation of AFTN/AMHS Gateways and ATN Routers

Figure 1. AMHS Network Configuration (to be continued)

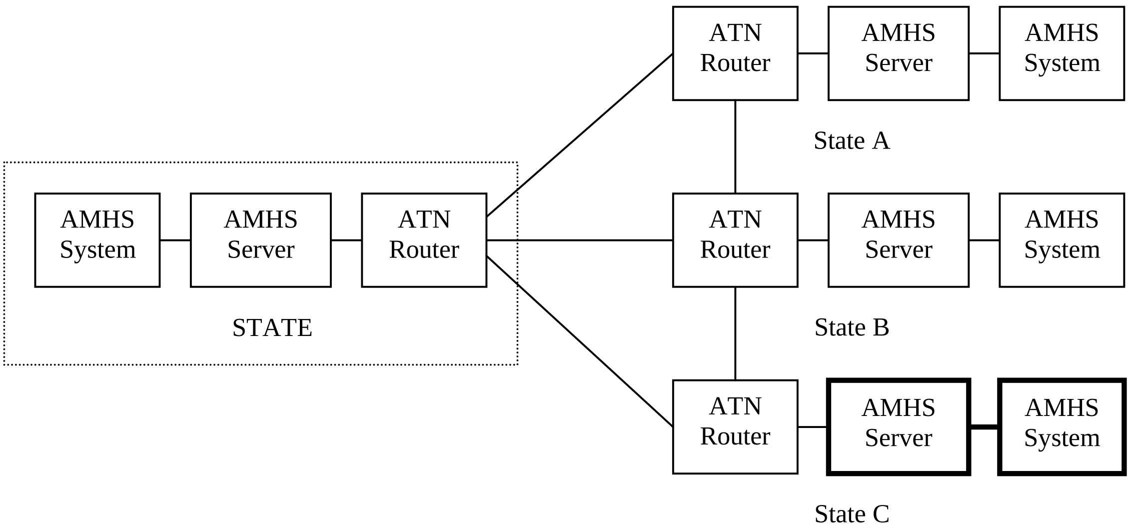


(3) Phase-3
Implementation of ATS Message Server and AMHS connections within State

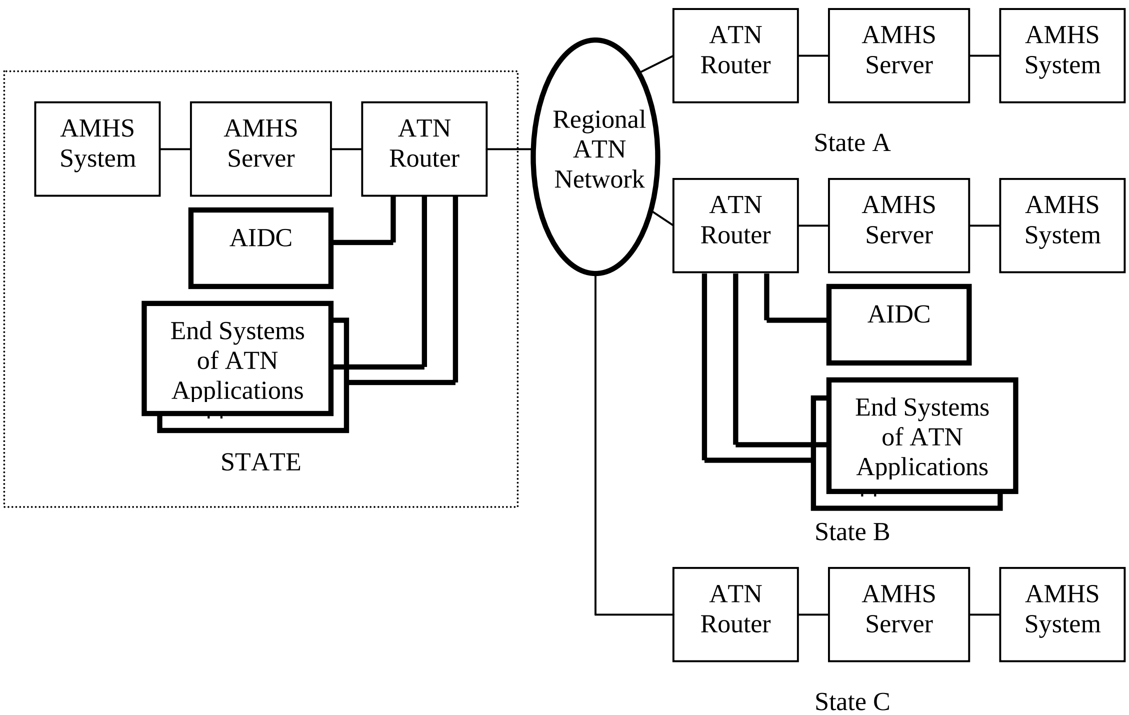


(4) Phase-4
Full AMHS international connections

Figure 1. AMHS Network Configuration (to be continued)



(5) Phase-5
Full AMHS connections



(6) Phase-6
Full ATN connections

Figure 1. AMHS Network Configuration

1.4 Protocol Specification Overview

1.4.1 Protocol Stack of AMHS and ATN Router

1.4.1.1 The following figure shows the OSI protocol stack of ES and IS in the ATN. AMHS is ES and ATN Router is IS.

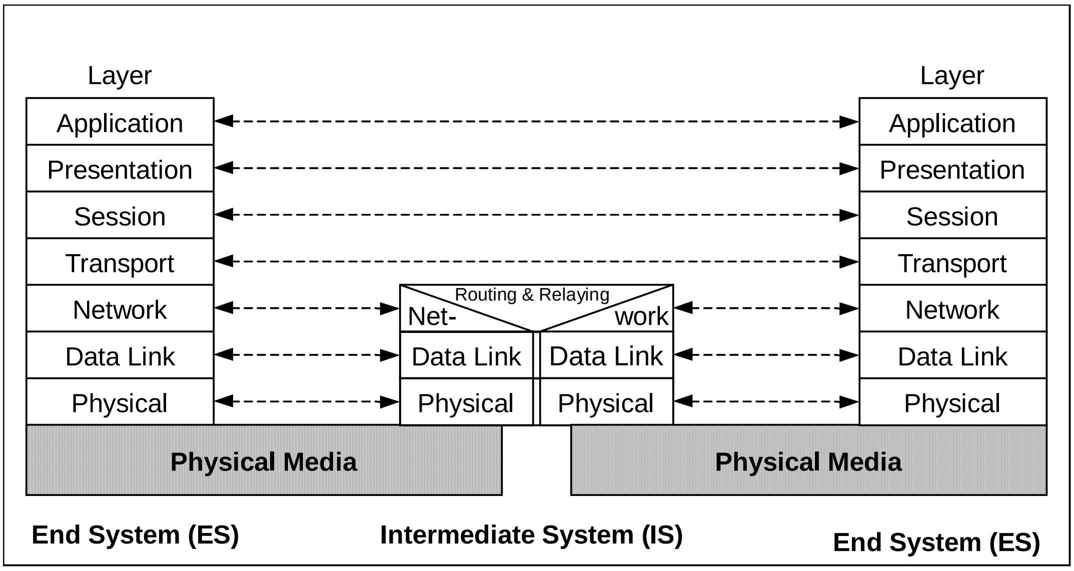


Figure 2. OSI Protocol Stack of ES and IS

1.4.2 AMHS Protocol Specification

1.4.2.1 The followings are the standards and/or ICAO Doc 9705/AN-956 descriptions of protocols at each OSI protocol layer, with which AMHS should comply.

(1) Application Layer

Application Layer is composed of MHS, RTSE, and ACSE.

MHS should comply with ITU-T X.400 (1988) and the additional requirements specified in 3.1 “ATS MESSAGE HANDLING SERVICE” of ICAO Doc 9705/AN-956. MHS supports all the mandatory elements of AMH11 and AMH21, and also supports the DL functional group.

RTSE should comply with ISO 9066-2 and support the mandatory services listed below among the services specified in ISO/IEC ISP 10611-2.

RT-OPEN
RT-CLOSE
RT-TRANSFER
RT-P-ABORT
RT-U-ABORT

ACSE should comply with ISO 8650 and support the mandatory functions of normal mode specified in ISO/IEC 10611-2. Moreover, the application-context name, which is used as a parameter of A-ASSOCIATE, should comply with ISO/IEC 10021-6.

(2) Presentation Layer

Presentation Layer should comply with ISO 8823 and support mandatory functions of normal mode specified in ISO/IEC ISP 10611-2.

(3) Session Layer

Session Layer should comply with ISO 8327 and support functional units listed below which are specified in ICAO Comprehensive ATN Manual and ISO/IEC ISP 10611-2.

Kernel
half duplex
exceptions
minor synchronize
activity management

(4) Transport Layer

COTP (Connection Oriented Transport Protocol) specified in ICAO Doc 9705/AN-956 should be used. COTP should comply with ISO/IEC8073 Class 4 and 5.5 “TRANSPORT SERVICE AND PROTOCOL SPECIFICATION” of ICAO Doc 9705/AN-956. The following functions should be supported as specified mandatory by ICAO Doc 9705/AN-956.

Both Initiating CR TPDU and Responding to CR TPDU	
Function of Non-use of checksum	
CR/CC/DR/DC/DT/ED/AK/EA/ER TPDUs	
Optional Parameters of CR/CC TPDUs	
	TSAP-ID (Transport-Selector designation)
	Additional option selection parameter
	Priority
	Acknowledgment time Negotiation
	Inactivity timer Negotiation
Optional Parameters of AK TPDU	
	Flow control confirmation
	Subsequence number

(5) Network Layer

The connection between AMHS and ATN Router ~~may be~~ is a local matter. However, CLNP (Connectionless Network Protocol) should be used ~~for~~ as the ~~communication~~ network ~~of subnetwork~~ protocol below the ~~with~~ Transport Layer.

CLNP should comply with ISO/IEC 8473 and 5.6 “INTERNETWORK SERVICE AND PROTOCOL SPECIFICATION” of ICAO Doc 9705/AN-956. The following functions should be supported as specified mandatory by ICAO Doc 9705/AN-956.

Security Parameter
Partial Route Recording
Priority
QoS Maintenance Information
Congestion Notification

CLNP uses an SNDCF (Subnetwork Dependent Convergence Function) over the ~~underlying~~ subnetwork. (Typically an ISO/IEC 8802 LAN is used for subnetwork between the AMHS and ATN router.) The SNDCF should comply with 5.7 "SPECIFICATION OF SUBNETWORK DEPENDENT CONVERGENCE FUNCTIONS" of ICAO Doc 9705/AN-956, and the appropriate standard corresponding to the subnetwork below:

- ISO/IEC 8802 Local Area Network : the SNDCF should comply with ISO/IEC 8473-2.
- ISO/IEC 8208: the SNDCF should comply with ISO/IEC 8473-3~~ and 5.7 "SPECIFICATION OF SUBNETWORK DEPENDENT CONVERGENCE FUNCTIONS" of ICAO Doc 9705/AN-956~~.

Only ES-IS in compliance with ISO/IEC9543 is used for addressing. ~~Routing protocol IDRP will not be supported.~~

(6) Data Link Layer

The connection between AMHS and ATN Router ~~may be~~ is a local matter.

(7) Physical Layer

The connection between AMHS and ATN Router ~~may be~~ is a local matter.

2. AMHS Specification

2.1 Guidance for Optional Parameters

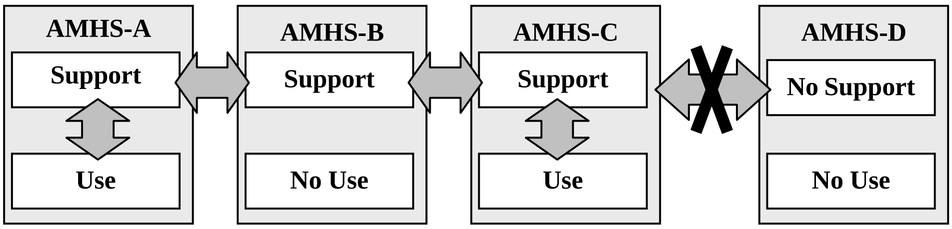
2.1.1 In the ICAO ATN SARPs (Doc 9705) as well as the International Standards, there are two kinds of parameters specified as "Mandatory" and "Optional".

"Mandatory" parameters are the requirements that all the AMHS must handle the parameters.
"Optional" parameters are specified as local matters and the handling must be decided locally; within State or Region.

2.1.2 In addition, each handling of parameter is specified by two profiles: "AMHS Support" and "AMHS Use".

"AMHS Support" means that the AMHS can receive or transfer the parameter.
"AMHS Use" means that AMHS uses the functionality specified by the parameter.

Conversely, "No Support" means that the AMHS cannot receive nor transfer the parameter, and "No Use" means that AMHS does not use the functionality.



AMHS-B does not use the optional parameter, however it can transfer the parameter.
AMHS-D does not support the optional parameter, therefore it cannot receive the parameter.
There is no combination of "No Support" with "Use".

When AMHS-B receives the parameter, no action will be performed.
When AMHS-D receives the parameter, there may be some error, which will depend on the system.

2.1.3 In order to keep the interoperability within the State and/or Region, it is necessary to unify the handling of the optional parameters by specifying the "AMHS Support" and "AMHS Use" uniformly.

2.1.4 As for the Inter-Regional AMHS connection, it is also preferable to unify the specification between the regions. However, in case there will be difference, handling of such difference will be done at either of the following AMHSs:

1) AMHS in the region who wants to communicate directly with the AMHS in the other region.
(This is the case when direct routing by BISs will be applied, where direct AMHS connection can be made.)

2) AMHS in the State who has Inter-Regional Trunk Connection by Backbone BIS.
(This is the case when AMHS routing will be applied, where all the connection of the AMHS in the region with the other region will be made, all the time, via the AMHS in the said State.)

NOTE : The detail of the handling for the difference deeply depends on which parameter will be concerned and how. Therefore, it is recommended to discuss the issue in the region when it becomes revealed. It is also recommended to watch the status in the other regions.

2.2 AMHS Specifications

2.2.1 Set up condition of each parameter for both AFTN/AMHS Gateway and ATS Message Server is specified in the appendix in the form of PICS. (Appendix: PICS of AMHS)

2.2.2 When only ATS Message Server without AFTN/AMHS Gateway is implemented, some part (the column “AMHS Action”) in the PICS can be ignored.

2.3 Upper Layer Specifications

2.3.1 Protocol Specification

The meaning of the each column in the tables is as follows:

(1) PICS Proforma Reference

The first letter of the column identifies the specific PICS proforma.

A : ACSE – ISO/IEC 8650-2
P : Presentation – ISO/IEC 8823-2
S : Session – ISO/IEC 8327-2

The characters from the second character to the solidus (/) form a reference to the specific sub clause in annex A of that PICS proforma which contains the table in question.

The number after the solidus references the row number in the table.

(2) Name of Item

(3) Normative reference

It is the referenced clause number in the ISO/IEC ISP 11188-1(1995).

(4) Status

Support Level is specified below:

m : mandatory support
o : optional support
o.n : optional with at least one of the marked items with the same number “n” being selected
c : conditional support
i : out of scope
– : not applicable

Where the status entry contains two classifications separated by a comma, these reference the sending and receiving capabilities respectively.

(5) Profile

The profile column reflects the requirement of this part of ISO/IEC ISP 11188. Each entry in this column is chosen from the following list:

m : mandatory support
C : conditional support
i : out of scope

Where the profile entry contains two classifications separated by a comma, these reference the sending and receiving capabilities respectively.

The value of “Cxx” is “m” or “i” according to the specified condition described below the each table.

NOTE: The definition of the value of “Cxx” is made by the following procedures:

a) *Confirm the item of reference number.*
b) *If AMHS supports referenced item, the item is "m" (mandatory).*
c) *If AMHS does not support referenced item, the item is "i" (out of scope).*

<Example> The following is an example in the case of "support operation of Session version 2" for ACSE in the next clause 2.3.1.1.

1) *Condition*
C11: if A.A.7/1 (1st row in the table of A.7 of ISO/IEC 8650-2) then m else I

2) *Procedures*
a) *The 1st row in the table of A.7 of ISO/IEC 8650-2 is the "Normal mode".*
b) *If AMHS supports "Normal mode", "support operation of Session version 2" is" m" (mandatory).*
c) *If AMHS does not support "Normal mode", "support operation of Session version 2" is "i" (out of scope).*

(6) AMHS Use

The column "AMHS use" states whether each item is "used (yes)" or "not used (no)".

2.3.1.1 ACSE

2.3.1.1.1 ACSE should comply with ISO 8650 and support the level specified in ISO/IEC ISP 11188-1(1995).

PICS Proforma Reference	Name of Item	Normative reference	Status	Profile	AMHS Use
A.A.7/4 (4th row in the table of A.7 of ISO/IEC 8650-2)	support operation of Session version 2	9.2.1	o	C11	Yes

C11 : if A.A.7/1 (1st row in the table of A.7 of ISO/IEC 8650-2) then m else i

NOTE: The relation between the Initiator/responder roles of ACSE, presentation and session in specified in 2.2.2 and 2.2.3.

2.3.1.2 Presentation PRL

2.3.1.2.1 Presentation PRL should comply with ISO 8823 and should support the level specified in ISO/IEC ISP 11188-1(1995) and AMHS Requirements.

Table 1 ISO/IEC ISP 11188-1

PICS Proforma Reference	Name of Item	Normative reference	Status	Profile	AMHS Use
P.A.6.1/1 (1st row in the table of A.6.1 of ISO/IEC 8823-2)	X.410(1984)	2.2.2	o.01	C21	No
P.A.6.1/2 (2nd row in the table of A.6.1 of ISO/IEC 8823-2)	Normal	2.2.2	o.01	C22	Yes
P.A.7.1.1.1/1 (1st row in the table of A.7.1.1.1 of ISO/IEC 8823-2)	Initiator(Presentation connection)		o.03	C23	Yes
P.A.7.1.1.1/2 (2nd row in the table of A.7.1.1.1 of ISO/IEC 8823-2)	Responder(Presentation connection)		o.03	C24	Yes
P.A.7.1.1.3/1 (1st row in the table of A.7.1.1.3 of ISO/IEC 8823-2)	Requestor(orderly release)		o.05	C25	Yes
P.A.7.1.1.3/2 (2nd row in the table of A.7.1.1.3 of ISO/IEC 8823-2)	Acceptor (orderly release)		o.05	C26	Yes

C21 : if A.A.7/2 (2nd row in the table of A.7 of ISO/IEC 8650-2) then m else i
C22 : if A.A.7/1 (1st row in the table of A.7 of ISO/IEC 8650-2) then m else i
C23 : if A.A.6.1/1 (1st row in the table of A.6.1 of ISO/IEC 8650-2) then m else i
C24 : if A.A.6.1/2 (2nd row in the table of A.6.1 of ISO/IEC 8650-2) then m else i
C25 : if A.A.6.2/1 (1st row in the table of A.6.2 of ISO/IEC 8650-2) then m else i
C26 : if A.A.6.2/2 (2nd row in the table of A.6.2 of ISO/IEC 8650-2) then m else i

Table 2 AMHS Requirements

Name of Item	ISO/IEC 8823-1 Reference	ISO Support	AMHS Use
user-data of CP PPDU	8.2	Either Simply-Encoded-Data or Fully-Encoded-Data	Fully-Encoded-Data
user-data of CPA PPDU	8.2	Either Simply-Encoded-Data or Fully-Encoded-Data	Fully-Encoded-Data
user-data of CPR PPDU	8.2	Either Simply-Encoded-Data or Fully-Encoded-Data	Fully-Encoded-Data
presentation-data-values of PDV-list	8.4.2	Either single-ASN1-type, octet-aligned, or arbitrary	single-ASN1-type

2.3.1.3 Session PRL

2.3.1.3.1 Session PRL should comply with ISO 8327 and support the level specified in ISO/IEC ISP 11188-1 (1995).

PICS Proforma Reference	Name of Item	Normative reference	Status	Profile	AMHS Use
S.A.6.2/2 (2nd row in the table of A.6.2 of ISO/IEC 8327-2)	Reuse of transport connection		o	i	Yes
S.A.6.2/4 (4th row in the table of A.6.2 of ISO/IEC 8327-2)	Extended Concatenation (sending)		o	i	Yes
S.A.6.2/5 (5th row in the table of A.6.2 of ISO/IEC 8327-2)	Extended Concatenation (receiving)		o	i	Yes
S.A.7.1.1.1/1 (1st row in the table of A.7.1.1.1 of ISO/IEC 8327-2)	initiator (session connection)		o.3	C41	Yes
S.A.7.1.1.1/2 (2nd row in the table of A.7.1.1.1 of ISO/IEC 8327-2)	Responder (session connection)		o.3	C42	Yes
S.A.7.1.1.2/1 (1st row in the table of A.7.1.1.2 of ISO/IEC 8327-2)	Requestor (orderly release)		o.4	C43	Yes
S.A.7.1.1.2/2 (2nd row in the table of A.7.1.1.2 of ISO/IEC 8327-2)	Acceptor (orderly release)		o.4	C44	Yes
S.A.7.1.1.3/1 (1st row in the table of A.7.1.1.3 of ISO/IEC 8327-2)	Requestor (normal data transfer)		o.5	C45	Yes
S.A.7.1.1.3/2 (2nd row in the table of A.7.1.1.3 of ISO/IEC 8327-2)	Acceptor (normal data transfer)		o.5	C46	Yes
S.A.7.1.2/2 (2nd row in the table of A.7.1.2 of ISO/IEC 8327-2)	Overflow Accept (OA)	9.2.2	c5,c6	i,i	No, No
S.A.7.1.2/3 (3rd row in the table of A.7.1.2 of ISO/IEC 8327-2)	Connection Data Overflow (CDO)	9.2.2	c5,c6	i,i	No, No

PICS Proforma Reference	Name of Item	Normative reference	Status	Profile	AMHS Use
S.A.7.5.1/1 (1st row in the table of A.7.5.1 of ISO/IEC 8327-2)	Requestor (expedited data)		o.6	C47	No
S.A.7.5.1/2 (2nd row in the table of A.7.5.1 of ISO/IEC 8327-2)	Acceptor (expedited data)		o.6	C48	No
S.A.7.6.1/1 (1st row in the table of A.7.6.1 of ISO/IEC 8327-2)	Requestor (typed data)		o.7	C49	No
S.A.7.6.1/2 (2nd row in the table of A.7.6.1 of ISO/IEC 8327-2)	Acceptor(typed data)		o.7	C50	No
S.A.7.7.1/1 (1st row in the table of A.7.7.1 of ISO/IEC 8327-2)	Requestor (capability data)		o.8	C51	No
S.A.7.7.1/2 (2nd row in the table of A.7.7.1 of ISO/IEC 8327-2)	Acceptor (capability data)		o.8	C52	No
S.A.7.8.1/1 (1st row in the table of A.7.8.1 of ISO/IEC 8327-2)	Requestor (minor synchronize)		o.9	C53	Yes
S.A.7.8.1/2 (2nd row in the table of A.7.8.1 of ISO/IEC 8327-2)	Acceptor (minor synchronize)		o.9	C54	Yes
S.A.7.11.1/1 (1st row in the table of A.7.11.1 of ISO/IEC 8327-2)	Requestor (major synchronize)		o.10	C55	No
S.A.7.11.1/2 (2nd row in the table of A.7.11.1 of ISO/IEC 8327-2)	Acceptor (major synchronize)		o.10	C56	No
S.A.7.14.1.1/1 (1st row in the table of A.7.14.1.1 of ISO/IEC 8327-2)	Requestor (activity start)		o.12	C57	Yes
S.A.7.14.1.1/2 (2nd row in the table of A.7.14.1.1 of ISO/IEC 8327-2)	Acceptor (activity start)		o.12	C58	Yes
S.A.7.14.1.2/1	Requestor (activity resume)		o.13	C59	Yes

PICS Proforma Reference	Name of Item	Normative reference	Status	Profile	AMHS Use
(1st row in the table of A.7.14.1.2 of ISO/IEC 8327-2)					
S.A.7.14.1.2/2 (2nd row in the table of A.7.14.1.2 of ISO/IEC 8327-2)	Acceptor (activity resume)		o.13	C60	Yes
S.A.7.14.1.3/1 (1st row in the table of A.7.14.1.3 of ISO/IEC 8327-2)	Requestor (activity interrupt)		o.14	C61	Yes
S.A.7.14.1.3/2 (2nd row in the table of A.7.14.1.3 of ISO/IEC 8327-2)	Acceptor (activity interrupt)		o.14	C62	Yes
S.A.7.14.1.4/1 (1st row in the table of A.7.14.1.4 of ISO/IEC 8327-2)	Requestor (activity discard)		o.15	C63	Yes
S.A.7.14.1.4/2 (2nd row in the table of A.7.14.1.4 of ISO/IEC 8327-2)	Acceptor (activity discard)		o.15	C64	Yes
S.A.7.14.1.5/1 (1st row in the table of A.7.14.1.5 of ISO/IEC 8327-2)	Requestor (activity end)		o.16	C65	Yes
S.A.7.14.1.5/2 (2nd row in the table of A.7.14.1.5 of ISO/IEC 8327-2)	Acceptor (activity end)		o.16	C66	Yes
S.A.7.14.1.6/1 (1st row in the table of A.7.14.1.6 of ISO/IEC 8327-2)	Requestor (give tokens confirm)		o	C67	Yes
S.A.7.14.1.6/2 (2nd row in the table of A.7.14.1.6 of ISO/IEC 8327-2)	Acceptor (give tokens confirm)		o	C68	Yes
S.A.8.1.3/4 (4th row in the table of A.8.1.3 of ISO/IEC 8327-2)	Data Overflow Item (CN)	9.2.2	c6,c5	i, i	No, No

1) Status

c5 : Condition is to support “Responder (session connection)”.
c6 : Condition is to support “Requestor (orderly release)”.

2) Profile

C41 : if A.A.6.1/1 (1st row in the table of A.6.1 of ISO/IEC 8650-2) then m else i
C42 : if A.A.6.1/2 (2nd row in the table of A.6.1 of ISO/IEC 8650-2) then m else i
C43 : if A.A.6.2/1 (1st row in the table of A.6.2 of ISO/IEC 8650-2) then m else i
C44 : if A.A.6.2/2 (2nd row in the table of A.6.2 of ISO/IEC 8650-2) then m else i
C45 : if P.A.7.1.1.2/1 (1st row in the table of A.7.1.1.2 of ISO/IEC 8823-2) then m else i
C46 : if P.A.7.1.1.2/2 (2nd row in the table of A.7.1.1.2 of ISO/IEC 8823-2) then m else i
C47 : if P.A.7.4.4/1 (1st row in the table of A.7.4.4 of ISO/IEC 8823-2) then m else i
C48 : if P.A.7.4.4/2 (2nd row in the table of A.7.4.4 of ISO/IEC 8823-2) then m else i
C49 : if P.A.7.4.5/1 (1st row in the table of A.7.4.5 of ISO/IEC 8823-2) then m else i
C50 : if P.A.7.4.5/2 (2nd row in the table of A.7.4.5 of ISO/IEC 8823-2) then m else i
C51 : if P.A.7.4.6/1 (1st row in the table of A.7.4.6 of ISO/IEC 8823-2) then m else i
C52 : if P.A.7.4.6/2 (2nd row in the table of A.7.4.6 of ISO/IEC 8823-2) then m else i
C53 : if P.A.7.4.7/1 (1st row in the table of A.7.4.7 of ISO/IEC 8823-2) then m else i
C54 : if P.A.7.4.7/2 (2nd row in the table of A.7.4.7 of ISO/IEC 8823-2) then m else i
C55 : if P.A.7.4.10/1 (1st row in the table of A.7.4.10 of ISO/IEC 8823-2) then m else i
C56 : if P.A.7.4.10/2 (2nd row in the table of A.7.4.10 of ISO/IEC 8823-2) then m else i
C57 : if P.A.7.4.13.1/1 (1st row in the table of A.7.4.13.1 of ISO/IEC 8823-2) then m else i
C58 : if P.A.7.4.13.1/2 (2nd row in the table of A.7.4.13.1 of ISO/IEC 8823-2) then m else i
C59 : if P.A.7.4.13.2/1 (1st row in the table of A.7.4.13.2 of ISO/IEC 8823-2) then m else i
C60 : if P.A.7.4.13.2/2 (2nd row in the table of A.7.4.13.2 of ISO/IEC 8823-2) then m else i
C61 : if P.A.7.4.13.3/1 (1st row in the table of A.7.4.13.3 of ISO/IEC 8823-2) then m else i
C62 : if P.A.7.4.13.3.2 (2nd row in the table of A.7.4.13.3 of ISO/IEC 8823-2) then m else i
C63 : if P.A.7.4.13.4/1 (1st row in the table of A.7.4.13.4 of ISO/IEC 8823-2) then m else i
C64 : if P.A.7.4.13.4/2 (2nd row in the table of A.7.4.13.4 of ISO/IEC 8823-2) then m else i
C65 : if P.A.7.4.13.5/1 (1st row in the table of A.7.4.13.5 of ISO/IEC 8823-2) then m else i
C66 : if P.A.7.4.13.5/2 (2nd row in the table of A.7.4.13.5 of ISO/IEC 8823-2) then m else i
C67 : if P.A.7.4.13.6/1 (1st row in the table of A.7.4.13.6 of ISO/IEC 8823-2) then m else i
C68 : if P.A.7.4.13.6/2 (2nd row in the table of A.7.4.13.6 of ISO/IEC 8823-2) then m else i

2.4 Lower Layer Specifications

2.4.1 Protocol Implementation Conformance Statements of COTP

2.4.1.1 In protocol layer 4, ICS SARPs recommend COTP. The functions of COTP are specified below.

(1) "ATN Support" indicates that the item is Mandatory ("M"), Option ("O") or Mandatory implemented and Optionally used ("MO").
(2) "AMHS Support" indicates whether the item is Supported ("yes") or NOT Supported ("no").
(3) "AMHS Use" indicates whether the item is Used ("yes") or NOT Used ("no") in transfer.

Table 1 Support Class

Class	ATN Support	AMHS Support	AMHS Use
Class 0	O	no	no
Class 1	O	no	no
Class 2	O	no	no
Class 3	O	no	no
Class 4 operation over CONS	O	no	no
Class 4 operation over CLNS	M	yes	yes

Table 2 ATN Requirements

Feature	ATN Support	AMHS Support	AMHS Use
Congestion Avoidance	M	yes	yes
Transport to Network Priority	M	yes	yes
ATN Security Label	M	yes	yes
Configurable Transport Timers	M	yes	yes
Enhanced encoding of Acknowledgment Time Parameter	M	yes	yes

NOTE: Implementation of the transport protocol shall support configurable values for all timers and protocol parameters, rather than having fixed values, in order to allow modification as operational experience is gained. The actual values of transport timers are to be determined through bilateral agreement on the AMHS systems connected each other. (See the Clause 2.4.2).

Table 3 Initiator/Responder Capability

Class	ATN Support	AMHS Support	AMHS Use
Initiating CR TPDU	M	yes	yes
Responding to CR TPDU	M	yes	yes

Table 4 Mandatory Functions

Function	ATN Support	AMHS Support	AMHS Use
TPDU transfer	M	yes	yes
Segmenting	M	yes	yes
Reassembling	M	yes	yes
Separation	M	yes	yes
Connection establishment	M	yes	yes
Connection refusal	M	yes	yes
Data TPDU numbering (normal)	M	yes	yes
Retention and acknowledgement of TPDUs (AK)	M	yes	yes
Explicit flow control	M	yes	yes
Checksum	M	yes	yes
Frozen references	M	yes	yes
Retransmission on time-out	M	yes	yes
Resequencing	M	yes	yes
Inactivity control	M	yes	yes

Table 5 Optional Functions

Feature	ATN Support	AMHS Support	AMHS Use
Data TPDU numbering (extended)	O	yes	yes
Non-use of checksum	M	yes	yes
Concatenation	O	no	no
Retention and acknowledgement of TPDUs Use of selective acknowledgement	O	no	no
Retention and acknowledgement of TPDUs Use of request acknowledgement	O	no	no

Table 6 Supported TPDUs

TPDUs		ATN Support	AMHS Support	AMHS Use
CR	supported on transmission	M	yes	yes
CR	supported on receipt	M	yes	yes
CC	supported on transmission	M	yes	yes
CC	supported on receipt	M	yes	yes
DR	supported on transmission	M	yes	yes
DR	supported on receipt	M	yes	yes
DC	supported on transmission	M	yes	yes
DC	supported on receipt	M	yes	yes
DT	supported on transmission	M	yes	yes
DT	supported on receipt	M	yes	yes
ED	supported on transmission	MO	no	no
ED	supported on receipt	MO	no	no
AK	supported on transmission	M	yes	yes
AK	supported on receipt	M	yes	yes
EA	supported on transmission	MO	no	no
EA	supported on receipt	MO	no	no
ER	supported on receipt	M	yes	yes

Table 7 Parameter Values for CR TPDU

Feature	ATN Support	AMHS Support	AMHS Use
Bits 8 and 7 in the additional options selection parameter of a CR TPDU set to zero	M	yes	yes

Table 8 Optional Parameter for a CR TPDU

Supported parameters	ATN Support	AMHS Support	AMHS Use
Called Transport-Selector	M	yes	yes
Calling Transport-Selector	M	yes	yes
TPDU size	O	no	no
Version Number	O	no	no
Protection parameters	O	no	no
Additional option selection	M	yes	yes
Throughput	O	no	no
Residual error rate	O	no	no
Priority	M	yes	yes
Transit delay	O	no	no
Acknowledgement time	M	yes	yes
Preferred maximum TPDU size	O	no	no
Inactivity timer	M	yes	yes

Table 9 Optional Parameter for a CC TPDU

Supported parameters	ATN Support	AMHS Support	AMHS Use
Called Transport-Selector	M	yes	yes
Calling Transport-Selector	M	yes	yes
TPDU size	O	no	no
Protection parameters	O	no	no
Additional option selection	M	yes	yes
Throughput	O	no	no
Residual error rate	O	no	no
Priority	M	yes	yes
Transit delay	O	no	no
Acknowledgement time	M	yes	yes
Preferred maximum TPDU size	O	no	no
Inactivity timer	M	yes	yes

Table 10 Optional Parameter for a DR TPDU

Supported parameter	ATN Support	AMHS Support	AMHS Use
Additional information	O	no	no

Table 11 Optional Parameter for a DT TPDU

Supported parameter	ATN Support	AMHS Support	AMHS Use
Request of acknowledgement	M	yes	no

Table 12 Optional Parameter for an AK TPDU

Supported parameter	ATN Support	AMHS Support	AMHS Use
Flow control confirmation	M	yes	yes

Table 13 Subsequence Number Parameter in the AK TPDU

Supported parameter	ATN Support	AMHS Support	AMHS Use
Subsequence number	M	yes	yes

Table 14 Selective Acknowledgement Parameter in the AK TPDU

Supported parameter	ATN Support	AMHS Support	AMHS Use
Selective acknowledgement parameters	O	no	no

Table 15 Optional Parameter for an ER TPDU

Supported parameter	ATN Support	AMHS Support	AMHS Use
Invalid TPDU	O	no	no

Table 16 User Data in Issued TPDUs

User Data	ATN Support	AMHS Support	AMHS Use
User data of up to 32 octets in a CR with preferred class 4 ?	M	yes	yes
User data of up to 32 octets in a CC ?	M	yes	yes
User data of up to 64 octets in a DR ?	M	yes	yes

Table 17 User Data in Received TPDUs

User Data	ATN Support	AMHS Support	AMHS Use
32 octets of user data in a CC TPDU ?	M	yes	yes
64 octets of user data in a DR TPDU ?	M	yes	yes
32 octets of user data in a CR TPDU ?	M	yes	yes

Table 18 Class Negotiation - Initiator

Feature	ATN Support	AMHS Support	AMHS Use
The preferred class in the CR TPDU may contain any of the classes supported by the implementation	Class 4	Class 4	Class 4

Table 19 The table below specifies valid alternative classes

Preferred class	ATN Support	AMHS Support	AMHS Use
Class 4 over CLNS	None	None	None

Table 20 Class negotiation - responder side

Preferred class	ATN Support	AMHS Support	AMHS Use
What classes can you respond with if CR proposes only class 4?	Class 4	Class 4	Class 4
What classes can you respond with if CR proposes class 4 as preferred class and the alternative class parameter is present?	Class 4	Class 4	Class 4

Table 21 TPDU Size Negotiation

TPDU Size	ATN Support	AMHS Support	AMHS Use
If maximum TPDU size is proposed in a CR TPDU then the initiator shall support all TPDU sizes from 128 octets to the maximum proposed	M	yes	yes
If the preferred maximum TPDU size parameter is used in a CR TPDU then the initiator shall support all TPDU sizes, except 0, that are multiples of 128 octets up to the preferred maximum proposed	M	yes	yes
What is the largest value of the preferred maximum TPDU size parameter in a CR TPDU?	any multiple of 128 octets	any multiple of 128 octets	any multiple of 128 octets
What is the largest value of the preferred maximum TPDU size parameter in a CC TPDU?	any multiple of 128 octets	any multiple of 128 octets	any multiple of 128 octets
What is the largest value of the maximum TPDU size parameter in a CR TPDU with preferred class 4?	One of 128, 256, 512, 1024, 2048	One of 128, 256, 512, 1024, 2048	One of 128, 256, 512, 1024, 2048
What is the largest value of the maximum TPDU size parameter which may be sent in the CC TPDU when class 4 is selected?	128, 256, 512, 1024, 2048	128, 256, 512, 1024, 2048	128, 256, 512, 1024, 2048

Table 22 Use of Extended Format

Extended format	ATN Support	AMHS Support	AMHS Use
What formats can you propose in the CR TPDU in class 4?	normal, extended	extended	extended
What formats can you select in CC when extended has been proposed in CR in class 4?	normal, extended	extended	extended

NOTE: Extended format is needed to be selected for the use of the Data TPDU numbering (extended) (see the Table 5 in this Clause). The Data TPDU numbering (extended) is able to increase the throughput of messages between AMHS systems by increasing the number of the data which can be sent without waiting for the acknowledgement from the other AMHS system.

Table 23 Expedited data Transport service

Expedited data	ATN Support	AMHS Support	AMHS Use
Is the expedited data indication supported in CR and CC TPDU?	MO	yes	yes

Table 24 Non-use of Checksum

Non-use of checksum	ATN Support	AMHS Support	AMHS Use
What proposals can you make in the CR?	non-use, use	use	non-use
What proposals can you make in CC when non-use of checksum has been proposed in CR?	non-use, use	use	non-use

Table 25 Use of selective acknowledgement

Selective Acknowledgement	ATN Support	AMHS Support	AMHS Use
Is use of selective acknowledgement proposed in CR TPDUs ?	O	no	no
Is use of selective acknowledgement selected in a CC when it has been proposed in a CR ?	O	no	no

Table 26 Use of Request Acknowledgement

Request of Acknowledgement	ATN Support	AMHS Support	AMHS Use
Is use of request of acknowledgement proposed in CR TPDUs ?	O	no	no
Is use of request of acknowledgement selected in a CC when it has been proposed in a CR ?	O	no	no

Table 27 Action on Detection of a Protocol Error

Item	ATN Support	AMHS Support	AMHS Use
Class 4 over CLNS	ER, DR, Discard	ER, DR, Discard	ER, DR, Discard

Table 28 Actions on receipt of an invalid or undefined parameter in a CR TPDU

Event	ATN Support	AMHS Support	AMHS Use
A parameter not defined in ISO/IEC 8073 shall be ignored	M	yes	yes
An invalid value in the alternative protocol class parameter shall be treated as a protocol error	M	yes	yes
An invalid value in the class and option parameter shall be treated as a protocol error	M	yes	yes
On receipt of the additional option selection parameter bits 8 to 7, and bits 6 to 1 if not meaningful for the proposed class, shall be ignored	M	yes	yes
On receipt of the class option parameter bits 4 to 1 if not meaningful for the proposed class shall be ignored	M	yes	yes
What action is supported on receipt of a parameter defined in ISO 8073 (other than those covered above) and having an invalid value ?	Ignore, Protocol Error	Ignore, Protocol Error	Ignore, Protocol Error

Table 29 Actions on receipt of an invalid or undefined parameter in a TPDU other than a CR

Event	ATN Support	AMHS Support	AMHS Use
A parameter not defined in ISO/IEC 8073 shall be treated as a protocol error	M	yes	yes
A parameter which has an invalid value as defined in ISO/IEC 8073 shall be treated as a protocol error	M	yes	yes
A TPDU received with a checksum which does not satisfy the defined formula shall be discarded	M	yes	yes

Table 30 Class 4 Timers and Protocol Parameters

Parameters	ATN Support	AMHS Support	AMHS Use
T1 (Local Retransmission)	M	yes	yes
N (Maximum Transmission)	M	yes	yes
I_L (Local Inactivity Time)	M	yes	yes
W (Window Update)	M	yes	yes
L (Frozen Reference Time)	M	yes	yes
R (Persistence)	O	no	no
M_{LR} (NSDU Lifetime)	O	no	no
M_{RL} (NSDU Lifetime)	O	no	no
E_{LR} (Maximum Transit Delay)	O	no	no
E_{RL} (Maximum Transit Delay)	O	no	no
A_L (Acknowledgement Time)	M	yes	yes
A_R (Acknowledgement Time)	M	yes	yes
I_R (Remote Inactivity Time)	M	yes	yes
Does IUT support optional timer TS2 when operating in class 4?	O	no	no

2.4.2 Parameter values

2.4.2.1 The range of values set in the protocol layer 3 and 4 of AMHS are specified below. The actual values are to be determined through bilateral agreement on the AMHS systems connected each other.

2.4.2.2 The following table shows only the parameters, which may influence interoperability. Other parameters are also to be determined through the bilateral agreement.

Parameters set or set to the frame are shown in the following table.

Name	Lower	Upper
Local Retransmission Time(T1){COTP}[SEC]	12	300
Window Time(W){COTP}[SEC]	160	6000
Maximum Number of Transmissions(N){COTP}	1	10
Maximum size of TPDU{COTP}[OCTETS]	1024	1024
Lifetime{CLNS}[IN UNITS OF 500MSEC]	10	30
Reassembly Time{CLNS}[IN UNITS OF 500MSEC]	10	30

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Appendix: <u>PICS of AMHS</u>

This appendix specifies the PICS of AMHS for both AFTN/AMHS Gateway and ATS Message Server. When only ATS Message Server without AFTN/AMHS Gateway is implemented, the column "AMHS Action" in the tables can be ignored.

Followings are the contents included in this appendix.

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Table 6.1 Probe Transfer Envelope
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INTRODUCTION

Description of each column in the table header is as follows;

"support" indicates the specification in the ISP and in the SARPs (ICAO ATN SARPs) respectively. The contents in the table are extracted from the ISP and the SARPs.

"AMHS-Action" indicates the specified action at Origination and at Reception in the SARPs. Please refer to the "Action" column in the SARPs. The contents in the table are extracted from the SARPs.

"AMHS-support" indicates the status of AMHS to be implemented.

"Detailed Action" indicates the detailed action specified in the SARPs, when it is described in the SARPs. The contents in the table are extracted from the SARPs.

"Origination" and "Reception" are also the terms described in the SARPs. They are abbreviated as “O” and “R” respectively in the column of “AMHS-Action” and “AMHS-support” in the table headings.

Definition of each support level and actions is specified in the table below :

support level and actions	Origination	Reception
M	The value is always set.	It is mandatory to set the value.
O	The value is set on conditions.	When the value is set, service is provided.
M-	-	Only the minimal support of this element. 1) allowed to set the value but no service provided 2) value is transparent when relayed
X	The value is not set.	When the value exists, it is considered to be an error.
T	Translated.	Translated.
G	Generated.	-
G1	Optionally generated.	-
G2	Conditionally generated.	-
D	-	Discarded.

1. Message Transfer Envelope for IPM

Table 1.1 Message Transfer Envelope

(Based on : ATSMHS SARPs Table 3.1.2-6 for O, Table 3.1.2-12 for R)

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
1	MessageTransferEnvelope	M	M	T	T	M	M	-			
1.1	per message fields										
1.1.1	message-identifier	M	M	G	D	M	M	-			See Table 2/1
1.1.2	originator-name	M	M	T	T	M	M	-			
1.1.3	original-encoded-information-types	O	M	G	D	M	M	-			
1.1.4	content-type	M	M	G	D	M	M	-	BuiltInContentType is set the abstract value "interpersonal-messaging-1984(2) or 1988(22)"	If the value of BuiltInContentType is neither interpersonal-messaging-1984(2) nor interpersonal-messaging-1988(22), then generate NDR[NDRC=1,NDDC=15].	
1.1.5	content-identifier	O	M-	G	D	M	M-	<=16			"G"
1.1.6	Priority	M	M	T	D	M	M	-			
1.1.7	per-message-indicators	M	M	G	D	M	M	-			See Table 1.2/4
1.1.8	deferred-delivery-time	O	M-	G	D	M	M-	-			
1.1.9	per-domain-bilateral-information	O	M-	X	D	X	M-	-			
1.1.10	trace-information	M	M	G	D	M	M	-			
1.1.11	Extensions	M	M	G	D	M	O	-			In X.400, if the value doesn't exist, it is considered to be not selected.

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
	Type	M	M	G	D	M	M	-			Only supports "standard-extension".
	Criticality	M	M	G	D	M	M	-			In X.400, if the value doesn't exist, it is considered to be not selected.
	Value	M	M	M	D	M	M	-	Set the value of "internal-trace-information"		
1.1.11.1	recipient-reassignment-prohibited	O	M-	X	D	X	M-	-			
1.1.11.2	dl-extension-prohibited	O	M-	X	D	X	M-	-			
1.1.11.3	conversion-with-loss-prohibited	O	M-	X	D	X	M-	-			
1.1.11.4	latest-delivery-time	O	M-	X	D	X	O	-		If this exists, and the current time exceeds the value, then generate NDR[NDRC=1,NDDC=5].	
1.1.11.5	originator-return-address	O	M-	X	D	X	M-	-			
1.1.11.6	originator-certificate	O	M-	X	X	X	M-/X	-		If the value is "CRITICAL FOR DELIVERY" then generate NDR[NDRC=1,NDDC=18].	
1.1.11.7	content-confidentiality-algorithm-identifier	O	M-	X	X	X	M-/X	-		If the value is "CRITICAL FOR DELIVERY" then generate NDR[NDRC=1,NDDC=18].	

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
1.1.11.8	message-origin-authentication-check	O	M-	X	X	X	M-/X	-		If the value is "CRITICAL FOR DELIVERY" then generate NDR[NDRC=1,NDDC=18].	
1.1.11.9	Message-security-label	O	M-	X	X	X	M-/X	-		If the value is "CRITICAL FOR DELIVERY" then generate NDR[NDRC=1,NDDC=18].	
1.1.11.10	content-correlator	O	M-	X	D	X	M-	<= 512			
1.1.11.11	dl-expansion-history	O	M-	X	D	X	O	-			
1.1.11.12	internal-trace-information	O	M-	G	D	M	M-	-			See Table 3/5
1.2	per-recipient-fields	M	M	T	T	M	M	-		Support maximum of 21 parameters. (This number may be changed when negotiated.)	
1.2.1	recipient-name	M	M	T	T	M	M	-	Set the values of the recipient's MF ~~or XF~~ (XF or CAAS) address.		
1.2.2	originally-specified-recipient-number	M	M	G	D	M	M	-	Set the value which comply with 12.2.1.1.1.5 of ISO/IEC 10021-4. (set continuous number from 1 to the first recipient)		

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
1.2.3	per-recipient-indicators	M	M	G	D	M	M	-	Set following value : responsibility=responsible(1) originating-MTA-reportrequest=non-delivery-report(01) originator-report-request=non-delivery-report(01)	For the parameter "per-recipients-fields", only "responsibility=responsible (1)" is relayed or delivered. Reportrequest=delivery-request(10) is ignored.	BITSTRING
1.2.4	explicit-conversion	O	M-	X	D	X	M-	-			
1.2.5	Extensions	M	M-	X	D	X	M	-			In X.400, if the value doesn't exist, it is considered to be not selected.
	Type	M	M	-	D	X	M	-			Only supports "standard-extension".
	Criticality	M	M	-	D	X	M	-		If the value does not exist, all bits are considered to be OFF.	BITSTRING for-submission(0) for-deliver(1) for-transfer(2)
	Value	M	M	-	D	X	M	-			
1.2.5.1	originator-requested-alternate-recipient	O	M-	-	D	X	M-	-			
1.2.5.2	requested-delivery-method	O	M-	-	D	X	M-	-			
1.2.5.3	physical-forwarding-prohibited	O	M-	-	X	X	M-/X	-		If the criticality is "CRITICAL FOR DELIVERY", then generate NDR[NDRC=3,NDDC=18].	

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
1.2.5.4	physical-forwarding-address-request	O	M-	-	X	X	M-/X	-		If the criticality is "CRITICAL FOR DELIVERY", then generate NDR[NDRC=3,NDDC=18].	
1.2.5.5	physical-delivery-modes	O	M-	-	X	X	M-/X	-		If the criticality is "CRITICAL FOR DELIVERY", then generate NDR[NDRC=3,NDDC=18].	
1.2.5.6	registed-mail-type	O	M-	-	X	X	M-/X	-		If the criticality is "CRITICAL FOR DELIVERY", then generate NDR[NDRC=3,NDDC=18].	
1.2.5.7	recipient-number-for-advice	O	M-	-	X	X	M-/X	-		If the criticality is "CRITICAL FOR DELIVERY", then generate NDR[NDRC=3,NDDC=18].	
1.2.5.8	physical-redirection-attributes	O	M-	-	X	X	M-/X	-		If the criticality is "CRITICAL FOR DELIVERY", then generate NDR[NDRC=3,NDDC=18].	

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
1.2.5.9	physical-delivery-report-request	O	M-	-	X	X	M-/X	-		If the criticality is "CRITICAL FOR DELIVERY", then generate NDR[NDRC=3,NDDC=18].	
1.2.5.10	message-token	O	M-	-	X	X	M-/X	-		If the criticality is "CRITICAL FOR DELIVERY", then generate NDR[NDRC=3,NDDC=18].	
1.2.5.11	content-integrity-check	O	M-	-	X	X	M-/X	-		If the criticality is "CRITICAL FOR DELIVERY", then generate NDR[NDRC=3,NDDC=18].	
1.2.5.12	proof-of-delivery-request	O	M-	-	X	X	M-/X	-		If the criticality is "CRITICAL FOR DELIVERY", then generate NDR[NDRC=3,NDDC=18].	
1.2.5.13	redirection-history	O	M-	-	D	X	M-	-			
2	Content	M	M	T	T	M	M	-	Set the generated IPM.		

Table 1.2 Common Data Types
(Based on : ATSMHS SARPs Table 3.1.2-6 for O, Table 3.1.2-12 for R)

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
1	MTS-Identifier										
1.1	global-domain-identifier	M	M	G	D	M	M	-			
1.2	local-identifier	M	M	G	D	M	M	<=32	Set the characters which identifies message in ia-5 characters.		
2	GlobalDomainIdentifier										
2.1	country-name	M	M	G	D	M	M	2 or 3	Set the country name of AMHS management domain.		
2.2	administration-domain-name	M	M	G	D	M	M	<=16	Set the AMHS management domain name.		
2.3	private-domain-identifier	O	M-	X	D	X	M-	<=16			The value of this parameter may be used in the future.
3	EncodedInformationTypes										
3.1	built-in-encoded-information-types	M	M	G	D	M	M	-	Set the value of "ia5-text(2)=1"		BITSTRING
3.2	non-basic parameters	O	M-	X	D	X	M-	-			
3.3	extended-encoded-information-types	O	M	X	D	X	O	-			
4.	PerMessageIndicators	M	M	G	D	M	M	-			BITSTRING In X.400, if the value doesn't exist, all bits are considered to be OFF.
4.1	disclosure-of-other-recipients(0)	M	M	G	D	M	M	-	Set the abstract value "disclosure-of-other-recipients-prohibited(0)"		

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
4.2	implicit-conversion-prohibited(1)	M	M	G	D	M	M	-	Set the abstract value "implicit-conversion-prohibited(1)"		
4.3	alternate-recipient-allowed(2)	M	M	G	D	M	M	-	Set the abstract value "alternate-recipient-allowed(1)"		
4.4	content-return-request(3)	M	M	G	D	M	M	-	Set the abstract value "content-return-not-requested(0)"	Ignored and considered "content-return-not-requested(0)". However, if error occurs in the ATN component of AMHS and "content-return-request(1)" is set, it is impossible to restrain this service.	
5	PerDomainBilateralInformation	O	M-	X	D	X	M-	-			
6	TraceInformation										
6.1	TraceInformationElement	M	M	G	D	M	M	-			
6.1.1	global-domain-identifier	M	C1	X	D	X	M	-		If the last trace information of this parameter differs from the input MTA, then generate NDR.	
6.1.2	domain-supplied-information	M	M	G	D	M	M	-			
6.1.2.1	arrival-time	M	C2	G	D	M	M	-	Set the value of the time which AFTN/AMHS Gateway received the message.		
6.1.2.2	routing-action	M	M-	G	D	M	M	-	Set the abstract value of "relayed(0)".		
6.1.2.3	attempted-domain	O	M-	X	D	X	M-	-			

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
6.1.2.4	additional actions	O	M-	X	D	X	M-	-			
6.1.2.4.1	deferred-time	O	M-	X	D	X	M-	-			
6.1.2.4.2	converted-encode-information-types	O	M-	X	D	X	O	-			
6.1.2.4.3	other-actions	O	M-	X	D	X	M-	-			

Table 1.3 Extension Data Types
(Based on : ATSMHS SARPs Table 3.1.2-6 for O, Table 3.1.2-12 for R)

		support		AMHS-Action		AMHS-support			Detailed Action		
NO.	element	ISP	SARPs	O	R	O	R	size	Origination	Reception	Note
5	internal-trace-information	O	M-	G	D	M	M-	-			
5.1	global-domain-identifier	M	M	G	D	M	M	<=16	Set the value which identifies AMHS Management Domain.		
5.2	mta-name	M	M	G	D	M	M	<=32	Set the value of mta-name of AMHS.		
5.3	domain-supplied-information	M	M	G	D	M	M	-			
5.3.1	arrival-time	M	M	G	D	M	M	-	Set the value of the time which AFTN/AMHS Gateway received the message		
5.3.2	routing-action	M	M	G	D	M	M	-	Set the abstract value "relayed(0)"		
5.3.3	attempt-domain	O	C1	X	D	X	M-	-			
5.3.4	additional actions	O	C2	X	D	X	M-	-			
5.3.4.1	deferred-time	O	M-	X	D	X	M-	-			
5.3.4.2	converted-encoded-information-types	O	M-	X	D	X	O	-			
5.3.4.3	other-actions	O	M-	X	D	X	M-	-			

2. IPM

Table 2.1 IPM
(Based on : ATSMHS SARPs Table 3.1.2-5 for O, Table 3.1.2-11 for R)

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
1	Interpersonal message(IPM)	M	M	T	T	M	M	-			
1.1	heading	M	M	T	T	M	M	-			
1.1.1	this-IPM	M	M	T	D	M	M	-			
1.1.1.1	user	O	M	T	D	M	M-	-	Set the same value as the originator.		
1.1.1.2	user-relative-identifier	M	M	G	D	M	M	<=64			Set the value which identifies this IPM in less than 64 octets.
1.1.2	originator	O	M	T	D	M	M-		Set the originator XF or CAAS address converted from AF address of AFTN message.		
1.1.3	authorizing-users	O	O	X	D	X	M-	-			
1.1.4	primary-recipients	O	M	T	D	M	O	-		At least one of the primary-recipients, copy-recipients, or blind-copy-recipients is mandatory.	
1.1.4.1	RecipientSpecifier	M	M	T	D	M	M	-			If the value of this parameter is as same as P1, then maximum number is 21.
1.1.4.2	recipient	M	M	T	D	M	M	-	Set the recipient XF or CAAS address converted from AF address of AFTN message.		

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
1.1.4.3	notification-requests	O	M	T	D	M	M	-	Set the bit of rn and nrn ON if and only if the value of ATS-priority-indicator is SS. (In other cases, both bits are not ON.)	If ATS-priority-indicator is SS, and value of notification of the element "primary-recipient", "copy-recipient", "blind-copy-recipient is different from "rn", and the value of per-recipient-fields is "responsible", then it is logged as an error.	According to X.400, if this parameter does not exist, all bits are considered OFF.
1.1.4.3.1	rn(0)	O	O	T	D	M	O	-			
1.1.4.3.2	nrn(1)	O	M	T	D	M	M-	-		Ignored.	
1.1.4.3.3	ipm-return(2)	O	O	X	D	X	M-	-	Always set OFF.	Ignored.	
1.1.5	copy-recipients	O	M	X	D	X	O	-	Not set.	Processed as same as primary-recipients.	
1.1.6	blind-copy-recipients	O	M	X	D	X	O	-	Not set.	Processed as same as primary-recipients.	
1.1.7	replied-to-IPM	O	M	X	D	X	M-	-			
1.1.8	obsoleted-IPMs	O	M	X	D	X	M-	-			
1.1.9	related-IPMs	O	M	X	D	X	M-	-			
1.1.10	subject	O	M	G2	D	O	M-	<=128			
1.1.11	expiry-time	O	M	X	D	X	M-	-			
1.1.12	reply-time	O	M	X	D	X	M-	-			
1.1.13	reply-recipients	O	O	X	D	X	M-	-			
1.1.14	importance	O	O	X	D	X	M-	-			
1.1.15	sensitivity	O	O	X	D	X	M-	-			
1.1.16	auto-forwarded	O	O	X	D	X	M-	-			
1.1.17	extensions	O	O	X	D	X	M-	-			
1.1.17.1	incomplete-copy	O	O	X	D	X	M-	-			
1.1.17.2	langages	O	O	X	D	X	M-	-			

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
1.1.17.3	auto-submitted	O	O	X	D	X	M-	-			
1.2	IPM BODY	M	M	M	M	M	M	-		One of the ia5-text, ia5-text-body-part, or general-text-body-part has to be set.	
1.2.1	ia5-text	O	M	T	T	M	O	-			
1.2.1.1	parameters	M	M	G	D	M	M	-			
1.2.1.1.1	repertoire	M	M	G	D	M	M	-	Set the value IA5(5).		
1.2..1.2	data	M	M	T	T	M	M	-			
1.2.2	voice	I	X	X	X	X	X	-			
1.2.3	g3-facsimile	O	X	X	X	X	X	-			
1.2.4	g4-class-1	O	X	X	X	X	X	-			
1.2.5	teletex	O	X	X	X	X	X	-			
1.2.6	videotex	O	X	X	X	X	X	-			
1.2.7	encrypted	I	X	X	X	X	X	-			
1.2.8	message	O	X	X	X	X	X	-			
1.2.9	mixed-mode	O	X	X	X	X	X	-			
1.2.10	bilaterally-defined	O	X	X	X	X	X	-			
1.2.11	nationally-defined	O	X	X	X	X	X	-			
1.2.12	externally-defined	O	X	X	X	X	X	-			
1.3	Extended Body Part										
1.3.1	ia5-text-body-part	O	X	X	T	X	O	-			
1.3.2	g3-facsimile-body-part	O	X	X	X	X	X	-			
1.3.3	g4-class1-body-part	O	X	X	X	X	X	-			
1.3.4	teletex-body-part	O	X	X	X	X	X	-			
1.3.5	videotex-body-part	O	X	X	X	X	X	-			
1.3.6	encrypt-body-part	I	X	X	X	X	X	-			
1.3.7	message-body-part	O	X	X	X	X	X	-			
1.3.8	mixed-mode-body-part	O	X	X	X	X	X	-			
1.3.9	bilaterally-defined-body-part	O	X	X	X	X	X	-			
1.3.10	nationally-defined-body-part	O	X	X	X	X	X	-			

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
1.3.11	general-text-body-part	O	X	X	T	X	O	-			
1.3.12	file-transfer-body-part	O	X	X	X	X	X	-			
1.3.13	voice-body-part	I	X	X	X	X	X	-			
1.3.14	oda-body-part	O	X	X	X	X	X	-			

Table 2.2 IPM Support of the Basic ATS Message Service
(Based on : ATSMHS SARPs Table 3.1.2-5 for O, Table 3.1.2-11 for R)

		support		AMHS-Action		AMHS-support			Detailed Action		
NO.	element	ISP	SARPs	O	R	O	R	size	Origination	Reception	Note
1	ATS-Message-Header	-	M	T	T	M	M	-			
1.1	start- of heading	-	M	G	-	M	M	-	Set (SOH)		
1.2	ATS-Message-Priority	-	M	T	T	M	M	-			
1.2.1	priority-prompt	-	M	G	-	M	M	-	Set the value "PRI:(single space)".		
1.2.2	priority-indicator	-	M	T	T	M	M	-			
1.2.3	priority-separater	-	M	G	-	M	M	-	Set (CR)(LF)		
1.3	ATS-Message-Filing-Time	-	M	T	T	M	M	-			
1.3.1	filing-time-prompt	-	M	G	-	M	M	-	Set the value "FT:(single space)".		
1.3.2	filing-time	-	M	T	T	M	M	-			
1.3.3	filing-time-separater	-	M	G	-	M	M	-	Set (CR)(LF)		
1.4	ATS-Message-Optional-Heading-Info	-	O	T1	T1	O	M	-			
1.4.1	OHI-prompt	-	M	G	-	M	M	-	Set the value "OHI:(single space)".		
1.4.2	optional-heading-information	-	M	T	T	M	M	-			
1.4.3	OHI-separater	-	M	G	-	M	M	-	Set (CR)(LF)		
1.5	end-of-heading-blank-line	-	M	G	-	M	M	-	Set (LF)		
1.6	start-of-text	-	M	G	-	M	M	-	Set (STX)		
2	ATS-Message-Text	-	M	T	T	M	M	-			

3. Message Transfer Envelope for IPN

Table 3.1 Message Transfer Envelope (IPN)
(Based on: ATSMHS SARPs Table 3.1.2-6 and Table 3.1.2-9 for O, Table 3.1.2-12 and Table 3.1.2-15 for R)

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
1	MessageTransferEnvelope	M	M	T	T	M	M	-			
1.1	per message fields	M	M					-			
1.1.1	message-identifier	M	M	G	D	M	M-	-			
1.1.2	originator-name	M	M	T	T	M	M	-	Set the originator XF or CAAS address converted from AF address of AFTN acknowledgement message.		
1.1.3	original-encoded-information-types	O	M-	G	D	X	M-	-			
1.1.4	content-type	M	M	G	D	M	M	-	BuiltInContentType is set the abstract value "interpersonal-messaging-1984(2) or 1988(22)"	If the value of BuiltInContentType is neither interpersonal-messaging-1984(2) nor interpersonal-messaging-1988(22), then generate NDR[NDRC=1,NDDC=15].	
1.1.5	content-identifier	O	M-	G	D	X	M-	<=16			
1.1.6	priority	M	M	G	D	M	M	-	Set "urgent".		
1.1.7	per-message-indicators	M	M	G	D	M	M	-			See Table 3.2/4
1.1.8	deferred-delivery-time	O	M-	X	D	M	M-	-			
1.1.9	per-domain-bilateral-information	O	M-	X	D	X	M-	-			
1.1.10	trace-information	M	M	G	D	M	M	-			

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
1.1.11	extensions	M	M	G	D	M	M-	-			In X.400, if the value doesn't exist, it is considered to be not selected.
	type	M	M	G	D	M	M	-	Set the abstract value "internal-trace-information (38)".		Only supports "standard-extension".
	criticality	M	M	G	D	M	M	-			In X.400, if the value doesn't exist, it is considered to be not selected.
	value	M	M	M	D	M	M	-	Set the value of "internal-trace-information "		
1.1.11.1	recipient-reassignment-prohibited	O	M-	X	D	X	M-	-			
1.1.11.2	dl-extension-prohibited	O	M-	X	D	X	M-	-			
1.1.11.3	conversion-with-loss-prohibited	O	M-	X	D	X	M-	-			
1.1.11.4	latest-delivery-time	O	M-	X	D	X	M-	-		If this exists, and the current time exceeds the value, then generate NDR[NDRC=1,NDDC=5].	
1.1.11.5	originator-return-address	O	M-	X	D	X	M-	-			
1.1.11.6	originator-certificate	O	M-	X	X	X	X	-		If the value is "CRITICAL FOR DELIVERY" then generate NDR[NDRC=1,NDDC=18].	

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
1.1.11.7	content-confidentiality-algorithm-identifier	O	M-	X	X	X	X	-		If the value is "CRITICAL FOR DELIVERY" then generate NDR[NDRC=1,NDDC=19].	
1.1.11.8	message-origin-authentication-check	O	M-	X	X	X	X	-		If the value is "CRITICAL FOR DELIVERY" then generate NDR[NDRC=1,NDDC=20].	
1.1.11.9	message-security-label	O	M-	X	X	X	X	-		If the value is "CRITICAL FOR DELIVERY" then generate NDR[NDRC=1,NDDC=21].	
1.1.11.10	content-correlator	O	M-	X	D	X	M-	<= 512			
1.1.11.11	dl-expansion-history	O	M-	X	D	X	O	-			
1.1.11.12	internal-trace-information	O	M-	G	D	M	M-	-			
1.2	per-recipient-fields	M	M	T	D	M	M	-			Number of recipient is always one.
1.2.1	recipient-name	M	M	T	D	M	M	-	Set the MF (XF or CAAS) address of the originator of the subject IPM.		
1.2.2	originally-specified-recipient-number	M	M	G	D	M	M	-	Set "1".		

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
1.2.3	per-recipient-indicators	M	M	G	D	M	M	-	Set the following values : responsibility=responsible(1) originating-MTA-reportrequest=non-delivery-report(01) originator-report-request= non-delivery-report(00)		BITSTRING
1.2.4	explicit-conversion	O	M-	X	D	X	M-	-			
1.2.5	extensions	M	M-	X	D	X	M-	-			In X.400, if the value doesn't exist, it is considered to be not selected.
	type	M	M	-	D	-	M	-			Only supports "standard-extension".
	criticality	M	M	-	D	-	M	-			
	value	M	M	-	D	-	M	-			
1.2.5.1	originator-requested-alternate-recipient	O	M-	-	D	-	M-	-			
1.2.5.2	requested-delivery-method	O	M-	-	D	-	M-	-			
1.2.5.3	physical-forwarding-prohibited	O	M-	-	X	-	M-/X	-		If the criticality is "CRITICAL FOR DELIVERY", then generate NDR[NDRC=3,NDDC=18].	
1.2.5.4	physical-forwarding-address-request	O	M-	-	X	-	M-/X	-		If the criticality is "CRITICAL FOR DELIVERY", then generate NDR[NDRC=3,NDDC=18].	

		support		AMHS-Action		AMHS-support			Detailed Action		
NO.	element	ISP	SARPs	O	R	O	R	size	Origination	Reception	Note
1.2.5.5	physical-delivery-modes	O	M-	-	X	-	M-/X	-		If the criticality is "CRITICAL FOR DELIVERY", then generate NDR[NDRC=3,NDDC=18].	
1.2.5.6	registed-mail-type	O	M-	-	X	-	M-/X	-		If the criticality is "CRITICAL FOR DELIVERY", then generate NDR[NDRC=3,NDDC=18].	
1.2.5.7	recipient-number-for-advice	O	M-	-	X	-	M-/X	-		If the criticality is "CRITICAL FOR DELIVERY", then generate NDR[NDRC=3,NDDC=18].	
1.2.5.8	physical-redirection-attributes	O	M-	-	X	-	M-/X	-		If the criticality is "CRITICAL FOR DELIVERY", then generate NDR[NDRC=3,NDDC=18].	
1.2.5.9	physical-delivery-report-request	O	M-	-	X	-	M-/X	-		If the criticality is "CRITICAL FOR DELIVERY", then generate NDR[NDRC=3,NDDC=18].	

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
1.2.5.10	message-token	O	M-	-	X	-	M-/X	-		If the criticality is "CRITICAL FOR DELIVERY", then generate NDR[NDRC=1,NDDC=18].	
1.2.5.11	content-integrity-check	O	M-	-	X	-	M-/X	-		If the criticality is "CRITICAL FOR DELIVERY", then generate NDR[NDRC=1,NDDC=18].	
1.2.5.12	proof-of-delivery-request	O	M-	-	X	-	M-/X	-		If the criticality is "CRITICAL FOR DELIVERY", then generate NDR[NDRC=1,NDDC=18].	
1.2.5.13	redirection-history	O	M-	-	D	-	M-	-			
2	content	M	M	T	T	M	M	-	Set the generated IPN.		

Table 3.2 Common Data Type

(Based on : ATSMHS SARPs Table 3.1.2-6 and Table 3.1.2-9 for O, Table 3.1.2-12 and Table 3.1.2-15 for R)

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
1	MTS-Identifier										
1.1	global-domain-identifier	M	M	G	D	M	M	<=16			
1.2	local-identifier	M	M	G	D	M	M	<=32	Set the characters which identifies message in ia-5 characters.		
2	GlobalDomainIdentifier										
2.1	country-name	M	M	G	D	M	M	2 or 3	Set the country name of AMHS management domain.		
2.2	administration-domain-name	M	M	G	D	M	M	<=16	Set the AMHS management domain name.		
2.3	private-domain-identifier	O	M-	X	D	X	M-	-			
3	EncodedInformationTypes										
3.1	built-in-encoded-information-types	M	M	G	D	X	M	-			BITSTRING
3.2	non-basic parameters	O	M-	X	D	X	M-	-			
3.3	extended-encoded-information-types	O	M	X	D	X	O	-			
4.	PerMessageIndicators	M	M	G	D	G	D	-			BITSTRING In X.400, if the value doesn't exist, all bits are considered to be OFF.
4.1	disclosure-of-other-recipients(0)	M	M	G	D	G	D	-	Set the abstract value "disclosure-of-other-recipients-prohibited(0)"		
4.2	implicit-conversion-prohibited(1)	M	M	G	D	G	D	-	Set the abstract value "implicit-conversion-prohibited(1)"		

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
4.3	alternate-recipient-allowed(2)	M	M	G	D	G	D	-	Set the abstract value "alternate-recipient-allowed(1)"		
4.4	content-return-request(3)	M	M	G	D	G	D	-	Set the abstract value "content-return-not-requested(0)"	Ignored and considered "content-return-not-requested(0)". However, if error occurs in the ATN component of AMHS and "content-return-request(1)" is set, it is impossible to restrain this service.	
5	PerDomainBilateralInformation	O	M-	X	D	X	D	-			
6	TraceInformation										
6.1	TraceInformationElement	M	M	G	D	M	M	-			
6.1.1	global-domain-identifier	M	C1	X	D	M	M	-		If the last trace information of this parameter differs from the input MTA, then generate NDR.	
6.1.2	domain-supplied-information	M	M	G	D	M	M	-			
6.1.2.1	arrival-time	M	C2	G	D	M	M	-	Set the value of the time which AFTN/AMHS Gateway received the message		
6.1.2.2	routing-action	M	M-	G	D	M	M	-	Set the abstract value of "relayed(0)".		
6.1.2.3	attempt-domain	O	M-	X	D	X	M-	-			
6.1.2.4	additional actions	O	M-	X	D	X	M-	-			
6.1.2.4.1	deferred-time	O	M-	X	D	X	M-	-			

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
6.1.2.4.2	converted-encode-information-types	O	M-	X	D	X	M-	-			
6.1.2.4.3	other-actions	O	M-	X	D	X	M-	-			

Table 3.3 Extension Data Types
(Based on: ATSMHS SARPs Table 3.1.2-6 for O, Table 3.1.2-12 for R)

		support		AMHS-Action		AMHS-support			Detailed Action		
NO.	element	ISP	SARPs	O	R	O	R	size	Origination	Reception	Note
5	internal-trace-information	O	M-	G	D	M	M-	-			
5.1	global-domain-identifier	M	M	G	D	M	M	16	Set the value which identifies AMHS Management Domain.		
5.2	mta-name	M	M	G	D	M	M	32	Set the value of mta-name of AMHS.		
5.3	domain-supplied-information	M	M	G	D	M	M	-			
5.3.1	arrival-time	M	M	G	D	M	M	-	Set the value of the time which AFTN/AMHS Gateway received the message		
5.3.2	routing-action	M	M	G	D	M	M	-	Set the abstract value "relayed(0)"		
5.3.3	attempt-domain	O	C1	X	D	X	M-	-			
5.3.4	additional actions	O	C2	X	D	X	M-	-			
5.3.4.1	deferred-time	O	M-	X	D	X	M-	-			
5.3.4.2	converted-encoded-information-types	O	M-	X	D	X	O	-			
5.3.4.3	other-actions	O	M-	X	D	X	M-	-			

3. IPN

Table 4.1 IPN
(Based on: ATSMHS SARPs Table 3.1.2-8 for O, Table 3.1.2-14 for R)

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
1	Interpersonal Notification(IPN)	M	M	-	-	M	M	-			
1.1	Common-fields	M	M	-	-	M	M	-			
1.1.1	subject-ipm	M	M	G	D	M	M	-	Set the value of this-IPM of the subject IPM.		
1.1.2	ipn-originator	O	M	T	D	M	O	-	Set the originator XF and CAAS address converted from AF address of AFTN message.		
1.1.3	ipm-preferred-recipient	O	M	G2	D	O	O	-	This parameter exists when the recipient indicated by subject IPM and the real recipient differs, and set the recipient which was on the subject IPM.		
1.1.4	conversion-eits	O	M	G2	D	O	O	-	If the originally-encoded-information-types of the subject IPM and encoded-information types at the reception differ, set the encoded-information-types at the reception.		
1.1.5	notification-extensions	O	M	X	D	X	M	-			
1.2	non-receipt-fields	M	M	X	D	X	O	-		Either non-receipt-field or receipt-field is mandatory.	

		support		AMHS-Action		AMHS-support			Detailed Action		
NO.	element	ISP	SARPs	O	R	O	R	size	Origination	Reception	Note
1.3	receipt-fields	M	M	T	T	M	M	-			
1.3.1	receipt-time	M	M	T	T	M	M	-	Convert the time to UTC-TIME format and set the value.	Convert to AFTN format.	UTC-TIME format is YYMMDDhhmm[ss]Z or YYMMDDhhmm[ss]+(or -) hhmm
1.3.2	acknowledgment-mode	O	O	G	D	M	M-	-	Set the abstract value "manual(0)"		The default value of this element is "manual", so it is not necessary to set the value.
1.3.3	suppl-receipt-info	O	O	X	D	X	M-	-			
1.3.4	rn-extension	O	I	X		X	M-	-			
1.3.5	other-notification-type-fields	O	I	X		X	M-	-			

Table 4.2 OR Descripor
(Based on: ATSMHS SARPs Table 3.1.2-8 for O, Table 3.1.2-14 for R)

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
1	ORDescriptor										
1.1	formal-name	M	M	T	-	M	M	-			
1.2	free-form-name	O	O	X	-	X	M-	<=64			
1.3	telephone-number	O	O	X	-	X	M-	-			

5. ReportTransfer Envelope

Table 5.1 Report Transfer Envelope
(Based on: ATSMHS SARPs Table 3.1.2-17 for O, Table 3.1.2-18 for R)

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
1	ReportTransferEnvelope	M	M	G	D	M	M	-			
1.1	report-identifier	M	M	G	D	M	M	-			
1.2	report-destination-name	M	M	G	T	M	M	-	If the subject message has the element "dl-expansion-history", and OR name of last element of dl-expansion-history does not exist, set the originator-name of the subject message.		
1.3	trace-information	M	M	G	D	M	M	-			
1.4	extensions	M	M	G	D	M	M	-			In X.400, if the value doesn't exist, it is considered to be not selected.
1.4.1	type	M	M	G	D	M	M	-			Only supports "standard-extension".
1.4.2	criticality	M	M	G	D	M	M	-			In X.400, if the value doesn't exist, it is considered to be not selected.
1.4.3	value	M	M	M	D	M	M	-	Set the value of "internal-trace-information".		
1.4.4	message-security-label	O	M-	X	D	X	D	-			

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
1.4.5	originator-and-DL-expansion-history	O	M-	G2	D	O	D	-	Only when the element "DL-expansion-history" exists in the subject message, set the value.		
1.4.6	reporting-DL-name	O	M-	X	D	X	M-	-			
1.4.7	reporting-MTA-certificate	O	M-	X	D	X	M-	-			
1.4.8	report-origin-authentication-check	O	M-	X	D	X	M-	-			
1.4.9	internal-trace-information	O	M-	G	D	M	M-	-			
1.4.9.1	global-domain-identifier	M	M	G	D	M	M	<=16	Set the value which identifies the AMHS management domain.		
1.4.9.2	domain-supplied-information	M	M	G	D	M	M	-			
1.4.9.3	arrival-time	M	M	G	D	M	M	-	Set the value of the time which AFTN/AMHS Gateway received the message		
1.4.9.4	routing-action	M	M	G	D	M	M	-	Set the abstract value "relayed(0)".		
1.4.9.5	attempt-domain	O	C1	X	D	X	M	-			
1.4.9.6	additional actions	O	C2	X	D	X	M	-			
1.4.9.7	deferred-time	O	M-	X	D	X	M	-			
1.4.9.8	converted-encoded-information-types	O	M-	X	D	X	M	-			
1.4.9.9	other-actions	O	M-	X	D	X	M	-			
2	ReportTransferContent	M	M			M	M	-			
2.1	per report fields							-			
2.1.1	subject-identifier	M	M	G	D	M	M	-	Set the value of the "message-identifier" of the subject message."	It is expected that the value of message-identifier of the subject message is set.	

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
2.1.2	subject-intermediate-trace-information	O	M	G2	D	O	M-	-	If the originating-MTA-report-request of the per-recipient-indicator of the recipient of the subject message per-recipient-indicator takes the value "audited-report", set the value of trace-information of the subject message.		
2.1.3	original-encoded-information-types	O	M	X	D	X	M-	-			
2.1.4	content-type	O	M	X	D	X	M-	-			
2.1.5	content-identifier	O	M	X	D	X	M-	-			
2.1.6	returned-content	O	M-	X	D	X	M-	-			
2.1.7	additional-information	O	M-	X	D	X	M-	-			
2.1.8	extensions	M	M	G2	D	O	M-	-			
2.1.8.1	content-correlator	O	M	G2	D	O	M-	-	If the element "content-correlator" exists in the subject message, the value of the element is set.		
2.2	per-recipient-fields	M	M	T	T	M	M	-			
2.2.1	actual-recipient-name	M	M	T	T	M	M	-	Set the recipient-name of the corresponding per-recipient field of the subject message.		

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
2.2.2	originally-specified-recipient-number	M	M	G	D	M	M	-	Set the value of originally-specified recipient number of the corresponding per-recipient field of the subject message.		
2.2.3	per-recipient-indicators	M	M	G	D	M	M	-	Set the value of the corresponding per-recipient-indicator of the per-recipient-fields of the subject message.		BITSTRING
2.2.4	last-trace-information	M	M	G	D	M	M	-			
2.2.4.1	arrival-time	M	M	G	D	M	M	-	Set the value of the time which AFTN/AMHS Gateway received the message		
2.2.4.2	converted-encoded-information-types	O	M	G2	D	O	M-	-	If the original-EIT and the final EIT are different, set the value of the final EIT. In other cases, nothing is set.		
2.2.4.3	report-type	M	M	G	D	M	M	-			
2.2.4.3.1	delivery	M	M	G2	D	O	X	-	Set this value when the probe is successfully passed to AFTN Component.		
2.2.4.3.2	message-delivery-time	M	M	G	D	M	X	-	If the report is a delivery report, set the time at which the subject message has been successfully passed to AFTN Component.		

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
2.2.4.3.3	type-of-MTS-user	M	M	G	D	M	X	-	Set the abstract value "other(6)".		If this parameter is omitted, then set the value "public(0)".
2.2.4.3.2	non-delivery	M	M	G	D	M	M	-			
2.2.4.3.2.1	non-delivery-reason-code	M	M	G	D	M	M	-	Set the defined NDRC.	If NDRC=1 and NDDC=0, then generate unknown addressee AFTN service message.	
2.2.4.3.2.2	non-delivery-diagnostic-code	O	M	G	D	M	M	-	Set the defined NDDC.		
2.2.5	originally-intended-recipient-name	O	M-	G2	D	O	O	-	If there exists redirection-history element, set the first O/R name of the subject message.		
2.2.6	supplementary-information	O	M-	G2	D	O	O	<=256	a) If delivery report (probe), set the value "This report only indicates successful (potential) conversion to AFTN, not delivery to a recipient" b) If non-delivery report set the value defined in each error (if not defined, set nothing)		
2.2.7	extensions	M	M-	G2	D	O	O	-			In X.400, if the value doesn't exist, it is considered to be not selected.
2.2.7.1	type	M	M	G2	D	M	M	-			Only supports "standard-extension".
	criticality	M	M	G2	D	M	M	-			
	value	M	M	G2	D	M	M	-			

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
2.2.7.1.1	redirection-history	O	M-	G2	D	O	M-	-	If there exists the "redirection-history", set that value.		
2.2.7.1.2	physical-forwarding-address	O	M-	X	X	X	X	-			
2.2.7.1.3	recipient-certificate	O	M-	X	X	X	X	-			
2.2.7.1.4	proof-of-delivery	O	M-	X	X	X	X	-			

Table 5.2 Common Data Types
(Based on: ATSMHS SARPs Table 3.1.2-17 for O, Table 3.1.2-18 for R)

		support		AMHS-Action		AMHS-support			Detailed Action		
NO.	element	ISP	SARPs	O	R	O	R	size	Origination	Reception	Note
1	MTS-Identifier										
1.1	global-domain-identifier	M	M	G	D	M	M	<=16			
1.2	local-identifier	M	M	G	D	M	M	<=32	Set the value which identifies the report in ia-5 characters.		
2	GlobalDomainIdentifier										
2.1	country-name	M	M	G	D	M	M	2 or 3	Set the country name of the AMHS management domain.		
2.2	administration-domain-name	M	M	G	D	M	M	<=16	Set the name of the AMHS management domain.		
2.3	private-domain-identifier	O	M-	X	D	X	M-	<=16			
6	TraceInformation										
6.1	TraceInformationElement	M	M	G	D	M	M	-			
6.1.1	global-domain-identifier	M	C1	X	D	M	M	-		If the last trace information of the global-domain-identifier differs from input MTA, generate NDR.	
6.1.2	domain-supplied-information	M	M	G	D	M	M	-			
6.1.2.1	arrival-time	M	C2	G	D	M	M	-	Set the value of the time which AFTN/AMHS Gateway received the message.		
6.1.2.2	routing-action	M	M-	G	D	M	M	-	Set the abstract value "relayed(0)".		
6.1.2.3	attempt-domain	O	M-	X	D	X	M-	-			

NO.	element	support		AMHS-Action		AMHS-support		size	Detailed Action		Note
		ISP	SARPs	O	R	O	R		Origination	Reception	
6.1.2.4	additional actions	O	M-	X	D	X	M-	-			
6.1.2.4.1	deferred-time	O	M-	X	D	X	M-	-			
6.1.2.4.2	converted-encode-information-types	O	M-	X	D	X	M-	-			
6.1.2.4.3	other-actions	O	M-	X	D	X	M-	-			

6. Probe Transfer Envelope

Table 6.1 Probe Transfer Envelope

NO.	element	support ISP	AMHS support	size	Detailed Action Reception	Note
1	probeTransferEnvelope	M	M	-		
1.1	per message fields	M	M	-		
1.1.1	probe-identifier	M	M	-		
1.1.2	originator-name	M	M	-		
1.1.3	original-encoded-information-types	O	M	-		
1.1.4	content-type	M	M	-	If the value of BuiltInContentType is neither interpersonal-messaging-1984(2) nor interpersonal-messaging-1988(22), then generate NDR[NDRC=1,NDDC=15].	
1.1.5	content-identifier	O	M-	<=16		It was agreed to be "X" in the TMC.
1.1.6	content-length	O	M-	-		
1.1.7	per-message-indicators	M	M	-		BITSTRING In X.400, if the value doesn't exist, all bits are considered to be OFF.
1.1.7.1	disclosure-of-other-recipients(0)	M	M	-		
1.1.7.2	implicit-conversion-prohibited(1)	M	M	-		
1.1.7.3	alternate-recipient-allowed(2)	M	M	-		
1.1.7.4	content-return-request(3)	M	M	-		
1.1.8	per-domain-bilateral-information	O	M-	-		It was agreed to be "X" in the TMC."
1.1.9	trace-information	M	M	-		
1.1.10	extensions	M	M	-		In X.400, if the value doesn't exist, it is considered to be not selected.

NO.	element	support ISP	AMHS support	size	Detailed Action Reception	Note
	type	M	M	-		Only supports "standard-extension".
	criticality	M	M	-		In X.400, if the value doesn't exist, it is considered to be not selected.
	value	M	M	-		
1.1.10.1	recipient-reassignment-prohibited	O	M-	-		
1.1.10.2	dl-extension-prohibited	O	M-	-		
1.1.10.3	conversion-with-loss-prohibited	O	M-	-		
1.1.10.4	originator-certificate	O	M-/X	-	If the value is "CRITICAL FOR DELIVERY", then generate NDR[NDRC=1,NDDC=18].	
1.1.10.5	message-security-label	O	M-/X	-	If the value is "CRITICAL FOR DELIVERY", then generate NDR[NDRC=1,NDDC=21].	
1.1.10.6	content-correlator	O	M-	<=512		
1.1.10.7	probe-origin-authentication-check	O	M-	-		
1.1.10.8	internal-trace-information	O	M-	-		
1.1.10.8.1	global-domain-identifier	M	M	-		
1.1.10.8.2	mta-name	M	M	<=32	Set the value which identifies AMHS.	
1.1.10.8.3	mta-supplied-information	M	M	-		
1.1.10.8.3.1	arrival-time	M	M	-		
1.1.10.8.3.2	routing-action	M	M	-		
1.1.10.8.3.3	attempt-domain	O	M-	-		

NO.	element	support ISP	AMHS support	size	Detailed Action Reception	Note
1.1.10.8.4	additional actions	O	M-	-		
1.1.10.8.4.1	deferred-time	O	M-	-		
1.1.10.8.4.2	converted-encoded-information-types	O	M-	-		
1.1.10.8.4.3	other-actions	O	M-	-		
1.2	per-recipient-fields	M	M	-		
1.2.1	recipient-name	M	M	-		
1.2.2	originally-specified-recipient-number	M	M	-		
1.2.3	per-recipient-indicators	M	M	-		BITSTRING
1.2.4	explicit-conversion	O	M-	-		
1.2.5	extensions	M	M-	-		In X.400, if the value doesn't exist, it is considered to be not selected.
	type	M	M	-		Only supports "standard-extension".
	criticality	M	M	-		
	value	M	M	-		
1.2.5.1	originator-requested-alternate-recipient	O	M-	-		
1.2.5.2	requested-delivery-method	O	M-	-		
1.2.5.3	physical-redirection-attributes	O	M-/X	-	If the value is "CRITICAL FOR DELIVERY", then generate NDR[NDRC=1,NDDC=18].	
1.2.5.4	redirection-history	O	O	-		

Table 6.2 Common Data Type

NO.	element	support ISP	AMHS support	size	Action Reception	Note
1.	MTS-Identifier					
1.1	global-domain-identifier	M	M	<=16		
1.2	local-identifier	M	M	<=32		
2	GlobalDomainIdentifier					
2.1	country-name	M	M	2 or 3		
2.2	administration-domain-name	M	M	<=16		
2.3	private-domain-identifier	O	M-	<=16		The value of this parameter may be used in the future.
3	EncodedInformationTypes					
3.1	built-in-encoded-information-types	M	M	-		BITSTRING
3.2	non-basic parameters	O	M-	-		
3.3	extended-encoded-information-types	O	O	-		
6	TraceInformation					
6.1	TraceInformationElement	M	M	-		
6.1.1	global-domain-identifier	M	M	-	If the last trace information of this parameter differs from the input MTA, then generate NDR.	
6.1.2	domain-supplied-information	M	M	-		
6.1.2.1	arrival-time	M	M	-		
6.1.2.2	routing-action	M	M	-		
6.1.2.3	attempt-domain	O	M-	-		
6.1.2.4	additional actions	O	M-	-		
6.1.2.4.1	deferred-time	O	M-	-		

NO.	element	support ISP	AMHS support	size	Action Reception	Note
6.1.2.4.2	converted-encode-information-types	O	M-	-		
6.1.2.4.3	other-actions	O	M-	-		

**STRATEGY FOR AERONAUTICAL MOBILE (R) SERVICE
IN THE ASIA/PAC REGION**

Provision of Aeronautical Mobile (R) Service in the ASIA/PAC Region will be guided by following strategy:

1. A channel spacing of 25 kHz will continue to be operational specification.

2. The VHF voice service, backed by CPDLC and HF will be the primary communication medium for transcontinental traffic; and a combination of CPDLC and HF voice will be the communication medium for oceanic traffic.

3. The requirement for basic voice communication will continue, supplemented by data-link Flight Information Service (DFIS) applications including D-VOLMET, D-ATIS and PDC to significantly reduce pressure on VHF spectrum congestion.

4. Frequency band 136 – 137 MHz will be used exclusively for the air-ground VHF data-link application.

INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE

DRAFT GUIDANCE MATERIAL

FOR THE ASIA/PACIFIC REGION

FOR ADS/CPDLC/AIDC GROUND SYSTEMS

PROCUREMENT AND IMPLEMENTATION

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CHAPTER 1 INTRODUCTION

This material has been developed under an initiative of the Regional Airspace Safety Monitoring Advisory Group (RASMAG) of the Asia Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG) to assist air navigation service providers (ANSP) with the implementation of datalink-based air traffic management (ATM) systems.

For the purposes of this document, a datalink-based ATM system is one which supports automatic dependent surveillance (ADS), controller-pilot datalink communications (CPDLC) and air traffic service (ATS) interfacility datalink communications (AIDC).

Integrated datalink systems are playing an increasingly important role in air traffic management. Datalink operations support reduced separation minima and so directly contribute to increased airspace capacity. Controller and pilot workload is reduced, and operational safety enhanced, by the automation enabled by datalink systems. As the use of these systems spreads, so more ANSPs must equip with the appropriate facilities.

The material covers two main aspects of implementation: specification and deployment.

Technical systems must be carefully specified from both the technical and operational aspects, and at the right level of detail: enough to ensure that the requirements are met, but not so much that good solutions may be excluded.

The deployment of a new system involves a number of vital steps, such as testing, training, integrating and commissioning.

This material offers guidance, rather than solutions, with the emphasis on specifying systems supporting ADS, CPDLC and AIDC.

It is not the intention of this document to provide the detailed technical information required to specify datalink applications: this information may be found in the various ICAO and other documents referenced.

1.1 OBJECTIVE

The objective of this document is to provide guidance on the specification, procurement and implementation of datalink systems for States and service providers unfamiliar with these systems.

1.2 SCOPE

The material is divided into three sections. The first covers the generalities of procuring and implementing a new system, the second is concerned with the requirements of a datalink-based ATM system, and the third gives guidance on specifying a system.

For the purposes of this material, it is assumed that the ANSP is the organisation setting out to procure a system.

1.2.1 Procurement and Implementation

Procurement and implementation includes:

- Planning and contracting
- Supervision and inspection
- Preparation for operation
- Operational transfer

1.2.2 Requirements

The Requirements section covers general requirements for datalink systems and specific requirements for:

- Datalink Initiation Capability (DLIC)
- ADS
- CPDLC
- AIDC

1.2.3 Specification

The Specification section offers guidance on the specification of:

- System configuration
- Interfaces
- Functionality
- Human-Machine Interface
- Capacity and parameters
- Recording and data analysis

1.3 SYSTEMS OVERVIEW

A key objective of datalink systems is to support reduced separation minima: any new datalink system should be capable of supporting 30NM lateral and 30NM longitudinal separation based on RNP 4.

1.3.1 ADS

Automatic Dependent Surveillance is a surveillance technique in which aircraft automatically provide, via a data link, data derived from on-board navigation and position-fixing systems, including aircraft identification, four-dimensional position, and additional data as appropriate. There are two forms of ADS: broadcast ADS (ADS-B) and contract ADS (ADS-C). With ADS-B, aircraft broadcast positional data up to twice per second; the data may be used by ground systems (and other aircraft). With ADS-C, aircraft report directly to one or more ground systems with specified data at predetermined intervals (usually tens of minutes).

Note: Throughout this document, the abbreviation ADS refers to ADS-C.

The ADS data link application allows the implementation of reporting agreements, or "contracts", which, with the exception of an aircraft in an emergency situation, are established exclusively by the ground. An ADS contract is an ADS reporting plan which establishes the conditions of ADS data reporting (i.e. the data required by the ATC system and the frequency of the ADS reports which have to be agreed upon prior to the provision of the ADS services). ADS information may be exchanged between the ground system and the aircraft by means of a single contract or a series of contracts. An ADS contract specifies under what conditions an ADS report will be initiated, and what data groups will be included in the reports.

There are three types of contract:

- *Periodic contracts* provide a report at a regular periodic interval determined by the ground system.
- *Event contracts* provide a report when or if a specified event or events take place.
- *Demand contracts* provide a single report when requested by the controller.

1.3.2 CPDLC

Controller Pilot DataLink Communications (CPDLC) is a data link application that provides a means of communication between controller and pilot, using data link for ATC communications.

Sending a message by CPDLC consists of selecting the addressee, selecting and completing, if necessary, the appropriate message from a displayed menu or by other means which allow fast and efficient message selection, and executing the transmission. The messages include clearances, expected clearances, requests, reports and related ATC information. A "free-text" capability is also provided to exchange information not conforming to defined formats. Receiving the message will normally take place by display and/or printing of the message.

CPDLC overcomes a number of the shortcomings of voice communication, such as voice channel congestion, misunderstanding due to bad voice quality and/or misinterpretation, and corruption of the signal due to simultaneous transmissions.

1.3.3 AIDC

ATS Interfacility Datalink Communications is a data link application that provides the capability to exchange data between ATS units in support of critical ATC functions.

AIDC defines messages which are related to three phases of coordination as perceived by an ATSU.

- *Notification*, in which the aircraft trajectory and any changes may be conveyed to an ATSU from the current ATSU prior to coordination.
- *Coordination*, in which the aircraft trajectory is coordinated between two or more ATSUs when the flight approaches a common boundary.
- *Transfer*, in which communications and executive control authority is transferred from one ATSU to another.

Other AIDC messages support ancillary ATC data changes between ATSUs, including the exchange of free-text messages.

Other than the formal international communication protocol standards, internet protocol (TCP/IP) as a flexible and low cost de-fact industry standard is recommended.

CHAPTER 2 PROCUREMENT

2.1 GENERAL

2.1.1 System Quality

The overall quality of a system, the Total System Quality, is the product of three main elements: the quality of the design, the quality of production and the quality in operation.

The ***Design Quality*** is a measure how well the design process has translated the operational requirements into user specifications and the user specifications into product specifications. The design quality depends upon both the definition of operational requirements and development of user specifications by the ANSP and the system design skills of the vendor. If the operational requirements are not well defined, the specification will be compromised and the system design cannot be expected to be meet the real requirements. Similarly, if the specification does not correctly reflect the operational requirements, neither will the system design.

The ***Production Quality*** is a measure of how exactly the products match the specifications, and applies to the hardware, the software and the integration of these to form the system as a whole. In general, the vendor is responsible for production quality.

The ***Operational Quality*** is a measure of how the actual operation of the system realizes the operational objectives. This depends primarily on the way the system is operated: a badly operated system is not a good system. The operational quality is mainly influenced by the operational management of the ANSP.

The ***Total System Quality*** is the product of design quality, production quality and operational quality. To achieve high total system quality is clearly necessary to maintain the highest possible quality in each of the three areas.

Cooperation between the ANSP and the vendor is essential to achieve a high total system quality.

2.1.2 Roles and Responsibilities of the ANSP

The ANSP is ultimately responsible for successful implementation of the system. It is therefore vital that the ANSP takes a positive and active role throughout the system procurement and implementation.

The vendor is only responsible for developing and integrating a system to the ANSP's specific requirements.

Air traffic controllers, as the end-users of the system, must play a positive and active role throughout the procurement and implementation activities. The clear and complete definition of operational requirements and the final testing in an operational environment are both critical and are unlikely to be completed successfully without significant controller input. Clearly defined system requirements and specifications are vital in order for potential vendors to be able to offer a suitable system.

Controllers should also be able to contribute to the design, development and integration activities, and must be directly involved in the testing and commissioning processes.

2.1.3 Relationships: Requirements, Specification and Test/Evaluation

The figure below shows the relationships between the operational requirements, the system requirements, the specification, the design and the test and evaluation process. Only the combination of a complete and feasible definition of the requirements, consistent design, quality assured development and adequate review, testing and evaluation at each stage can provide a quality system.

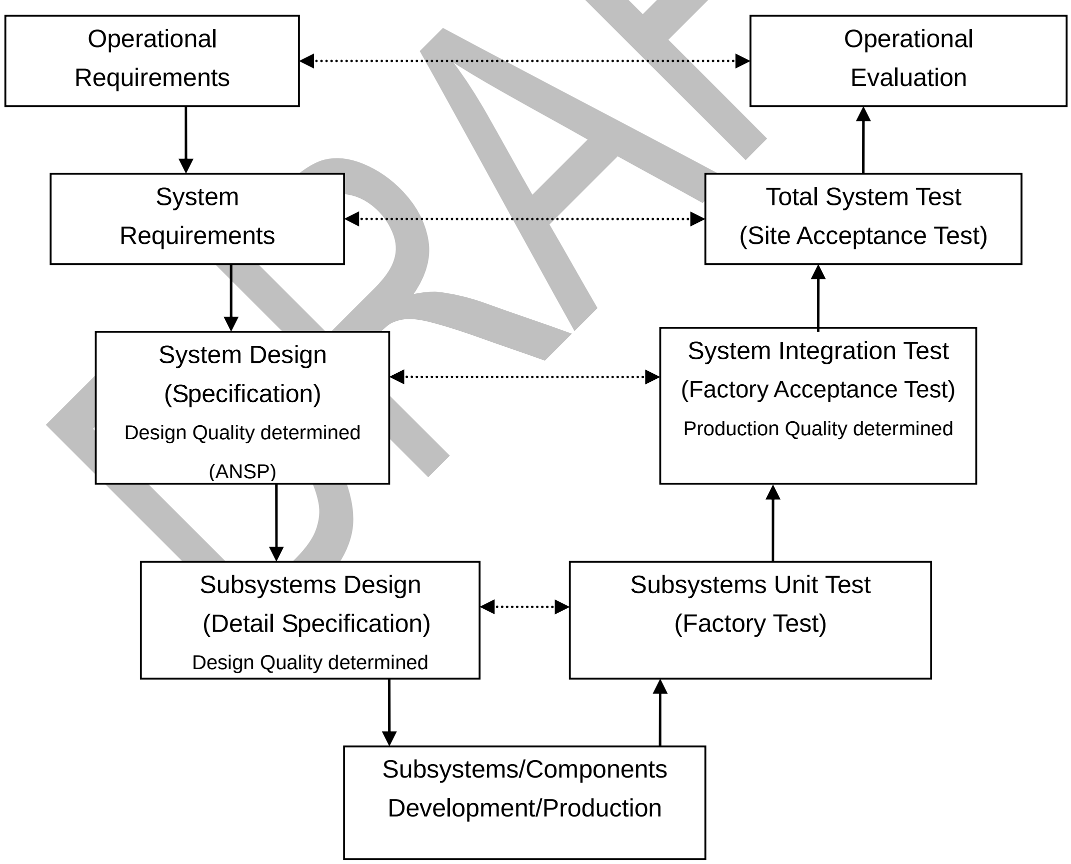

Figure1. Relationship between Requirement, Specification and Test/Evaluation

2.2 PROJECT MANAGEMENT

A project manager should be appointed as early as possible in the project. The basic role of the project manager is to ensure that the project proceeds within predetermined time, resource and cost boundaries. Project management requires a range of special skills, and serious consideration should be given to employing a professional project manager for the duration of the project.

The project manager must be given appropriate levels of financial and organisational authority so that he or she can make project decisions without constant recourse to higher management. It is essential that the terms of reference of the project manager are clearly documented and that they detail these authorities.

The project manager will be responsible for managing all aspects of the project, with particular emphasis on scheduling the many activities of ANSP personnel to match those of the system supplier. He or she will also play a major role in keeping the project within the time and budget constraints by determining what, if any, changes are made to the scope of the contract.

2.3 PLANNING AND CONTRACTING

2.3.1 Operational Requirements

The first, and perhaps most critical, stage of the planning and contracting phase is the definition of the ATS Operational Requirements; these must clearly define precisely what the system is to do. Operational requirements should not define how the results are to be achieved – that can be done in the specification.

There is no place for choice in a requirement, and the wording must reflect this; "must", "shall" and "will" make requirements mandatory. The use of words such as "may", "should" and "could", "maximum" and "minimum" and "if", "except" and "unless" make a requirement imprecise, because the reader does not know exactly what is required. "There should be 10 sectors" or "there should be at least 10 sectors" is vague. "There will be 10 sectors" is precise and leaves no doubt as to what is required.

The operational requirements should be established by a team of experienced controllers whose professional knowledge and experience encompasses all aspects of the ATS operation; the team should also include engineers and, as necessary, other specialists.

2.3.1.1 Studies of Existing Systems

The operational requirements team must have an appreciation of how datalink systems work in the operational environment; this is best achieved by studying existing systems and talking to experienced controllers, engineers and managers in other ATS facilities. The study should cover operational and technical practices and should pay particular attention to problems encountered and lessons learnt.

Controllers using these systems will be well aware of any features that do not work well or are not user-friendly, and will have suggestions for how the system could be improved. This is valuable information that should be considered when developing the specification and during the contract negotiation phase; in the latter case, a supplier could be invited to change such features in an otherwise satisfactory system.

2.3.1.2 Confirmation of Service Environments

The operational requirements team should establish the current ATS environment as the baseline, taking into account:

- Airspace structure and major airports.
- Sector configuration and VHF/radar coverage.
- The required separation minima (30/30NM horizontal separation or better)
- Traffic flows (routes, number, flight levels, etc.).
- ATS procedures.
- Related ATS facilities.

2.3.1.3 Operational Requirement Analysis

From the baseline, the team should analyse trends to determine the likely changes in the operational environment over the projected life of the system. The operational requirements can then be determined, if necessary using the projected environment at several points during the projected system life, and should detail, at the very least:

- The anticipated peak and mean traffic levels.
- The number of sectors, based on the traffic levels.
- Specific services for each sector.
- Inter-sector services.
- Inter-ATSU services.

Once these are established, the specific requirements to provide these services, such as displays and communications, can be determined.,

2.3.2 Design and Review

The next stage is for the team to define the system concept in terms of both operational requirements and technical feasibility, perhaps using other facilities as a base reference. The concept should be reviewed by controllers and managers who are not part of the team; any changes proposed should be discussed with the team and the concept modified accordingly.

2.3.2.1 Conceptual Design

The conceptual design must be documented clearly and should include the following:

- ATS functions needed (e.g. ADS reports, traffic display).
- Performance goals for the targeted airspace.
- Sector configuration.
- Physical configuration and layout.
- System operation (e.g. redundant parallel operation, automatic recovery, etc.).
- Standards to be applied (e.g. ARINC-745, RTCA DO-258A).
- Interface requirements for related ATS facilities.
- Datalink Service Provider (DSP) and its interface.
- Human Machine Interface (e.g. display size, use of colour, input devices).

The document should also identify any new operational procedures that may be required, both for new techniques, such as the use of ADS, CPDLC and AIDC, and for other changes.

2.3.2.2 Technical Feasibility Study

The team may then determine the technical feasibility of meeting the operational requirements, particularly in terms of the functionality required, the characteristics and performance of existing systems and the available budget. Preliminary information from vendors will give an indication of the systems and capabilities that are available, so that the team can decide on the most appropriate procurement option:

- A standard “off-the-shelf” system.
- A customized off-the-shelf system.
- A custom-built system.

The criteria to be used in evaluating systems in the market will include:

- Functionality meeting the requirements.
- Adequate performance and capacity to handle future traffic.
- User-friendly and intuitive operation.
- High reliability under all anticipated service conditions.
- Simple connection with related systems and facilities.
- Required standards are met.

2.3.2.3 Specification

When the operational requirements and the feasibility studies have been completed the specification can be developed. This is discussed in detail in CHAPTER 5.

2.3.2.4 Design Review

The purpose of this design review is to ensure that the conceptual design meets each and every one of the operational requirements and that it is technically achievable and attainable.

The design review team should be independent of the requirements team but should also comprise controllers, engineers and managers. The review may take the form of a walk-through of the conceptual design documents or a desk-top simulation.

The design review report should cover:

- Compliance with operational requirements.
- Connectivity with related systems and adjoining facilities.
- Flexibility and expandability in the future.
- Any operational or technical issues.

2.3.3 Request for Proposal (RFP)

A fully-documented and approved Request for Proposal (RFP) should be submitted to prospective vendors.

2.3.3.1 Objective

The objective of the RFP is to secure fully compliant proposals from a number of competent vendors.

2.3.3.2 Content

The RFP should contain all the information required for prospective vendors to make a complete and compliant proposal. Any omissions will result in enquiries from vendors, which will take time and effort to respond to. The RFP should contain:

- The specification.
- Operating environment, including:
  - External temperature and humidity ranges.
  - Temperature and humidity ranges in the equipment area and operational area.
  - Mains power supply voltage and frequency.
- Acceptance testing requirements.
- Maintenance support requirements.

- Training requirements.
- Warranty requirements.
- A draft contract, to allow vendors to see what contract requirements they will have to meet, and what arrangements they may have to make to meet them.
- Bidding conditions, including:
  - Submission of separate technical and financial bids.
  - Confidentiality.
  - The enquiry process.
  - The closing date for enquiries.
  - The closing date for bids.
  - Notification of short-listed bidders.
  - Notification of preferred bidder.
- Financial conditions, including
  - Bid bonds (if required).
  - Requirements for financing (if necessary).
  - Proposed payment schedule.
- The proposal evaluation process, including the evaluation criteria.

2.3.3.3 Enquiry Process

It is inevitable that some bidders will ask for clarification of details or for additional information. To avoid giving advantage to any particular bidder, there should be a formal process to ensure that all bidders receive the same information. This may be done by issuing a bulletin to all bidders containing each question received and the response. This should be done at frequent intervals so that vendors have time to adjust their proposals if necessary.

2.3.4 Evaluation of Proposals

Proposals must not be opened before the stated final date for bids.

The evaluation of proposals must be, and be seen to be, fair and traceable. All stages of the evaluation process should be clearly documented and the reasons for each decision recorded.

Ideally, the evaluation team will include all the members of the team that drew up the specification, complemented by other personnel as necessary. It is good practice to isolate the evaluation of the financial proposal from the rest of the process. Besides maintaining the confidentiality of the financial bids, this avoids any influence of the technical evaluation on the financial and *vice versa*.

The evaluation process and criteria stated in the RFP must be strictly followed: this should avoid any protest by unsuccessful bidders.

Proposals are not always perfect, nor do they always fully cover every item of the RFP, and so there may be a need for clarification during the evaluation phase. It may be necessary to request additional technical or financial information in order to complete the evaluation; this should take the form of a simple request for the specific information required. However, there should be no negotiation at this stage, of either technical or financial elements.

Once the preferred bidder has been selected, the other bidders should be informed that they may be invited to negotiate if a contract cannot be concluded with the preferred bidder.

2.3.5 Contract Negotiation

There should be no negotiation with bidders before the selection process has been completed. Once the preferred bidder has been determined, negotiations on the detailed conditions are acceptable. Negotiations may be by correspondence or face-to-face, and should involve the appropriate experts from the ANSP.

It is important that the negotiations cover all aspects of the contract, including the vendor's schedule. The negotiating advantage is with the purchaser until the contract is signed; it then passes to the vendor. Changes made after the contract has been signed are inevitably costly and often time-consuming.

The negotiations must be clearly documented.

If a satisfactory contract cannot be concluded, the next preferred bidder may be invited to negotiate a contract; alternatively, the tender process may be started again, but this is a costly process and is unlikely to produce a better outcome.

When the contract has been signed, the other bidders should be informed.

CHAPTER 3 IMPLEMENTATION

The implementation phase begins when the contract is signed.

Typically, the vendor's activities during the implementation phase include design review, manufacture, factory testing, documentation, training, delivery, installation, site acceptance testing and handover.

The ANSP is involved in all these activities to some degree, except manufacture; but the ANSP must also prepare for the operation of the system. This will involve developing test requirements, planning training, organising staff deployment, developing procedures and planning the operational transfer from the existing to the new system.

3.1 IMPLEMENTATION SCHEDULE

The project manager can now use the vendor's schedule as the basis for finalising the overall project schedule. The project schedule should detail all anticipated activities, including system design reviews, factory and site acceptance tests, training (both vendor training and internal training), commissioning and operational transfer. The schedule should also show related activities such as development of operational and technical procedures and preparation of operational material such as charts.

3.2 CONTRACT SUPERVISION

The project manager is normally responsible for supervision of the contract works. This can generally be achieved by monitoring the vendor's progress reports, at least until the vendor starts work on site.

It is likely that desirable changes to the specification or the contract will be identified during design reviews or factory testing. However, careful management of change is essential. Every change will incur costs and delays.

A formal change control system should be implemented, with every change being submitted for approval only after costs and delays have been established. The procedure should identify the levels of cost and delay that the project manager can approve.

3.3 SYSTEM DESIGN REVIEW

This review takes place after the vendor has completed the design for the system, and, as with the concept design review, is intended to ensure that the design meets all the operational and technical requirements. The design review is the point at which the design quality is determined It is also the last stage at which design changes should be made; however, changes made at this stage are likely to incur costs and delays.

3.4 FACTORY ACCEPTANCE TEST

The factory acceptance test is the last opportunity for the ANSP to identify problems before the system is shipped out from the factory and is the point at which the production quality is determined. It is also usually the first opportunity for ANSP personnel to examine and try out the system, and is often combined with factory-based training. It is important that operational as well as technical personnel attend the factory acceptance: it should be a test of operational features as well as of technical compliance.

The vendor should produce a detailed test schedule well before the beginning of the test, so that the ANSP can consider whether the tests meet the requirements and whether any additional tests should be included.

The results of any tests performed by the vendor before the acceptance test should be made available at the start of the acceptance test.

Any problems that are encountered during the factory test should result in agreed corrective actions to be undertaken by the vendor. These may be carried out before shipping or on site, according to the nature of the problem. The results of the factory test form an important part of the contract documentation, as they record the performance of the system and the agreed corrective actions.

3.5 PREPARATION FOR OPERATION

There are a number of items that the ANSP must address in preparation for operation of the new system. These include:

- Development of operational procedures.
- Development of system management procedures.
- Preparation of system data (for maps, etc).
- Establishment of system parameters.
- Development of internal training courses for controllers, system operators and technical staff.
- Development of operational transfer plan.
- Safety assessment.

The ANSP is responsible for carrying out these tasks, although some assistance and information from the vendor will be necessary to complete them. Some of the work can be carried before the installation begins, but it may be more convenient to leave some until the vendor's specialists are on site.

While it is not appropriate for this guidance material to address each item in detail, some items do merit discussion.

3.5.1 Operational Procedures

The FANS 1/A Operations Manual (FOM) has been adopted for Regional use and contains the procedures for the use of the datalink applications.

The ANSP may need to develop other procedures.

3.5.2 System Management Procedures

Procedures for managing the system must be developed. These should cover such topics as system start, changeovers between “main” and “standby” systems, contingency operations, map data management, data recording and monitoring,

3.5.3 Preparation of System Data

The ANSP will be required to provide data to define, for example, FIR boundaries for hand-off processing and airspace maps for the display system. The vendor will provide details of the information required and may either process the data into the system or, preferably, train and assist the ANSP staff to do so.

The preparation of this type of data can be a very detailed and time-consuming process, and due allowance should be made in the project plan.

3.5.4 Establishment of System Parameters

System parameters are used to set values for a number of variables used in the software. These parameters can be changed, but normally only by software specialists. Typical system parameters include timer intervals, for example to set the default interval between ADS periodic contracts, standard range settings, display colours, etc.

The vendor will detail the system parameters and will be able to suggest suitable values; however, the ANSP must make the final decision on each parameter. The parameters should be set before site acceptance testing, so that their effect can be determined. The parameter values should be finalised before operational transfer and changes avoided during the initial period of operation.

3.5.5 Development of Training Courses

It may not be practical or appropriate for the vendor to provide initial training for all personnel, and future training requirements must also be considered. The ANSP must develop its own training courses to complement the initial training by the vendor and to meet its future training requirements.

3.5.6 Operational Transfer Plan

The operational transfer plan should detail each step of the transfer, particularly with regard to contingency measures to recover from system problems or unexpected operational difficulties.

For each step, the plan should give details of the timing, the people involved and any other resources that may be required. It is important to clearly define the measures or events that determine that each step has been satisfactorily completed.

It is also important that the plan is made widely available so that everyone involved understands what will happen.

The operational transfer process is discussed in 3.8 below.

3.5.7 Safety Assessment

It is most important that a safety assessment (or safety case) is prepared for the introduction and operation of the system. The purpose of the safety assessment is to identify all the risks associated with the introduction and operation of the system, to establish the level of each risk and to determine how those risks can be removed or reduced to an acceptable level.

Examples of risks are ADS link failure, workstation failure, inadequate controller training, and failure to close a CPDLC message sequence.

The resulting safety assessment document will list all the risks that have been identified, the associated risk levels and the measures adopted to remove or mitigate each risk.

Safety assessments are described in detail in ICAO Doc 9859, Safety Management Manual.

3.6 TRAINING

Comprehensive training is vital so that controllers, system operators and maintenance personnel must all be able to carry out their tasks competently and effectively as soon as the system becomes operational. A comprehensive training plan is a prerequisite for a successful training programme.

Training is perhaps the most important of all the preparatory tasks.

3.6.1 Controller Training

While the separation standards that controllers apply will probably not change, at least not immediately on introduction of the new system, the tools they use will have changed significantly. The training must cover both the operation of the new workstations and the associated tools and, equally importantly, the procedures for using the datalink applications.

Training on the manipulation of the displays and controls should be provided initially by the vendor, and the ANSP's training staff should be included in the first courses. The training staff can then develop and deliver that training.

The procedures for the use of datalink applications have been developed within the Region and are laid out in regional documents. The vendor cannot be expected to provide training on datalink procedures; this is a task that must be performed by professional training controllers. The training modules must be developed well in advance, ideally in cooperation with the training sections of other ANSPs that have experience of datalink operations.

The timing of the training is important. There will almost certainly be several courses to train all controllers, and all training should be completed before operational transfer. The controllers on the earliest courses may have difficulty remembering what they have been taught; one solution is to provide short refresher courses shortly before operational transfer.

3.6.2 System Operator Training

The operation of the system includes starting and stopping the system, switching between operational and standby units, rebooting, system recovery, changing system parameters, loading data for maps, etc, and installing software changes.

The vendor must provide the first training courses for system operators. The syllabus must include the items identified above, with sufficient background to allow the operators to understand the implications of the various actions that they will be expected to perform. They should also be given a good understanding of the various functions of the system.

The training should include practical sessions using the full system, so that the operators experience the various tasks at first hand.

3.6.3 Maintenance Training

The first training courses for maintenance technicians must also be carried out by the vendor. With systems of this type, technicians must be able to diagnose faults down to circuit board level. However, as these systems include a number of computers, technicians must have an understanding of the general software structure. They should also be trained to differentiate between hardware and software faults, and to undertake simple software recovery activities.

3.6.4 Simulator Based Training

If simulator facilities are provided as part of the system, a large proportion of the training can be carried out using these facilities. Simulators are particularly valuable in allowing controllers to experience unusual or exceptional conditions, such as traffic overloads, weather deviations, route changes, emergency descents, conflictions and system failure.

3.7 SITE ACCEPTANCE TEST

The site acceptance test is the last stage before handover by the vendor. This test is crucial. It is the last opportunity to identify problems while the system remains the responsibility of the vendor and should be resolved at the vendor's expense. Once the acceptance documents are signed, the vendor can fairly claim that any new problems are the responsibility of the ANSP and will seek costs if asked to rectify them.

The vendor should produce a test schedule well before the tests are due to start, but it is unlikely that the schedule will contain tests that exercise operational procedures. The

ANSP, in consultation with the vendor, should develop operational scenarios that will test a wide range of procedures and functions and add these to the schedule.

3.7.1 Physical Checks

The first stage is typically a physical inspection and inventory check to ensure that all items are present and serial numbers recorded accurately. It is important to inspect the physical condition of all units and record any defects.

3.7.2 Technical Tests

This is generally followed by the technical tests which establish whether the system is correctly set up and is working properly. The system parameters are usually set during these tests, though some may need to be adjusted during the operational tests. System start-up, changeover and shut-down procedures, as well as contingency degradation and recovery processes, must also be tested.

3.7.3 Operational Tests

The operational tests determine whether the operational characteristics are correct, the controls function as expected and the system handles incoming and outgoing data correctly. There should also be tests to ensure that the system operates correctly under the specified maximum load.

These tests will typically take several days to complete as all functions must be tested from all workstations. A number of typical scenarios should be prepared in advance so that the tests can be carried out in a realistic environment.

It is essential that live testing of the datalink functions takes place. Tests of ADS and CPDLC will require the cooperation of either one or more airlines or alternatively an aircraft manufacturer with a suitable test-bench. If airlines are used, it must be quite clear that ATS instructions passed are for test purposes and are not to be complied with.

3.7.4 Results

As with the factory test, it is most important to record, in detail, all problems and unusual occurrences.

The outcome of the test should include an list of corrective actions to be undertaken by the vendor within an agreed timescale.

3.8 OPERATIONAL TRANSFER

The most usual ways of transferring operation to a new system are the phased transfer and the parallel operation transfer.

3.8.1 Parallel Operation Transfer

The parallel operation transfer starts with old system being used operationally and the new system running in parallel with its controllers going through their tasks as though that system was operational. When the time comes to switch over to the new system, the old is system is operated in parallel for a short time as a fall-back in case of unforeseen problems. Operation of the new system need not be full-time until shortly before transfer: for example, it would be appropriate to start parallel operations during low traffic periods and work up to busy periods. H24 parallel operation is not necessary until immediately before and after transfer.

The parallel operation transfer is generally preferable as it allows the new system to be run, in its entirety, in an environment that is as close as possible to fully operational before actually taking over the operational load. However, it does require full staffing of both systems during periods of parallel operation.

3.8.2 Phased Transfer

In the phased approach, operations are transferred bit by bit, typically one sector at a time, until the whole operation is running smoothly on the new system. This type of transfer may be more appropriate where the space available dictates that only one or two positions can be transferred at a time or where limited staff numbers mean that it is impossible to operate both systems simultaneously.

In this type of transfer, it is good practice to keep at least one sector available on the old system as a contingency position.

3.8.3 Preparation for Transfer

The transfer must be carefully planned; in particular, there must be close coordination with external ATS units that may be affected. Staff must be thoroughly briefed before the start of the transfer process and must be kept informed of any changes to the plan.

The criteria for deciding when operations can be transferred to the new system must be clearly defined in advance. If a phased transfer is planned, transfer criteria should be set for each phase.

It is quite possible that problems will arise and it may be necessary to return the operation to the current system or to the last successful step, as appropriate. The reversion process should be established in advance – if contingencies have not been planned for, it is very likely that mistakes will be made and the problem compounded.

After the transfer has been successfully completed, it is useful to hold a debriefing to determine what went well and what did not. This can identify potential problems and possible areas of concern with both the technical and the operational aspects of the system and the new procedures.

CHAPTER 4 REQUIREMENTS

4.1 GENERAL REQUIREMENTS

The integrated ATS datalink system will incorporate AFN, ADS, CPDLC and AIDC.

The system will be linked with other automated systems. The FDP system provides flight plan data, such as the flight identification and flight path. The ATS operation will be enhanced if the system has the ability to feedback current aircraft positions to the FDP system to update the flight data.

The system will be linked to aircraft by a datalink service provider (DSP).

The system will be capable of transmitting and receiving AFN, ADS and CPDLC messages complying with RTCA/DO258A-EUROCAE/ED-100 and AIDC messages complying with the Asia/Pacific Regional Interface Control Document for AIDC (ICD).

The system will include the ACARS Convergence Function (ACF) to convert messages between the character-oriented data of ACARS and the bit-oriented data used in ADS and CPDLC.

The system will provide air traffic controllers with:

- Display of message exchanges.
- Display of updated aircraft positions and maps.
- Tools for measuring separation in distance or time.
- Tools for measuring angles between aircraft flight paths.
- Information on aircraft flight status.
- HMI tools for composing ADS and CPDLC messages.
- Alerts for exception conditions (e.g. expected message not received, coordination overdue).
- Conflict probe capability.
- Electronic flight progress strips, and paper strips if required.
- Presentation of emergency status.
- Other information pertinent to ATS operations.

The system capacity will be determined from:

- Traffic density at the peak hours.
- Frequency and size of messages per aircraft.
- Airspace size and number of waypoints.
- Number of FANS capable aircraft operating in the airspace.

- Anticipated growth of FANS operation.
- Number of displays.
- Number of connections for terminal systems.

4.1.1 Notification of Error Messages

The system will be capable of performing the cyclic redundancy check (CRC) on each message.

The system will be capable of format and validity checks appropriate to each message.

Controllers will be notified when the system detects:

- A message error.
- A message sequence error.
- A duplicate message identification number.
- Message non-delivery.
- An expected response not received.

4.1.2 Time Stamps and Timers

CPDLC and AIDC messages will be time-stamped; however, the form of some timestamps is actually set differently from that specified in Doc 9694.

By setting and/or deactivating various timer values for the messages received in response to transmitted messages, the system will monitor whether or not aircraft responses arrive within a specified time limit.

Timers are generally based on the operational requirements of each ATSU. However, the timers for sending messages relating to the automatic transfer of CPDLC connection and to AIDC will be set according to bilateral agreements with adjacent ATSUs concerned.

A timer file will be provided in the system for:

- Timeout settings for delayed response.
- Timing to initiate actions in ADS/CPDLC operations for:
  - Connection request (CR).
  - ADS periodic, event and demand requests.
  - Automated transfer of connection to the next ATSU.
  - Sending Next Data Authority (NDA) message.
  - Sending AFN Contact Advisory (FN_CAD): at least 30 minutes prior to FIR boundary message.
  - Sending End Service message prior to the aircraft crossing the FIR boundary (e.g. 5 minutes before).

- Timer to trigger actions for sending AIDC messages.
- Timer for re-transmission of the message when no response is received within a specified time.

4.1.3 Applicable Documents

4.1.3.1 ICAO Documents

Annex 10, Volume III, Communication Systems

Manual of Technical Provisions for the Aeronautical Telecommunication Network – Doc 9750

Manual of Air Traffic Services Data Link Applications – Doc 9694

Regional Supplement to the ASTERIX Interface Control Document (ICD) for the Asia/Pacific Region

Asia/Pacific Regional Interface Control Document (ICD) for ATS Inter-facility Data Communications (AIDC), version 2

Guidance Material for End-to-End Safety and Performance Monitoring of ATS Datalink Systems in the Asia Pacific Region

FANS 1/A Operations Manual

4.1.3.2 Industry Standards

The industry standards for ATS datalink systems are described in the latest versions of the following documents.

- ARINC 622: ATS Datalink Applications over ACARS Air-Ground Network (end-to-end).
- RTCA DO-258/EUROCAE ED-100: Interoperability Requirements for ATS Applications Using ARNC 622 Data Communications.
- ARINC 620: Datalink Ground System Standard and Interface Specification (ground-to-ground).
- ARINC 619: ACARS Protocols for Avionics End Systems (Airborne).
- ARINC 429: Mark 33 Digital Information Transfer System (DITS).

Note: It should be noted that some message parameters for avionics are categorized as ‘option’ data, but provide information useful for ATS operations.

4.1.4 Data Recording

The contents and timestamps of all messages will be recorded by the system. There will be a facility to retrieve, display and printout the recorded data.

4.1.5 System Performance Monitoring Tool

The Central Reporting Agencies (CRAs) perform safety assessments of datalink performance, and to support this function, in accordance with the FOM, ATSUs are required to produce monthly statistics of end-to-end system performance in daily operations. The system performance criteria from the FOM are reproduced at APPENDIX C. The system should have appropriate tools for monitoring and analysing the performance data for reporting to the appropriate monitoring agency.

4.2 DATALINK INITIATION CAPABILITY

4.2.1 AFN Logon Functions

The AFN logon functions provide the necessary information to enable ADS and CPDLC communications between the system and aircraft avionics systems for:

- Logon.
- Forwarding logon information to the next ATSU.

Note: Details of Datalink Initiation Capability (DLIC) functional capabilities are provided in Doc 9694 Part 2.

The required capacity for AFN logons will be determined from the operational requirements, such as estimated number of FANS aircraft at the peak hours and anticipated growth of FANS traffic.

The system must be capable of accepting or rejecting AFN logon requests.

The system will be linked with the FDPS to correlate the AFN logon data automatically with the aircraft flight plan.

The controller's workstation should be capable of displaying the following data:

- Address and version number of the aircraft applications, if required.
- Response from the aircraft with timestamp.
- Status of correlation of the aircraft with its stored flight plan.
- Indication of 'Acceptance' or 'Rejection' to the logon request from aircraft.

When an aircraft downlinks its supported applications and their version numbers in an FN-CON message, the ground system response must indicate whether or not it supports those version numbers.

The system must be capable of sending the Acceptance message or the Rejection message with reason, as appropriate.

4.2.2 Use of AIDC for Forwarding AFN Message

The ATS system should be capable of sending the FANS application message (FAN), in accordance with the ICD. When possible, the system should use the AIDC FAN message for address forwarding in preference to the AFN application.

4.3 CPDLC

4.3.1 General

The required capacity of the CPDLC function will be determined by taking account of the operational policy and procedures and the airspace characteristics, such as the number of FANS-capable aircraft, airspace size and number of waypoints, the communications necessary in ATS operations, and of the estimated future growth of datalink operations.

The system will be capable of processing the specified number of message exchanged with each of the aircraft.

Down-linked CPDLC messages will be displayed to controllers. Tools must be provided to allow simple and intuitive initiation of, or response to, CPDLC messages.

Note: The size of the free text field is limited to 80 characters (instead of 256) for some specific aircraft types.

CPDLC position reports should be used to display aircraft positions when no ADS report is available.

The system will have the capability of terminating CPDLC connection with the aircraft.

4.3.2 Transfer of CPDLC between ATC Sectors

The system will allow transfer of CPDLC between sectors of an ATSU without changing the data authority and with the same CPDLC link.

4.3.3 CPDLC Message Exchange Requirements

The system will be capable of handling the message set and the standardized free text messages defined in the FOM, as well as free text.

The system will allow controllers to review uplink messages prior to sending.

4.3.4 Message Handling Order

Messages will be handled in order of priority.

Messages with the same priority will be processed in the time order of receipt.

The controller will be alerted to unsuccessful receipt of the required response in the specified time or receipt of Message Assurance Failure (MAF).

4.3.5 Responses

The system will allow controllers to send any response messages linking with the reference number of the message received. The relationship between the message and its intent and the response requirement is defined in the FOM.

4.3.6 Message Closure

A CPDLC dialogue will not be closed until an appropriate closure response for that message with same reference number is received.

When the closure response message is sent, the dialogue is closed and the system will reject any further attempt to send a response message.

The capability of closing a CPDLC dialogue, independent of CPDLC closure message receipt, will be provided.

4.4 ADS

4.4.1 General

The capacity of the ADS function will be determined from the operational policy and procedures and the airspace characteristics, including number of FANS capable aircraft, periodic reporting rate, airspace size, waypoint event report frequency, usage of event and demand contracts, and projected traffic growth.

The system will be capable of initiating periodic, event and demand contracts.

The system will be able to support a demand, an event and a periodic contract simultaneously with each aircraft.

The system will apply validation checks to incoming data by reference to flight plan data in relation to time, altitude, direction and position.

The system will be capable of processing ADS reports to display aircraft positions, tracks and altitude. Between ADS reports, aircraft positions will be extrapolated and displayed automatically at specified intervals.

The datalink system should have the capability of supporting 30NM lateral and 30NM longitudinal distance based separation standards.

Air and earth reference data of ADS reports will be provided for controllers if required.

The types of ADS contract are described at 5.3.1 ADS.

4.4.2 Message Handling

ADS messages will be processed by the system in the following order:

1. ADS emergency mode.
2. Demand/event reports.
3. Periodic report.

Within these categories, messages will be handled in the order received.

The following errors will be notified to controllers:

- Message validation error.
- Message sequence error detected with time stamp.

- Time-out of ADS report in response to request.
- Periodic and waypoint event report failure.

4.5 AIDC

4.5.1 General

General descriptions of AIDC applications, requirements, functional capabilities, and message contents are provided in the latest version of the ICD.

The AIDC application exchanges ATC coordination information between ATSUs.

Bilateral agreements between ATSUs are necessary to determine the operational and system requirements for both ATSUs, and should be made before developing the system. These agreements should cover:

- The ICD to be applied – Asia/Pacific or other ICD.
- message set to be used.
- usage of messages (e.g. timing of transmission).

The AIDC application requires that:

- messages are generated and sent in time-ordered sequence.
- messages are delivered in the order in which they are sent.

When an ATSU queues received messages, messages with the highest urgency type will be placed at the beginning of the queue. Messages will be assigned one of the following urgency attributes:

- Normal.
- Urgent.
- Distress.

The time used in the AIDC application will be accurate to within 1 second of UTC.

A timestamp will be generated when the message is dispatched and will consist of the date (YYMMDD) and time (HHMMSS).

Where an AIDC message is linked to a previously sent message, the message will contain reference information, including the ID of the referenced message.

4.5.2 Asia/Pacific Interface Control Document (ICD)

The Asia Pacific ICD for AIDC provides the standardized procedures for inter-facility message exchanges.

(The purpose of the ICD is to ensure that inter-facility message exchanges between ATSU equipped with automated ATS systems in the Asia/Pacific Region are harmonized to a common standard.)

Until ATN becomes available, the engineering details needed to implement the exchange of messages described in Appendix A of the ICD will need to be agreed to bilaterally.

4.5.3 Message Header

Every message will contain an AFTN header. The AFTN IA-5 message header, including the use of the Optional Data Field defined in Annex 10, will be employed for the exchange of data. AFTN priority indicator FF will normally be used for all data exchanges.

A message header consists of the optional data field (ODF), addressing, message/data identification number, reference information, time stamp and cyclic redundancy check (CRC).

4.5.4 ATS Coordination Messages

AIDC provides the means by which data is exchanged between and within ATSUs for the notification of flights approaching FIR boundary, the coordination of boundary crossing conditions and the transfer of ATC services.

AIDC messages are also used to exchange emergency, track definition, and application management information as well as for transfer of surveillance data.

4.5.5 Detailed Information Provided in ICD

The appendices to the ICD describe:

- ATS coordination messages (Appendix A).
- Error codes (Appendix B).
- ATM application naming conventions (Appendix C).
- Implementation Guidance Material – IGM (Appendix D).
- Relationship to ICAO AIDC messages (Appendix E).

4.5.6 Performance Requirements

The performance requirements for the trip time of messages need to be specified and agreed to with neighbouring ATSUs to ensure effective use of AIDC. Recommended performance figures are specified in Appendix D of the ICD.

The methodology for monitoring AIDC performance is provided in Appendix A of the Guidance Material for End-to-end Safety and Performance Monitoring of ATS Datalink Systems in the Asia/Pacific Region.

CHAPTER 5 SPECIFICATION

The development of the specification should, wherever possible, be a team effort, with operational and technical personnel working together to achieve the optimum result. System specifications should be based primarily on operational requirements; the technical specifications should be framed to support those requirements. ~~Specifications produced by technical personnel tend to concentrate on technical features, sometimes at the expense of operational suitability.~~

In developing a specification for any technical system, it is important to achieve the right level of detail. Too little detail leaves the purchaser at the mercy of potential suppliers, while too much may preclude suppliers from offering very suitable equipment. In general, it is probably appropriate to specify requirements in great detail only where those requirements are essential to the operation, and otherwise to leave the supplier a reasonable amount of freedom. An off-the-shelf system can be expected to be less expensive than one that is custom-designed.

It is also important to get the specification right. Proposals will be priced on the specification, and any changes required later, particularly after the contract is signed, will be costly in terms of price and completion time.

This section on specification covers the system configuration, its interfaces with other systems, its functionality, the operator interface, system capacity, and recording and data analysis.

5.1 SYSTEM CONFIGURATION

The system configuration depends upon the operational environment. In specifying the configuration, a number of issues must be considered:

- Is it to be a stand-alone ADS/CPDLC/AIDC system, is it to be part of an integrated system or is it to be interfaced with a separate ATM system?
- How many sectors are required?
- How many workstations are required per sector? If more than one, why?
- What contingency configuration is required?
- Is complete duplication of the system required?
- What are the requirements for main/standby computers and independent contingency workstations?
- Will there be duplication of communications bearers? If so, which ones?
- Assuming the normal operational configuration is one workstation per sector, how many contingency workstations are required?

5.2 INTERFACES

The System must have a number of interfaces to send and receive data; some of these are essential, others may be useful or just nice to have. This section concentrates on the essential and the useful.

5.2.1 Datalink Service Provider

In the current FANS 1/A environment, ADS and CPDLC messages are passed between aircraft and the System using the ACARS data messaging system. ACARS was developed by the DSPs to pass information between the airline operating centre (AOC) and the aircraft. ADS and CPDLC required an air-ground datalink and, in the absence of the Aeronautical Telecommunication Network (ATN), the ACARS system was used.

Access to the ACARS datalink is available only from the DSPs; ARINC and SITA are the major DSPs; they provide global coverage and complete management of the signal between the ATSU and the aircraft, including selection of most appropriate datalink path (VHF, satellite or HF). There are also some national or regional DSPs, such as AVICOM Japan.

It is essential therefore to specify the appropriate interface port(s) to connect to the chosen DSP. This is typically an RS232 serial port, but the exact requirement should be confirmed with the DSP.

5.2.2 ATN

It is intended that the ADS and CPDLC functions will eventually be carried by the ATN. The purpose of the ATN is to “provide data communication services and application entities in support of the delivery of air traffic services (ATS) to aircraft; the exchange of ATS information between ATS units; and other applications such as aeronautical operational control (AOC) and aeronautical administrative communication (AAC).” [Annex 10, Vol III, 3.3]

It is important, therefore, that any new system should either include provisions for, or have a defined upgrade path to provide, interfacing with the ATN.

ICAO Doc 9705 - Manual of Technical Provisions for the Aeronautical Telecommunication Network (ATN) is the appropriate source of interface data for the ATN.

At present, the ATN is under development and trials are being carried out in several ICAO Regions.

5.2.3 AFTN/AMHS

The AFTN is currently the carrier for ground-ground messaging between ATC units and carries AIDC messages in the FANS 1/A environment. The AHMS (Aeronautical Message Handling System) is the ground-ground messaging application of the ATN. The AMHS is also referred to as the ATSMHS (ATS Message Handling System).

AIDC messages will be passed via the AFTN until the ATN is operational. However, AFTN/AMHS gateways will increasingly be used to provide a transition between the AFTN and ATN. These gateways transpose AFTN messages into AMHS format and vice versa.

Any new system should include at least one AFTN/AMHS gateway. AIDC messages generated in AMHS structure can then be transmitted via the AFTN and incoming messages from the AFTN will be transposed to AMHS structure. After the ATN becomes operational and the AFTN is no longer used, the gateway can be removed.

5.2.4 ATS systems

In many cases, interfaces to other ATS systems will be necessary. This may be because an ADS/CPDLC system will use the flight data or other processing capability of another system or because the new system will be directly connected to another system.

5.2.4.1 Flight Data Processing System

Where an ADS/CPDLC system is to rely on an existing system to provide flight data, the interface required will depend on the data to be passed. The ADS/CPDLC system may have no flight data processing capability and merely require flight plan information for identification purposes, or it may have some capability to up-date flight plans received from the other system and return the up-dated information.

In either case, the interface may need to transform data formats between the 2 systems. It is therefore essential that the data formats used by the existing system are detailed in the specification so that they are allowed for in proposals; otherwise, costly contract variations may be required.

5.2.4.2 Radar Data Processing System

Data imported from a separate radar data processing system will take the form of track data or possibly plot data. As with interfaces for flight data, it is most important to detail the radar data formats in the specification.

If ADS data is to be exported to a separate radar data processing system or display system, the formats required by those systems also must be detailed.

5.2.4.3 Direct Connection between Systems

When a full system (with FDPS and perhaps RDPS as well as ADS/CPDLC/AIDC) is to be connected directly to an existing system for full data interchange, details of all the data formats of the existing system should be included in the specification.

5.2.5 Radar Data

If the System is to receive direct radar feeds from existing radars, the output data format of each radar must be detailed.

Most new systems are designed around the ASTERIX surveillance data formats; specifying ASTERIX where possible will allow the greatest flexibility for the future. The ASTERIX Standard was adopted as the ICD for surveillance data exchange for the Asia/Pacific Region in 1998. Information on ASTERIX may be found at: http://www.eurocontrol.int/asterix/public/subsite_homepage/homepage.html

The "Regional Supplement to the ASTERIX Interface Control Document for the Asia/Pac Region" gives details of location-specific ASTERIX coding.

Inputs from military radars may be non-standard or require additional processing; any available details should be included.

5.2.6 ADS B Data

Where ADS B data is available or anticipated, the system should be capable of accepting and processing such data.

5.2.7 Meteorological Data

Many modern systems make provision for the use of meteorological data for updating predicted waypoint times in near-real time. However, this type of prediction may require very large amounts of data and may not be justified if experience shows that weather variations have very little effect on the routes concerned or where the weather patterns are such that occasional manual input would suffice.

If there is a requirement for regular automatic data input, the available sources of data should be investigated and the appropriate formats should be specified.

5.3 FUNCTIONALITY

This section covers the core applications of the system, ADS, CPDLC and AIDC, and their supporting functions, AFN and ACF.

5.3.1 ADS

ADS is a means of surveillance in which an aircraft reports its current position, intent and other pertinent information via the datalink function to an ATSU. ADS is detailed in ARINC 745-2.

The ADS reporting rate and the types of data to report are determined by ADS contract requests from an ATSU. An aircraft can report to up to four ATSUs simultaneously.

There are three types of ADS contract: the periodic contract, the event contract and the demand ("one-shot") contract.

5.3.1.1 Periodic Contract

The ATSU sets up a periodic contract with the aircraft to obtain regular position reports; the contract specifies to the aircraft the reporting rate, any optional data groups be added to the basic ADS report, and the frequency at which the optional groups are to be included in the reports.

Only one periodic contract can be established between an ATSU end system and a particular aircraft at any one time. The periodic contract normally remains in effect until the contract is cancelled by the ATSU.

The system must be capable of pre-defining the reporting rate as a system parameter and of allowing the controller to change the rate, on a case by case basis, to meet operational requirements.

The system must also allow the controller to include any of the permissible additional data groups in a periodic contract request.

Some systems have the capability of automatically changing the reporting rate from one area to another; however, this could increase system cost and complexity.

5.3.1.2 Event Contract

An event contract specifies a request for reports whenever a defined ‘event’ occurs. Only one event contract can be established between a ground system and a particular aircraft at any one time; however, the event contract can contain multiple event types. There are four event types.

The **Vertical Rate Change Event** is triggered when the aircraft’s vertical rate is either less than or greater than a parameter defined in the contract.

The **Lateral Deviation Change Event** is triggered when the aircraft’s actual position exceeds a lateral distance parameter from the aircraft’s expected position on the active flight plan in the FMC.

The **Altitude Range Change Event** is triggered when the aircraft’s altitude exceeds the altitude ceiling or floor defined in the contract by the ground system.

Once a vertical rate, lateral deviation or altitude range event trigger has occurred, a recurrence of this event no longer triggers an event report. If required, a new event contract must be initiated each time one of these specific events occurs.

The **Waypoint Change Event** is triggered by a change to the next or the next-plus-one waypoints. Such a change normally occurs due to routine waypoint sequencing. However, it will also be triggered by occurrences such as a change to a non-ATS waypoint entered by the pilot for operational reasons, or execution of a new route affecting the next or next-plus-one waypoints. Unlike the other event contracts, the waypoint change event trigger remains in effect for all waypoint changes.

Once an event contract has been established, it remains in effect until the specific event requests are fulfilled, or it is cancelled by the ground system.

The system must be capable of pre-defining the event trigger parameters and of allowing the controller to change the event parameters as required.

5.3.1.3 Demand Contract

The demand contract is a "one-off" request from the ground system for an ADS report containing specific data as defined in the request. A demand contract can be requested by the ground system at any time. The demand contract request does not affect any existing contracts.

The system must allow the controller to initiate a demand contract, including optional data fields.

5.3.1.4 Emergency Mode

The emergency mode can only be activated by the pilot and is normally cancelled by the pilot. While it is possible for a ground system to cancel the emergency mode status, most ground systems do not have this capability; however, some ground systems allow the controller to modify the "display" of the emergency mode status.

The system must recognise the emergency flag and display the emergency status to the controller.

5.3.2 CPDLC

CPDLC provides a two-way message system between controller and pilot. It comprises an number of pre-defined up-link and down-link messages, some of which are complete in themselves, while others require data (such as time, flight level, etc) to be added. There are also two free-text messages available in each direction, one reserved for emergency use.

To send a message, the controller selects the required message and enters any required data. (Options for selecting messages and entering data are discussed below under Human-Machine Interface.) The system then automatically codes the message in bit-oriented format and presents it for transmission.

On reception of a down-link message, the CPDLC application decodes the message and presents it to the controller.

The current message set is detailed in the FOM, and the system must provide the complete up-link message set and be capable of accepting and decoding the complete down-link message set.

Some message sequences require “closure”:

- A message requiring a response remains open until a referenced response is received.
- A message is closed when either a response is not technically required, or after a referenced response other than STANDBY or REQUEST DEFERRED has been received.

The system must manage message closure protocols in accordance with the requirements of the FOM.

5.3.3 ACF

ADS and CPDLC both operate on bit-oriented data, while ACARS is character-oriented. The ACARS Convergence Function (ACF) converts the bit-oriented data of ADS and CPDLC to the character-oriented data used by ACARS, and vice versa.

If the system is to operate over ACARS, the ACF must be specified as an essential requirement.

(The ACF is not required where the ATN is the carrier.)

5.3.4 AFN

The AFN function provides the transfer of information required to support the initiation of datalink connectivity between an aircraft and an ATSU. The AFN is a character-oriented application.

Because it is essential to ADS and CPDLC operation over ACARS, the AFN function as detailed in ARINC 622-4 must be a requirement of the system specification.

5.3.5 AIDC

The AIDC application supports information exchanges for notification, coordination, and the transfer of communications and control functions between automated ATS systems located at different ATSUs.

The AIDC message set is defined in the ICD. This message set was based on ICAO agreed methods and messages wherever possible; elsewhere, new messages used existing ICAO field definitions to the extent possible.

5.4 OPERATOR INTERFACE

5.4.1 Human Factors

Human factors play a major part in the success or failure of a system to meet its operational objectives. A system that is uncomfortable to use will lead to controller dissatisfaction, which as controllers are an essential part of the overall system, can only degrade the overall system performance.

Displays and keyboards that are poorly designed from a human factors aspect will be inefficient and may cause actual harm to the users. Bad display design can affect the eyes and bad keyboard design may result in occupational overuse syndrome (repetitive strain injury). The human factors implications of the system specification should be very carefully considered, and it may be appropriate to get specialist advice.

5.4.2 Displays

One or more displays are required to handle the ADS, CPDLC and AIDC messages. Many systems incorporate message handling in the situation display.

Modern displays use LCD technology and may be as large as 600 x 600mm, with typical resolution of 2048 x 2048 pixels. Smaller displays may be more appropriate for some uses, particularly if there are 2 displays at a controller position: a second display is often used for flight data handling. However, the arrangement of displays will largely depend on the extent to which the new system is to be integrated with existing systems.

While colour displays offer great advantages in differentiating between different categories of data, the choice of colours for the various categories can be very contentious. It is essential that colour allocation is not arbitrarily decided, but is based upon sound human factors principles. Inappropriate colour choices can contribute to fatigue, confusion and errors. To avoid these problems, a human factors expert should be engaged to advise on the use of colour.

Different symbols should be used for radar tracks, ADS-B tracks, ADS-C tracks and tracks generated from flight plan information. The track symbol should be that of the source of the highest quality information. At the current stage of development of ADS-B systems, radar is generally accepted as the best surveillance data, followed by ADS-B and then by ADS-C. Flight plan tracks are the lowest quality.

The status of the CPDLC connection is important information for the controller and is best displayed in the track label.

5.4.3 Message Handling

Message handling for ADS, CPDLC and AIDC messages is usually achieved by some form of menu access for generating messages and by pop-up windows for replying to incoming messages. Most systems now offer access via the track label.

For CPDLC, there are two elements to generating most messages: selection of the specific message and entry of necessary data. The message selection should be simple: there are about 180 uplink messages available. Some systems present a selection of appropriate messages – for example, by offering only height-related messages if the height field in the track label is selected. ADS contract messages are more simple and infrequently required, so that a simple menu-type operation is normally adequate. AIDC messages can usually be generated automatically form flight plan data.

If a particular message handling method is required, it should be clearly stated in the specification.

The language for all menus and message sets should be English: English is the de facto language for radiotelephony within the Asia-Pacific Region. While it may seem attractive for menus and CPDLC messages to be displayed in a local language, this will inevitably lead to loss of English language proficiency and so will work against the new ICAO language proficiency provisions in Annexes 1, 6, 10 and 11. These provisions require that from March 2008, pilots, aeronautical station (radio) operators and air traffic controllers shall demonstrate the ability to speak and understand the language used for radiotelephony communications to specified levels.

5.4.4 Input Devices

The controller input devices include the text input device and the pointing device.

The text input device is normally a keyboard and there are various types of keyboard (standard, ergonomic, etc). The type should be specified if it is considered important; however, it is worth noting that controllers do not have to input large amounts of text in an ADS/CPDLC system. Touch panels may be offered instead of keyboards.

The mouse is the most common and probably most flexible pointing device; others include the track-ball and the light pen. It is difficult to locate a track-ball and keyboard so that they are well-placed for both left- and right-handed people, and light pens have been poorly received by many controllers.

Wireless connections for the input devices will reduce the clutter on the workstation working surface and allow more freedom of movement for the pointing devices. However, electro-magnetic compatibility with nearby equipment must be carefully considered.

5.5 CONTROLLER TOOLS

Controller tools include such items as:

- Conflict probe
- Temporary maps
- Bearing-distance lines
- Velocity vectors

- Label overlap avoidance

5.5.1 Conflict Probe

Conflict Probe is a tool to determine whether a proposed flight plan will come into conflict with another during a specified period.

The Conflict Probe is normally initiated by the controller for a particular aircraft. The probe compares the proposed trajectory with the current planned trajectories of other aircraft information and displays the position and time of calculated conflicts to the controller. The period covered by the probe is typically fairly long (up to several hours), as the main use of Conflict Probe is when a routing change is proposed under a flexible track regime.

Conflict Probe is a very complex function, requiring considerable computer power, and consequentially can be expected to be expensive.

5.5.2 Temporary Maps

Temporary maps allow controllers to depict on the display areas of interest on a temporary basis. Temporary maps should be simple both to construct – a few straight lines is usually adequate – and to switch on or off on the display.

5.5.3 Bearing-Distance Line

As its name suggests, a bearing-distance line allows a controller to measure the bearing and distance between 2 points on a display. The points might be an aircraft track symbol and a reporting point or 2 aircraft track symbols.

Some systems allow one or both ends of the line to lock on to an aircraft track symbol, so that the bearing and distance information displayed is updated as the aircraft move.

Multiple bearing distance lines, if available, can be useful.

5.5.4 Velocity Vectors

Velocity vectors display a vector from the track symbol showing the calculated position of the track after a specific time. The time is normally preset to a default value (typically 2 minutes); most systems allow the controller to set a different value.

Some systems also allow velocity vectors to be shown for all tracks or for a selected track only.

5.5.5 Label Overlap Avoidance

Label overlap avoidance allows the track labels to be moved to avoid labels overlapping one another. This is done by rotating some labels to new positions relative to the track symbol or by changing the distance of some labels from their symbols. The process is normally automatic, but should allow the controller to set selected labels to a preferred position.

5.6 SYSTEM CAPACITY

The required system capacity is directly related to the number of ADS, CPDLC and AIDC messages, the number of radar tracks, the number of active flight plans, the number of workstations and so on. These, in turn, are directly related to the volume of traffic, particularly the peak traffic volume.

The system capacity is normally expressed as the number of active flight plans that the system can handle at one time; in this context, “active” means that the system is using or processing the flight plan information in some way.

It is clearly important that the system capacity should allow for traffic growth over the projected life of the system, which for modern systems is typically 5 to 7 years between major upgrades or replacement. The anticipated growth should therefore be carefully assessed using the best projections available, and should allow for daily and seasonal traffic peaks.

However, it is also important not to set the capacity requirement too high, as this will almost certainly result in increased cost.

Some growth rates over those periods are shown below to give an indication of future capacity requirements based on current traffic:

Anticipated Annual Growth	Total Growth over		
	5 years	6 years	7 years
5%	28%	34%	41%
7.5%	44%	54%	66%
10%	61%	77%	95%

5.7 RECORDING AND DATA ANALYSIS

The system should record all incoming and outgoing ADS, CPDLC and AIDC messages for use in incident and accident investigations. It is imperative that all recordings are time-stamped. Messages are typically recorded onto a tape cartridge or DVD, and the system should allow change-over of the cartridge or DVD with no interruption to the recording.

Annex 10 Vol II and Annex 11 require communications, including AIDC and CPDLC, to be recorded and the recordings to be retained for at least 30 days for accident/incident investigation purposes. Chapter 3 of the FOM details some specific recording requirements for both safety investigation and performance monitoring.

The recording system should allow replaying of the situation and identification of messages were sent or received by the system.

Provision should also be made for recording data for use by the agencies monitoring RNP, RVSM and datalink performance. These are the Safety Monitoring Agency (SMA), the Regional Monitoring Agency (RMA) and the Central Reporting Agency (CRA) respectively. Generally, the data required by RMAs and SMAs is captured by the FDPS.

To meet CRA requirements, the specification should include a requirement for datalink performance monitoring tools and analysis software. The analysis software should, at the least, be capable of extracting time-stamps, addressees and message types from all incoming and outgoing messages.

The table below summarises the FOM datalink monitoring requirements for ANSPs.

Requirements	**Monitor/Record**
Operational Procedures	Time stamped ATS messages with identification and reference numbers
	Message Assurance
	Anomaly event report
Performance	End-system availability
	Transit times
Safety (i.e. operational, performance and interoperability requirements which are used to mitigate the effect of a failure condition)	Time stamped ATS messages with identification and reference numbers/MAS
	Anomaly event reports
Interoperability	Time stamped ATS messages with identification and reference numbers/MAS

APPENDIX A GLOSSARY

ACARS	Aircraft Communications Addressing and Reporting System
ACAS	Aircraft Collision Avoidance System (ICAO
ADS	Automatic Dependent Surveillance
AEEC	Airline Electronic Engineering Committee
AFN	ATS Facilities Notification
AFTN	Aeronautical Fixed Telecommunication Network
AIDC	ATC Inter-Facility Data Communications
AIP	Aeronautical Information Publication
AMHS	Aeronautical Message Handling System
ANSP	Air Navigation Service Provider
AOC	Airline Operational Communications
APANPIRG	Asia/Pacific Air Navigation Planning and Implementation Regional Group
ARINC	Aeronautical Radio Incorporated
ATC	Air Traffic Control
ATM	Air Traffic Management
ATN	Aeronautical Telecommunication Network
ATS	Air Traffic Services
ATSMHS	ATS Message Handling System
ATSU	ATS unit
AVICOM	AVICOM Japan Co. LTD
CAA	Civil Aviation Authority
CNS	Communications, Navigation, Surveillance
CPDLC	Controller Pilot Data Link Communications
CRA	Central Reporting Agency (for datalink)
CRC	Cyclic Redundancy Check
DL	Downlink message
DSP	Datalink Service Provider
EUROCAE	European Organization for Civil Aviation Equipment
FANS	Future Air Navigation System
FIR	Flight Information Region
FIT	FANS Interoperability Team (IPACG, ISPACG)
	FANS Implementation Team (FIT-BOB, FIT-SEA)
FMC	Flight Management Computer
FMS	Flight Management System
GES	Ground Earth Station (satellite)
GPS	Global Positioning System (USA)
HF	High Frequency (3-30 MHz)
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
IFATCA	International Federation of Air Traffic Controllers Associations
IFALPA	International Federation of Air Line Pilots' Associations

IPACG	Informal Pacific ATC Coordinating Group
ISPACG	Informal South Pacific ATS Coordinating Group
MAS	Message Assurance (data message)
MCDU	Multipurpose Control Display Unit (ACARS & FMC)
MU	Management Unit (ACARS)
NDA	Next Data Authority
NOTAM	Notice To AirMen
RASMAG	Regional Airspace Safety Monitoring Advisory Group
RMA	Regional Monitoring Agency (for RVSM)
RNP	Required Navigation Performance
RTCA	RTCA Inc.
RVSM	Reduced Vertical Separation Minima
SATCOM	Satellite Communication
SATVOICE	Satellite Voice Communication
SITA	Société Internationale de Télécommunications Aéronautiques
SMA	Safety Monitoring Agency (for RNP)
SR&O	System Requirements and Objectives (FANS-1 document)
TCAS	Traffic Alert and Collision Avoidance System (USA)
TMU	Traffic Management Unit
UL	Uplink message
VHF	Very High Frequency (30-300 MHz)

APPENDIX B REFERENCES

Annex 10, Volume III, Communication Systems		ICAO
Procedures for Air Navigation Services, Air Traffic Management	Doc 4444	ICAO
Manual of Technical Provisions for the Aeronautical Telecommunication Network (ATN)	Doc 9750	ICAO
Basic Air Navigation Plan – Asia and Pacific Regions	Doc 9673	ICAO
Manual on Airspace Planning Methodology for the Determination of Separation Minima	Doc 9689	ICAO
Manual of Air Traffic Services Data Link Applications	Doc 9694	ICAO
Safety Management Manual	Doc 9859	ICAO
Asia/Pacific Regional Plan for the new CNS/ATM Systems		ICAO Asia Pacific Office
Regional Supplement to the ASTERIX Interface Control Document (ICD) for the Asia/Pac Region		ICAO Asia Pacific Office
Asia/Pacific Regional Interface Control Document (ICD) for ATS Inter-facility Data Communications (AIDC), version 2		ICAO Asia Pacific Office
Guidance Material for End-to-End Safety and Performance Monitoring of ATS Datalink Systems in the Asia Pacific Region		ICAO Asia Pacific Office
FANS 1/A Operations Manual		
Interoperability Requirements for ATS Applications using ARINC 622 Data Communications	DO-258A / ED-100A	RTCA and EUROCAE
Air-Ground Character-Oriented Protocol Specification	618-5	ARINC
Data Link Ground Systems Standard and Interface Specification (DGSS/IS)	620-5	ARINC
ATS Data Link Applications Over ACARS Air-Ground Network	622-4	ARINC
Aircraft Communications Addressing Reporting System (ACARS)	724B-5	ARINC
Air Traffic Services Systems Requirements & Objectives (ATS SR&O)		Boeing

APPENDIX C PERFORMANCE CRITERIA

Criteria	Definition	Values
Performance	End-to-end round trip time for uplinks. (from sending of the uplink until reception of the MAS)	Round trip time of 2 minutes, 95% of messages. Round trip time of 6 minutes, 99% of messages.
	End-to-end one way time for downlinks. (comparison of message time stamp and receipt time)	One way time of 1 minute, 95% of messages. One way time of 3 minutes, 99% of messages
	Uplink messages only: Undelivered messages will be determined by: • Message assurance failure is received. After trying both VHF and SATCOM. Depending on reason code received, the message might, in fact, have reached the aircraft. • No message assurance or flight crew response is received by ATSU after 900 seconds	Less than 1% of all attempted messages undelivered
Availability	The ability of the network data link service to perform a required function under given conditions at a given time: The maximum allowed time of continuous unavailability or downtime should be declared (MTTR)*	99.9% TBD
Reliability	The ability of a data link application/system to perform a required function under given conditions for a given time interval: it can be expressed in MTBF (Mean Time Between Failure) *	TBD
Integrity	The probability of an undetected failure, event or occurrence within a given time interval.	10^{-6}/hour

∗ Availability = MTBF x 100/(MTBF+MTTR)

Note: RTCA SC189/EUROCAE WG 53 defines the performance requirements for specific operational environments.

~~UPDATED~~ STRATEGY FOR THE PROVISION OF ~~APPROACH, LANDING & DEPARTURE GUIDANCE~~ NAVIGATION SERVICES IN THE ASIA/PACIFIC REGION ~~SYSTEMS~~

Considering:

a) in the Asia/Pacific region, ILS is capable of meeting the majority of requirements for precision approach and landing;

b) requirements for provision of terrestrial-based navigation facilities, non-precision and precision approach and ~~landing have~~landing have been implemented in most cases;

c) the availability ~~of ICAO~~of ICAO SARPs and guidance material for GNSS with augmentation to support Cat I precision approach and approach and landing with vertical guidance (APV);

d) the evolution of ~~Required Navigation Performance~~ Performance Based Navigation for all phases of flight including for approach, landing and departure operations;

e) the knowledge that APV operations may be conducted using GNSS with augmentation as required or barometric vertical guidance and GNSS or DME/DME RNAV lateral guidance;

f) APV operations provide enhanced safety and generally lower operational minima as compared to non-precision approaches;

g) the knowledge that GNSS without augmentation can support non-precision approaches ~~and that~~and that augmented GNSS-based systems support Category I operations~~;...~~;

h) GNSS with augmentation to support category II and III operations is projected to be available in 2010-2015 time frame;

i) MLS Cat I is operational and ground and airborne CAT III B certification is in progress;

j) the material contained in the ~~draft~~ Performance Based Navigation Manual (Doc 9613) ~~for approach~~for approach, landing and departure operations;

k) the need to maintain aircraft interoperability both within the region and between the Asia/Pacific region and other ICAO regions and to provide flexibility for future aircraft equipage;

l) operators will equip aircraft to support PBN ~~RNP and GNSS~~ operations

THE STRATEGY FOR ASIA/PACIFIC REGION IN THE PROVISION OF NAVIGATION SERVICES INCLUDING APPROACH, LANDING AND DEPARTURE GUIDANCE IS:

a) retain ILS as an ICAO standard system for as long as it is operationally acceptable and economically beneficial;

b) implement GNSS operations including the early implementation of non-precision RNAV (GNSS) approaches.~~;~~

c) transition to PBN ~~introduce applicable Required Navigation Performance (RNP)~~ operations;

d) implement GNSS with augmentation as required for APV and Category I operations where operationally required and economically beneficial;

e) promote the use of APV operations, particularly those using GNSS vertical guidance, to enhance safety and accessibility;

f) to support contingency operations, provide RNAV (GNSS) procedures for approach, landing and departure guidance;

g) conduct necessary on-going PBN ~~GNSS and RNP~~ studies, education and training;

h) consider the implementation ~~of MLS~~of MLS where operational requirements cannot be satisfied by ILS or GNSS; and

i) protect radio frequency spectrum of ILS, MLS and GNSS since the transition from ILS to GNSS and /or MLS will be evolutionary and will take some time.

J) Closely monitor the implementation of PBN to ensure continued civil-military interoperability.

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STRATEGY FOR THE IMPLEMENTATION OF GNSS NAVIGATION CAPABILITY IN THE ASIA/PACIFIC REGION

Considering that:

1) Safety is the highest priority;

2) Elements of Global Air Navigation Plan for CNS/ATM system on GNSS and requirements for the GNSS implementation have been incorporated into the CNS part of FASID;

3) GNSS SARPs, PANS and guidance material for GNSS implementation are available;

4) The availability of avionics, their capabilities and the level of user equipage;

5) Development of GNSS including satellite constellations and improvement in system performance;

6) Airworthiness and operational approvals allowing the current GNSS to be used for en-route operations~~, and~~, and non-precision and APV approaches without the need for augmentation services external to the aircraft;

7) Development status of GNSS augmentation systems;

8) Human, environmental and economic factors will affect the implementation of GNSS;

9) The need to protect GNSS frequencies;

10) The effects of the ionosphere on GNSS and availability of mitigation techniques;

11) Integrity, accuracy and distribution of aeronautical information; and

12) The importance for ICAO to implement the Aeronautical Information Management (AIM) Concept and provide States with guidance and training on its implementation;

13) The regional navigation requirements are:

(a) RNP10/RNP4 for en-route;
(b) RNP4 for *transition to* terminal phase of flight;
(c) RNP1 or less for terminal phase of flight;
(d) RNP/RNAV based arrivals and departures;
(e) APV (with interim RNAV (GNSS) for approaches); and
(f) Precision approaches at selected runways.

THE GENERAL STRATEGY FOR THE IMPLEMENTATION OF GNSS IN THE ASIA/PACIFIC REGION IS DETAILED BELOW:

1) Introduction of GNSS Navigation Capability should be consistent with the Global Air Navigation Plan;

2) During transition to GNSS, sufficient ground infrastructure for current navigation systems must remain available. Before existing ground infrastructure is considered for removal, users should be given reasonable transition time to allow them to equip with GNSS to attain equivalent navigation service. States should approach removal of existing ground infrastructure with caution to ensure that safety is not compromised, such as by performance of safety ~~assessment,,consultation~~assessment, consultation with users through regional air navigation planning process;

3) Implementation shall be in full compliance with ICAO SARPs and PANS and support the new ICAO Global Plan Initiatives;

4) Introduction of GNSS for en-route, terminal, approach and departure navigation. States should coordinate to ensure that harmonized separation standards and procedures are developed and introduced concurrently in all flight information regions along major traffic flows to allow for a seamless transition to GNSS-based navigation;

5) States are encouraged to implement any new ~~future~~basic GNSS approvals based on TSO 145/6a receiver standards or equivalents and take into account the availability of GNSS augmentation technologies for more demanding requirements;

6) States should work co-operatively on a multinational basis to implement GNSS in order to facilitate seamless and inter-operable systems and undertake coordinated R & D programmes on GNSS implementation and operation;

7) States consider segregating traffic according to navigation capability and granting preferred routes to aircraft with better navigation performance**,** taking due consideration of the need of State aircraft;

8) ICAO and States should undertake education and training to provide necessary knowledge in Performance Based Navigation (PBN), GNSS theory, AIM concept and operational application;, and

9) States establish multidisciplinary GNSS implementation team~~s~~ in accordance to Section 5.2.2 ~~, using Attachment A to Appendix C~~ of Doc 9849 AN/457, the Global Navigation Satellite System (GNSS) Manual, and work out ~~an~~a GNSS implementation plan using Attachment A to Appendix C of ~~Doc 9849~~Doc 9849 as a guide.

Note 1: Identified SBAS systems are EGNOS, MSAS, GAGAN and WAAS. The MSAS is expected to ~~be~~ have initial operational capability ~~available~~ by ~~– early~~September ~~–~~2007 for provision of augmentation to the Asia/Pacific region while GAGAN is expected to be ~~available~~operational by ~~2009~~2010 .

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UPDATED ADS-B SUBJECT/TASKS LIST

No.	Subject/Tasks List	Associated with Strategic Objective	Associated GPI	Deliverables	Target Date	Action to be taken and led by
1	Conduct study and present a paper on a study for the use of ADS-B technology in airspace in the North Asia.	D. Efficiency	GPI01/02/05/06/07/09/ 14/16/17/21/22	Report of study for the use of ADS-B in North Asia area	10/2007	IATA
2	Report Organizational Policy on ADS-B data sharing with neighbors.	A. Safety D. Efficiency	GPI01/02/05/06/07/09/ 10/11/14/16/17/21/22	Status report	10/2007	All Members
3	Each State report on the number of airframes fitted and transmitting with good NUC/NIC.	D. Efficiency	GPI01/05/06/09/14/16/ 17/21/22	Report on statistics conducted	10/2007	All Members with Ground Stations
4	Develop draft comparison of surveillance technologies document including required site and network architecture, expected surveillance coverage, cost of system.	D. Efficiency	GPI01/02/05/06/07/09/ 14/16/17/21/22	A regional guidance material for implemetation	Completed (4/2007)	Greg Dunstone
5	Develop draft update to AIGD to incorporate multilateration.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	The second amendment to the AIGD	Completed (4/2007)	Nick King, Chainan Chaisompong & Howard Anderson Anderson)
6	Provide a paper with an update on available equipment standards: (ARINC, Eurocae, RTCA, ICAO, TSO)	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	An information document for implementation	10/2007	USA
7	Develop a table detailing readiness of Airspace users & ATS providers	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Report of a survey conducted	Completed (4/2007)	Singapore

No.	Subject/Tasks List	Associated with Strategic Objective	Associated GPI	Deliverables	Target Date	Action to be taken and led by
8	Provide details of potential areas (FIRs) that where there is a positive cost/benefit for near term implementation of ADS-B Out	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Report of result of studies	4/2008	All
9	Develop a paper on how Probability of detection should be reported for ADS-B so that it can be compared to radar probability of detection	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Guidance material for implementation	10/2007	Greg Dunstone
10	Develop guidelines on how ADS-B equipage should be reported in future, especially the definition of "equipped".	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Guidelines for implementation	04/2008	Greg Dunstone
11	Develope outline of the performance criteria and identify issues to be considered when introducing ADS-B into an Air Traffic Control multi-sensor fusion process	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Guidance material for implementation	04/2008	Rick Castaldo, Greg Dunstone Michel G. Procoudine
12	Deveop brief guidance paper on security issues associated with ADS-B	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Guidance material for implementation	10/2007	Patrick Souchu, Greg Dunstone, Mike Gahan

PROPOSEDTHE REVISED TERMS OF REFERENCE OF ADS-B STUDY AND IMPLEMENTATION TASK FORCE

- Compare currently available technologies with respect to concept of operations, relative costing, technical and operational performance and maturity of alternative technology/solutions (~~compare~~primary, secondary ~~SSR~~ radar including Mode-S, ADS-B, multilateration, ADS-C);

- Develop an implementation plan for near term ADS-B applications in the Asia Pacific Region including implementation target dates taking into account:

  - available equipment standards;
  - readiness of airspace users and ATS providers;
  - identifying sub-regional areas (FIRs) where there is a positive cost/benefit for near-term implementation of ADS-B OUT;
  - developing a standardised and systematic task-list approach to ADS-B OUT implementation; and
  - holding educational seminars and provide guidance material to educate States and airspace users on what is required to implement ADS-B OUT.

- Study and identify applicable multilateration applications in the Asia and Pacific Region considering:

  - Concept of use/operation;
  - Required site and network architecture;
  - Expected surveillance coverage;
  - Cost of system;
  - Recommended separation minimums; and
  - If multilateration can be successfully integrated into an ADS-B OUT system for air traffic control

- Coordinate ADS-B implementation plan and concept of operations with other ICAO regions where ADS-B implementation is going on and with relevant external bodies such as EUROCONTROL, EUROCAE, RTCA and Industry.

Note: The Task Force, while undertaking the tasks, should take into account of the work being undertaken by SAS, AS Panels with a view to avoid any duplication.

The Task Force should report to the APANPIRG, through the CNS/MET Sub-group and provide briefing to the ATM/AIS/SAR Sub-group.

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INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE

DRAFT

GUIDANCE MATERIAL ON COMPARISON OF SURVEILLANCE TECHNOLOGIES (GMST)

Version xx

27 April 2007

GUIDANCE MATERIAL ON COMPARISON OF SURVEILLANCE TECHNOLOGIES (GMST)

1 Introduction

A number of surveillance technologies suitable for the delivery of ATC services to separate aircraft are currently available.

This paper will concentrate on enroute, and terminal applications rather than airport surface surveillance. It will consider the sensor component of the ATC system only – and will ignore the ATC display system. These sensors can support simple display systems or sophisticated automation systems.

2 The need for ATC Surveillance

Surveillance plays an important role in Air Traffic Control (ATC). The ability to accurately and reliably determine the location of aircraft has a direct influence on the separation distances required between aircraft (i.e. separation standards), and therefore on how efficiently a given airspace may be utilised.

In areas without electronic surveillance, where ATC is reliant on pilots to verbally report their position, aircraft have to be separated by relatively large distances to account for the uncertainty in the estimated position of aircraft and the timeliness of the information.

Conversely in terminal areas where accurate and reliable surveillance systems are used and aircraft positions are updated more frequently, the airspace can be used more efficiently to safely accommodate a higher density of aircraft. It also allows aircraft vectoring for efficiency, capacity and safety reasons.

ATC surveillance serves to close the gap between ATC expectations of aircraft movements based on clearances or instructions issued to pilots, and the actual trajectories of these aircraft. In this way it indicates to ATC when expectations are not matched, providing an important safety function. Surveillance provides “blunder” detection.

The demand for increased flexibility to airspace users by reducing restrictions associated with flying along fixed routes requires improved navigation capability on board the aircraft. Equally, accurate surveillance is required to assist in the detection and resolution of any potential conflicts associated with the flexible use of the airspace which is likely to result in a more dynamic environment.

Accurate surveillance can be used as the basis of automated alerting systems. The ability to actively track aircraft enables ATC to be alerted when an aircraft is detected to deviate from its assigned altitude or route, or when the predicted future positions of two or more aircraft conflict. It also supports minimum safe altitude warnings, danger area warnings and other similar alerts.

Surveillance is used to update flight plans, improving estimates at future waypoints and also removing the workload for pilots in providing voice reports on reaching waypoints.

3 General Requirements of an Air - Ground Surveillance System

The most basic function of a surveillance system is to periodically provide an accurate estimate of the position, altitude and identity of aircraft. Depending on the ATC application that a surveillance system is intended to support, there will be other requirements of the system.

A surveillance system may be characterised in terms of the parameters listed below:

1. Coverage volume – the volume of airspace in which the system operates to specification.

2. Accuracy – a measure of the difference between the estimated and true position of an aircraft.

3. Integrity – an indication that the aircraft's estimated position is within a stated containment volume of its true position. Integrity includes the concept of an alarm being generated if this ceases to be the case, within a defined time to alarm. Integrity can be used to indicate whether the system is operating normally.

4. Update rate – the rate at which the aircraft's position is updated to users.

5. Reliability – the probability that the system will continue operating to specification within a defined period. Sometimes this is called continuity.

6. Availability – the percentage of the total operating time during which the system is performing to specification.

Other issues which need to be considered when designing a surveillance system for ATC are:

1. The ability to uniquely identify targets.

2. The impact of the loss of surveillance of individual aircraft both in the short (few seconds) and long term

3. The impact of the loss of surveillance over an extended area.

4. Backup or emergency procedures to be applied in the event of aircraft or ground system failure.

5. The ability to operate to specification with the expected traffic density.

6. The ability to operate in harmony with other systems such as the Airborne Collision Avoidance Systems (ACAS) and Airborne Separation Assistance Systems (ASAS).

7. The ability to obtain Aircraft Derived Data (ADD).

8. The interaction between communication, navigation, and surveillance functions.

4 A Surveillance Sensor is One Part of a Surveillance System

Whilst this paper concentrates on the possible surveillance sensors, they are just one part of an overall system that provides data for use in ATC. A complete system includes:

- Position and altitude sensors. Some of these sensors may be ground based (e.g. radars) or may be airborne (e.g. altitude sensors). Datalinks are used to transmit data from airborne sensors to the ground,
    - The Fundamental Data provided to the air traffic controller is aircraft position, aircraft identity and altitude. Further information such as aircraft direction, speed, the rate of climb may also be provided.

- A system to transmit the data from the reception point on the ground to the ATC centre,

- A display system or ATC automation system
    - Data from a sensor system may be presented on a standalone display or combined with data from other sensor(s) and/or other data in an automation system and then presented on a plan view situation display.
    - The situation display provides Air Traffic Controllers with plan view of the position of aircraft relative to each other and to geographic features. This supports controllers in providing Separation and other services to aircraft.
    - Automation systems may use surveillance data to implement automated safety net functions such as Route Adherence Monitoring, Cleared Level Alarm, Conflict Alert, Lowest Safe Altitude and Danger Area Infringement Warning. These facilities increase overall safety.

- Suitably trained air traffic controllers, aircrew and

- Suitable standards and procedures to use the system including separation minima
    - ICAO PANS-ATM (Doc.4444, Chapter 8) details radar separation minima of five (5) and three (3) nautical miles. These minima allow for a considerable increase in airspace utilisation compared to procedural control. Changes to ICAO documents are about to be published (2007) recognising ADS-B use to support 5 nautical mile separation standards. ICAO's Separation & Airspace Safety Panel (SASP) is working on proposals to allow 3 nautical mile separation standards using ADS-B and also on the use of multilateration to support both 3 and 5 nautical mile separation standards.
    - Due to the low update rate, ACARS based ADS-C is unlikely to ever support 3 and 5 nautical mile separation standards. However it is used to support 30/30 and 50/50 nautical mile procedures used in some regions. ATN and VDL2 based ADS-C may reduce the achievable separation standards in some regions.

5 The Technologies

Knowledge of the position of aircraft is essential to an Air Traffic Controller in the provision of most air traffic services. Certainly knowledge of aircraft position is required to provide separation services. The provision of knowledge regarding aircraft position is referred to as surveillance. Position reports from pilots can provide knowledge of aircraft position to a controller. However the inherent inaccuracy, infrequent updates and scope for error due to misunderstandings requires very large spacing between aircraft to maintain safety. This technique is known as procedural separation.

Today there are primarily four classes of surveillance technology available to support air traffic control services;

1. Radar
2. ADS-B alone
3. Wide Area Multilateration (typically with ADS-B but may be supplied without)
4. ADS-C

5.1 Radar

Radar provides the controller with an accurate, trustworthy on-screen plan view of the aircraft position in real-time. The required separation between aircraft for safe operation can be greatly reduced compared to procedural separation. It also allows vectoring, ATC directed terrain avoidance and the provision of safety nets.

Radar is a technology which detects the range and azimuth of an aircraft based upon the difference in time between transmission of pulses to the aircraft and the receipt of energy from the aircraft. Typically the technology uses a large rotating antenna and associated machinery.

A radar system requires a number of racks of equipment (normally on a plinth) normally in an air-conditioned shelter. A typical site consumes between 10 and 20 kWof electricity and this needs to be backed up by generators and battery backup Uninterruptible Power Supplies (UPS). A specialised tower installation is required.

A radar typically takes a number of months for site preparation and deployment unless special, transportable systems are deployed.

5.1.1 Primary Radar

Primary Surveillance Radar (PSR) transmits a high power signal, some of which is reflected by the aircraft back to the radar. The radar determines the aircraft's position in range from the elapsed time between transmission and reception of the reflection. The direction of the aircraft is the direction in which the narrow beam radar antenna is facing.

PSR does not provide the identity or the altitude of the aircraft. However, PSR does not require any specific equipment on the aircraft.

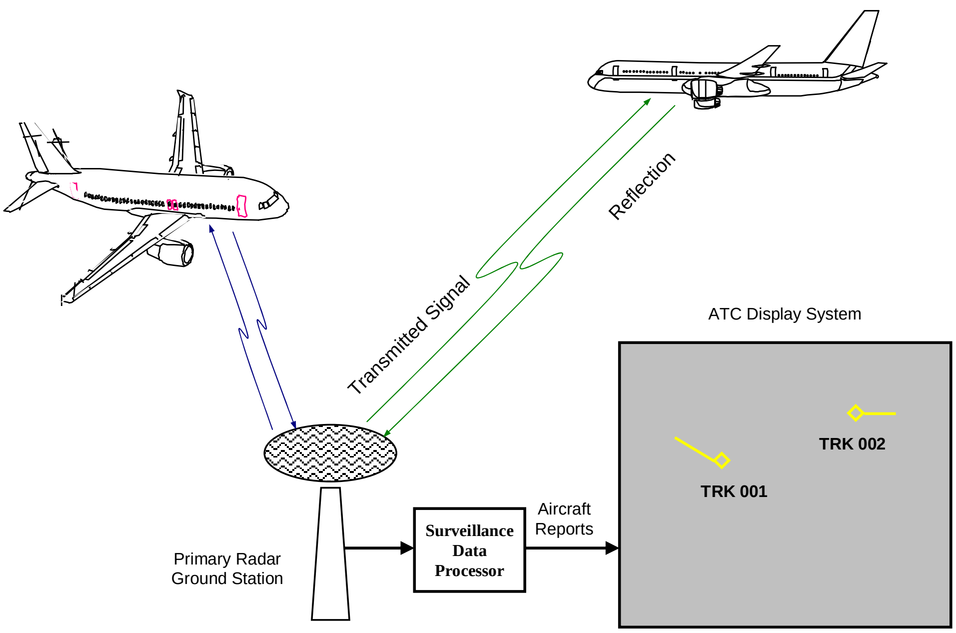

Figure 1 - Primary Radar

Strengths

- PSR does not require a transponder to be installed or operating on aircraft thus allowing the detection and management of non equipped/faulty aircraft or non co-operative aircraft[1]
- Can provide a weather channel output if display of weather is required.
- Well suited for aerodrome surface surveillance

Weaknesses

- PSR does not provide identity
- Does not provide altitude[2]
- Position is based on slant range measurement rather than true range (which presents some difficulties for multi-radar tracking systems)
- Can often report false targets (ground vehicles, weather, birds etc)
- Poor detection performance in the presence of ground and weather clutter especially for flight tangential to the radar
- Expensive compared to Secondary Surveillance Radar (SSR)
- A update rate between 4 and 12 seconds (longer than typical multilateration or ADS-B)
- High transmitter power required for long range performance – brings interference and environmental concerns
- Systems are very expensive to install and maintain
- Systems require optimum site with unobstructed view to aircraft, and with the minimum of ground clutter visible to the radar
- Cannot resolve two aircraft at a similar location at the same range, due to poor azimuth resolution performance.

5.1.2 Secondary Surveillance Radar

Secondary Surveillance Radar (SSR) systems consist of two main elements, a ground based interrogator/receiver and an aircraft transponder. The aircraft's transponder responds to interrogations from the ground station, enabling the aircraft's range and bearing from the ground station to be determined.

Refer to the ICAO Manual of Secondary Surveillance Radar (SSR) Systems (Doc 9684) for a detailed study of the subject.

The development of SSR evolved from military Identification Friend or Foe (IFF) systems and allows the use of the Mode A/C service for civil aviation. Since then it has been significantly developed to include the Mode S service. SSR frequencies of 1030 and 1090 MHz remain shared with the military.

In many cases SSR is co-located with a PSR, usually with the SSR mounted on the top of the PSR antenna.

Mode A/C transponders provide identification (Mode A code) and altitude (Mode C) data with 100 foot resolution information in reply to interrogations. Therefore in addition

[1] ICAO Annex 6 says at para 6.13.1 "From 1 January 2003, unless exempted by the appropriate authorities, all aeroplanes shall be equipped with a pressure-altitude reporting transponder which operates in accordance with the relevant provisions of Annex 10,Volume IV". A number of authorities provide exemptions.

[2] Some primary radars have height finder capabilities although these are normally too expensive for ATC use and have poor altitude accuracy with respect to civil aviation needs.

to being able to measure the aircraft's range and bearing, the Mode A/C system is also able to request the aircraft to provide its identity and altitude.

Mode S is an improvement of Mode A/C. It contains all the functions of Mode A/C, and also allows selective addressing of targets by the use of unique 24 bit aircraft addresses, and a two-way data link between the ground station and aircraft for the exchange of information. It provides the transponder capability to report altitude data with 25 foot resolution although accuracy and resolution also depend on the altitude sensor systems on board the aircraft.
SSR determines the aircraft's position in range from the elapsed time between the Interrogation and reception of the Reply. The direction of the aircraft is determined from the direction in which the narrow beam radar antenna is facing. The Reply contains the aircraft Identity and/or Altitude. The Identity information is able to be input by the pilot and the altitude information comes from a barometric encoder or air data computer on the aircraft. SSR will only detect an aircraft fitted with a functioning transponder. SSR with Mode S may also data-link many aircraft parameters such as heading, track, bank angle and selected altitude to the Radar.

Whilst SSR independently calculates geographical position, pressure altitude data, flight identity (4 digit octal code) and other data such as emergency flags are provided by airborne sensors or systems and datalinked to the ground.
SSRs transmit pulses on 1030 MHz to trigger transponders installed in aircraft to respond on 1090 MHz. This datalink can theoretically support 4 Mbits/second uplink and 1Mbits/second downlink.

There are two classes of SSR used today:

Classical SSR: typically uses a hog-trough antenna. This SSR system relies on the presence or absence of SSR transponder replies within the beamwidth. Performance can be quite poor, particularly azimuth accuracy and resolution. This type of system is also subject to significant multipath anomalies due to the poor antenna pattern. Range accuracy depends on variability of the fixed delay in the ATC transponder[3].

Monopulse SSR: Monopulse SSR systems measure the azimuth position of an aircraft within the horizontal antenna pattern using diffraction techniques. These techniques improve azimuth accuracy and resolution. In addition, these radars typically have large vertical aperture antennas and hence are less subject to multipath effects.

[3] Time allowed for transponder to reply : 3 uS +- 0.5 us as per SARPS

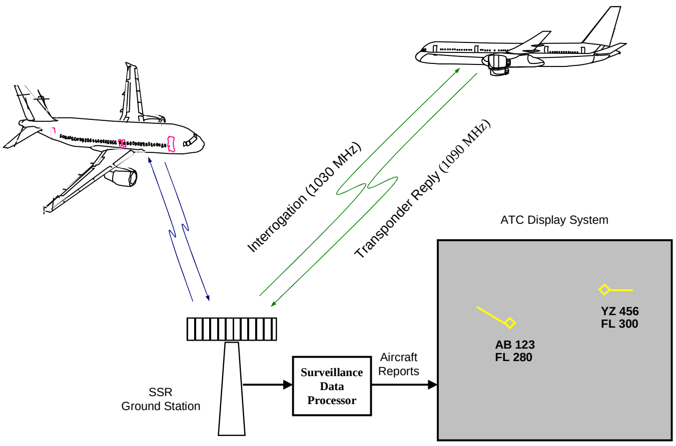

Figure 2 - Secondary Surveillance Radar

Strengths

- o SSR allows communication of identity (4 digit octal codes) when matched with flight plan data held by the ground system
- o Allows communication of altitude and emergency states to ground system
- o Provides good detection capability independent of clutter and weather.
- o Provides moderately high update rate.
- o Provision of altitude allows correction for slant range error

Weakness

- o Poor azimuth accuracy and resolution (particularly for classical SSR)
- o Can sometimes report false targets or position (reflections, multipath)
- o Can sometimes confuse Mode A replies as Mode C and vice versa
- o Can sometimes report false altitude or 4 digit code
- o No error detection provided in downlinked 4 digit code and altitude from Mode C transponders
- o Systems are expensive to install and maintain
- o Systems require optimum site with unobstructed view to aircraft
- o Cannot resolve two aircraft at the same location (garbling/ resolution performance)
- o Dependent on aircraft avionics
- o Not accurate enough for aerodrome surface applications due to transponder delay uncertainty

5.1.3 Mode S Secondary Surveillance Radar

Mode S radars typically use monopulse techniques to measure the azimuth position of an aircraft and have large vertical aperture antennas and hence are less subject to multipath effects. In addition, they are able to discretely interrogate single aircraft transponders and hence can discriminate between two aircraft at the same geographical position.

Mode S has additional capabilities which provide:

- improved ability to distinguish between Mode S equipped aircraft (resolution performance)
- error detection and correction of downlinked data
- improved tracking relying on Mode S 24 bit address (reduced tracking ambiguity)
- improved altitude quantisation

- ability to downlink a wide variety of information from Mode S equipped aircraft

A Mode S radar is backwards compatible with a conventional SSR Mode A/C radar and the detection and processing of Mode A/C transponder replies is essentially identical. To achieve Mode S benefits, the aircraft transponders must be Mode S capable transponders.

All ACAS II (v6.04 or v7.0) equipped aircraft have mode S transponders.

Europe has issued Mode S mandates requiring all aircraft in certain airspace to be Mode S equipped. Some exemptions will exist.

The European mandate also requires support of

Elementary surveillance (ELS) which requires the aircraft to be able to downlink callsign in response to Mode S interrogations and

Enhanced surveillance (EHS) which requires the aircraft to be able to downlink

- Selected Altitude
- Roll Angle
- Track Angle Rate
- Track Angle
- Ground Speed
- Magnetic Heading
- Indicated Airspeed/Mach No
- Vertical Rate

Strengths

- Altitude and identity is protected and the downlink is error free (of course flight identity could have been entered incorrectly)
- Can resolve two aircraft at the same location
- Provides 25 foot altitude quantisation (instead of conventional 100 foot resolution)
- Operates with Mode A/C aircraft albeit with no advantages compared to a Mode A/C radar

Weakness

- Benefits apply only to Mode S equipped aircraft
- More complex to set up than SSR
- Some currently deployed Mode A/C transponders are non compliant with the standards and fail to respond to Mode S interrogations properly – whilst these transponders are tolerated by Mode A/C radars
- Dependent on aircraft avionics – but most **airliners** are equipped with Mode S as a result of ACAS mandates
- Systems require optimum site with unobstructed view to aircraft

5.1.4 Secondary Radar Alone

SSR alone is used for en route radar control in many States where intruder detection is not required. An SSR only installation is less expensive than a combined primary plus secondary radar, but involves a significant outlay for buildings, access roads, mains electrical power, standby generators, towers and turning gear to rotate a large elevated antenna etc.

ICAO Document 4444, Procedures for Air Traffic Services – Air Traffic Management, sets out the requirements for Radar Services in Chapter 8. An extract is copied at Attachment 1. In particular, Section 8.1.9 states:

"SSR systems, especially those with monopulse technique or Mode S capability, may be used alone, including in the provision of separation between aircraft, provided:

a) The carriage of SSR transponders is mandatory within the area; and

b) Aircraft identification is established and maintained by use of assigned discrete SSR codes"

5.1.5 Combined Primary plus Secondary Radar

Combined Primary & Secondary Radar makes use of the advantages of the two types of radar in one installation. Typically, the PSR antenna and the SSR antenna are mounted on the same turning gear and the associated processing performs filtering, combines the SSR and primary data and tracks the radar reports. One track message is output per aircraft each antenna rotation.

The primary radar provides detection of intruder aircraft and the SSR performs detection of co-operative aircraft as well as providing altitude and identity information.

Digital tracking systems gain significantly benefits from having SSR and PSR installed on the same rotating antenna. SSR can resolve tracking ambiguities that would exist in a PSR only solution and vice versa.

Some States choose to mount PSR and SSR systems at separate locations thus providing separate antenna platforms. This has the advantage of a level of redundancy since one antenna stops, a level of service can be provided from the other. However, in this case, the advantages of improved tracking performance are forgone – unless the antennas are nearby and antenna rotation is synchronised[4].

Combined PSR/SSR systems are usually provided to support approach departure ATC in terminal manoeuvring area airspace. It is in the busy terminal area airspace that the probability of general aviation aircraft straying into controlled airspace is higher – and therefore some States prefer to have PSR in these environments.

Often such systems are backed up by offsite SSR only systems.

5.2 ADS-B alone

ADS-B is a system that uses transmissions from aircraft to provide geographical position, pressure altitude data, positional integrity measures, flight identity, 24 bit aircraft address, velocity and other data which have been determined by airborne sensors.

Typically, the airborne position sensor is a GPS receiver, or the GPS output of a Multi-Mode Receiver (MMR). This sensor must provide integrity data that indicates the containment bound on positional errors. The altitude sensor is typically the same barometric source / air data computer source used for SSR. Integrated GPS and inertial systems are also used. Currently inertial only sensors do not provide the required integrity data although these are likely to be provided in the future.

[4] Mechanical slaving brings another degree of complexity and failure modes and is rarely implemented (for good reasons)

An ADS-B ground system uses a non-rotating antenna positioned within a coverage area, to receive messages transmitted by aircraft. Typically a simple pole (DME like) antenna can be used.

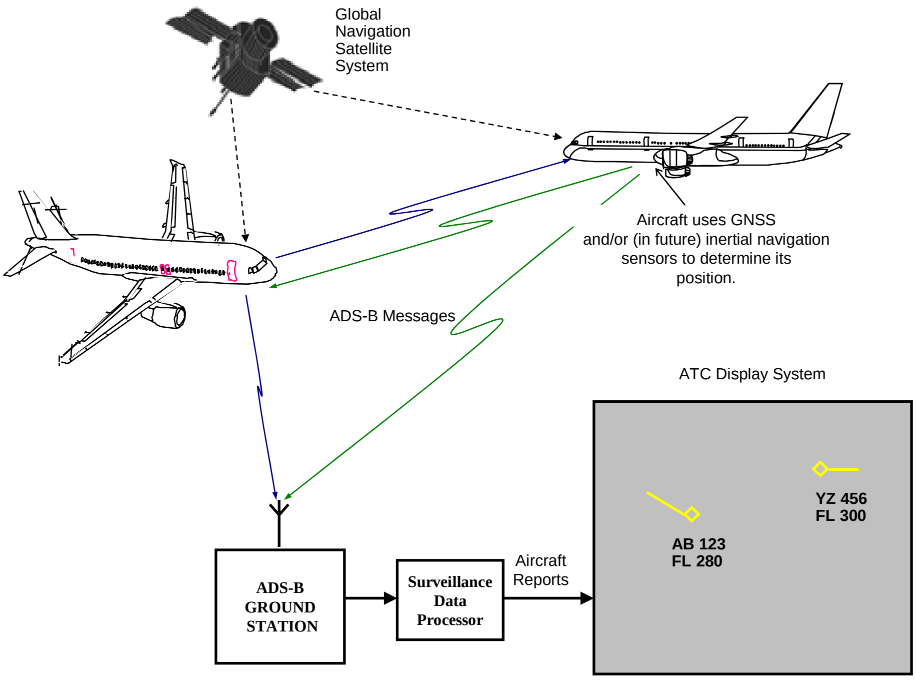

Figure 3 - Automatic Dependent Surveillance - Broadcast

The ADS-B ground system does not necessarily transmit anything. ADS-B receiver ground stations are the simplest and lowest cost installations of all options to provide air-ground surveillance, although costs may increase if ADS-B transmitter (to broadcast or rebroadcast ADS-B data e.g. TIS-B, ADS-R or FIS-B) capabilities are deemed necessary.

An ADS-B receiver is typically less than six inches high by nineteen inches wide and a duplicated site consumes less than 200 watts of electricity. An ADS-B ground station can normally be installed in an existing VHF communications facility.

The installed cost of a duplicated ADS-B ground station is lower than other alternatives. If it can be housed in an existing communications facility, installation can be as short as one week after delivery of equipment from the manufacturer.

While ADS-B has the advantage of quite low ground station cost, it has the disadvantage of requiring aircraft to equip with ADS-B transponders, which will take time. Voluntary equipage among jet airline fleets is still expected to be high, and ADS-B remains very attractive in the longer term.

Many avionics vendors have included ADS-B capability in the software release that supports ELS and EHS.

Some ATC systems can support ADS-B use, including delivery of separation services, when there is partial aircraft ADS-B equipage. Other ATC systems require complete equipage for ADS-B use to be viable.

The use of ADS-B along the Flight Information Region (FIR) boundary may be easily shared by the boundary States. ADS-B technology is generally not sensitive to military authorities because it is co-operative in nature and hence such authorities are less likely to block data sharing.

The low marginal cost of ground stations encourages FIR boundary data sharing where large parts of coverage benefit the adjacent FIR. This data sharing can be considered similar to the sharing of ADS-C data when adjacent Air Navigation Service Providers (ANSPs) use service providers to deliver ADS-C data.

Strengths

- Simple ground station design without transmitter
- Can be installed at sites shared with other users
- Very low ground station cost (but highly variable ADS-B avionics fitment cost)
- Very high update rate
- Almost perfect resolution
- High accuracy and integrity (airborne measurements)
- Higher performance velocity vector measured by avionics and then broadcast, rather than determined from positional data received on the ground
- Accuracy not dependent on range from ground station
- Facilitates exchange of surveillance data across FIR boundaries
- Can be easily deployed for temporary use (emergency, special events etc)
- Can support the display of callsigns on simple display systems without interfaces to flight planning systems since callsign is provided directly from the aircraft
- Facilitates future provision of innovative ATM services based on air-to-air ADS-B.

Weakness

- Dependent on aircraft avionics. This can be a major issue in some environments.
- Equipage rates are relatively low at this stage (2007)
- Systems require optimum site with unobstructed view to aircraft
- Some outages expected due to poor GPS geometry when satellites out of service, although exposure expected to reduce in the future with use of GNSS augmentation & internal support[5]
- ADS-B has the capacity to evolve towards the broadcast and use of other data, such as Trajectory Change Point (TCP) or others, already defined in the standard

ADS-B Critical issue

The critical issue for ADS-B is that it requires ADS-B avionics including GPS or similar in participating aircraft. Whilst many airliner manufacturers produce aircraft with ADS-B out avionics a large legacy fleet remains to be equipped.

The situation is different in different regions of the world. Some States have new airliner fleets which are growing rapidly – and the new aircraft are fitting with ADS-B. In other States very large numbers of legacy aircraft remain unequipped.

The situation is also different in different aviation segments.

[5] Analysis of 37 million ADS-B samples by one State over a 4 month period indicated that 99.8% of samples were acceptable for ATC 5 nautical mile separation. See ADS-B SITF/5-IP/8

Whilst large aircraft are equipping, few regional airliners are equipped.

General Aviation (GA) is another area that can be problematic. In some States the cost to equip the GA fleet is small. In others with a large fleet it can be very expensive. Some States envisage subsidies to assist GA equipage so that all aviation segments benefit. Some States also envisage the mandatory fitment of ADS-B with and without subsidies.

Timing of transition to match aircraft equipage of ADS-B will be critical for many States.

At the same time, the benefits of ADS-B equipage are significant and may allow other surveillance systems to be decommissioned and supports delivery of air-air surveillance applications. ADS-B avionics support the ADS-B application in all locations to which the aircraft travels.

5.3 Multilateration

Multilateration is a system that uses aircraft transponder transmissions (Mode A/C, Mode S or ADS-B) to calculate a 2D or 3D position.

Multilateration relies on signals from an aircraft's transponder being detected at a number of receiving stations to locate the aircraft. It uses a technique known as Time Difference of Arrival (TDOA) to establish surfaces which represent constant differences in distance between the target and pairs of receiving stations, and determines the position of the aircraft by the intersection of these surfaces.

The accuracy of a multilateration system is dependent on the geometry of the target in relation to the receiving stations, and the accuracy to which the relative time of receipt of the signal at each station can be determined.

Multilateration is mainly used for airport surface and terminal area surveillance, although with careful design and deployment it may be used in segments of enroute airspace.

Multilateration independently calculates geographical position in 2D, or in 3D if more sensors are installed.

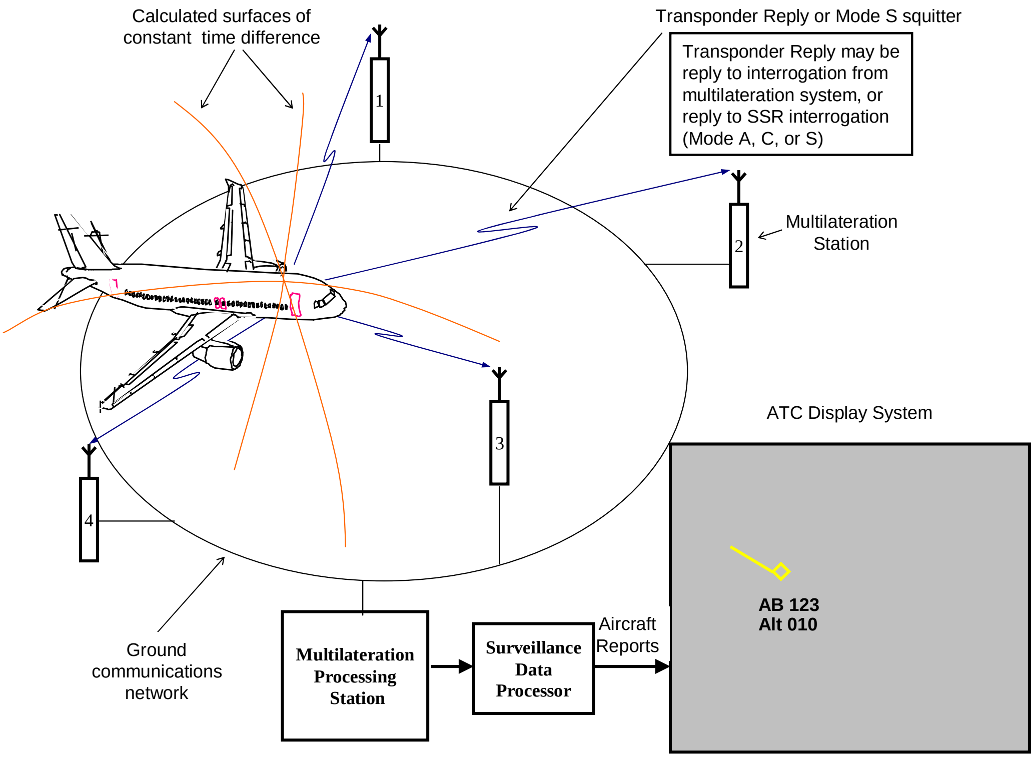

Figure 4 - Transponder Multilateration

Multilateration systems can be defined as being either passive or active. Passive systems require only ground receivers. An active system requires ground receivers and at least one interrogator. Multiple interrogators may be required to meet coverage requirements. The latter enables the system to be independent from other sources to trigger transmissions from aircraft. In most practical ATM applications multilateration systems are active and must interrogate aircraft to obtain altitude and identity data. Passive systems usually rely on nearby radars to perform interrogation[6]. They could operate on ADS-B signals which do not require interrogators.

Multilateration systems will provide a range of fundamental data items relative to a specific target depending on the airborne derivation of the data and if they are transmitted within the aircraft signal used by the multilateration system, i.e. MSSR Mode A or MSSR Mode C or 1090 MHz Extended Squitter (ADS-B). Derived data can include:

- Pressure altitude data derived from decoding ADS-B transmissions or replies to Mode C interrogations.

- Flight identity obtained by decoding ADS-B transmissions or replies to Mode A interrogations.

- 24-bit aircraft address obtained by decoding ADS-B transmissions, DF11 Mode S autonomous transmissions[7] or replies to Mode S interrogations.

[6] Difficulties in distinguishing between Mode A and Mode C replies will be experienced unless the interrogator pulses are available.

[7] DF11 is an autonomous transmission from a Mode S transponder which provides aircraft 24 bit code only. It was primarily designed to support self announcement to TCAS systems. Multilateration systems can

Additionally, multilateration systems can make use of position messages provided by ADS-B systems, i.e. each multilateration receiver can usually be configured to operate as an ADS-B receiver. These can be used as standalone ADS-B sensors.

Initially multilateration systems have been used for surface surveillance. More recently States have begun deploying multilateration for wide area applications of terminal area size. These wide areas tend to be smaller than the area covered by radars.

System performance in the service volume is determined primarily by the geometry of the ground station deployment. Therefore the number of sites and the geographical disposition of those sites (site selection) are the critical factors in achieved performance. The availability of such sites and reliable, high performance communications to the central processing system is required.

One requirement of multilateration systems is that the central processing must be able to determine the time DIFFERENCE of arrival of signals from aircraft. This requires a synchronisation of the ground stations typically using either:

a) A reference transmitter visible to multiple receiver stations, or
b) Use of common clock (GPS or other) to time synchronise the receptions, or
c) The transmission of the received signals by wideband datalink to the central processing system, or
d) Very accurate clocks at each sensor (atomic standard).

Mutilateration systems require a number of ground stations to detect each aircraft transmission.

- For surveillance of airborne aircraft a minimum of four ground stations must receive each message to determine a position.
  - Three ground stations can be used if pressure altitude is also used but the position accuracy will be adversely affected due to 100 foot barometric pressure altitude quantisation and because this altitude varies[8] and does not match the WGS84 geoid.
  - An additional ground station may be necessary to support the ability to continue operations with one ground station failed.
  - One less ground station is required if a ground station uses “radar ranging” to measure the distance of the aircraft from the interrogating station.

- For surface movement applications a minimum of three ground stations must receive each message to determine a position.

- “Ranging” via interrogation of SSR transponders can be used in some cases to improve accuracy.

Strengths

- Provides aircraft identification using 4 digit octal codes, 24 bit Mode S codes or Flight Identity (ADS-B or Mode S based) to ground system
- Allows communication of identity, altitude and emergency states downlinked from aircraft

determine position from DF11 transmissions. These transmissions do not provide altitude or flight ID data. Mode A/C transponders need to be interrogated to determine position.

[8] Due to atmospheric pressure

- Provides good detection capability independent of clutter and weather
- Is able to provide a high update rate
- Can resolve two aircraft at the same location (garbling / resolution performance) if aircraft are Mode S capable using selective address interrogation
- Can operate as a set of multiple ADS-B ground stations
- Can be installed at sites shared with other users
- Is an attractive transition path before widescale ADS-B equipage occurs in some States
- Lower cost than radar[9]
- Data feed can be made to resemble radar data (and hence can be used in some ATC automation systems that are not adapted to support native multilateration data)[10]
- In some locations, when existing infrastructure is available, the systems can be inexpensive to install and maintain compared to alternative systems.

Weakness

- Requires multiple sites
- Requires multiple communication links
- Sometimes reports false targets (reflections, multipath)
- No error detection provided in downlinked 4 digit code and altitude from Mode C transponders
- Systems can be moderately expensive to install and maintain because of the costs associated with the provision and maintenance of multiple sites especially if existing infrastructure is not available.
- Systems require multiple sites with unobstructed view to aircraft. This can be a significant problem in some environments
- Requires a transmitter to trigger aircraft to transmit the data required for ATC applications
- Not yet endorsed by ICAO
- Requires multiple transmitter sites for large coverage, due to the poor uplink antenna gain when omni-antenna used (compared to high gain radar antenna).

5.4 ADS-C

ADS-C (Contract) is also known as Automatic Dependent Surveillance – Addressed (ADS-A) or simply Automatic Dependent Surveillance (ADS). With ADS-C the aircraft uses on-board navigation systems to determine its position, velocity, and other data, and reports this information to the responsible air traffic control centre.

Information that may be sent in ADS-C reports includes:

a. Present position (latitude, longitude, altitude, time stamp, and FOM)
b. Predicted route in terms of next and (next + 1) waypoints
c. Velocity (ground or air referenced)
d. Meteorological data (wind speed, wind direction, and temperature)

ADS-C reports are sent by point to point satellite or VHF data links. The data links are typically provided by service providers. Typically fees are charged for the transmission of each message; as most of these costs are borne by the airlines, there is a reluctance to use ADS-C at

[9] There is a wide variability of the costs for multilateration since site costs typically dominate the total costs. In some environments multilat costs could approach those of radar

[10] Usually brings some additional inaccuracies that are tolerable.

higher rates than 10-15 minutes between messages]. Sometimes HF datalink is used, but with reduced performance.

With ADS-C the airborne and ground systems negotiate the conditions (the Contract) under which the aircraft submits reports (i.e. periodic reports, event reports, demand reports, and emergency reports). Reports received by the ground system are processed to track the aircraft on ATC displays in a similar way to surveillance data obtained from SSR.

ADS-C is typically used in oceanic and remote areas where there is no radar, and hence it is mainly fitted to long range air transport aircraft. The aircraft avionics chooses VHF communication when in coverage of the VHF network to lower costs and improve performance. Satellite data-communications is used at other times such as when the aircraft is over the ocean.

Typically messages are transmitted infrequently (~ each 15 minutes). The positional data is accompanied by a "figure of merit" value which indicates the accuracy. It is not an integrity value.

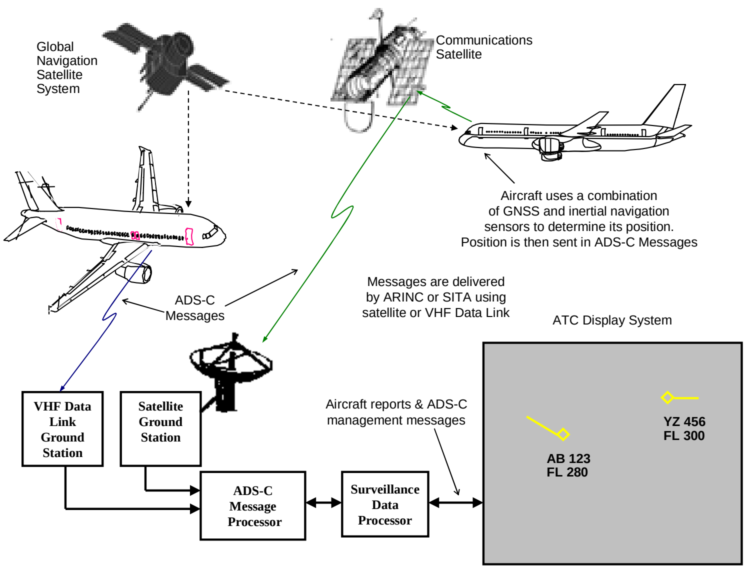

Figure 5 - Automatic Dependent Surveillance - Contract

Strengths

- Provides surveillance coverage over very remote regions and oceans except in the polar regions
- Supports a subset of the safety net applications (Cleared Level Adherence Monitoring : CLAM, Route adherence monitoring : RAM , and ADS Route conformance warning : ARCW[11]) but unable to support more tactical alerts like STCA
- Low capital cost for ANSP
- Minimal maintenance costs

Weakness

- High costs per report (service provider)
- Low reporting rates
- No ability to offer radar like separation services (vectoring etc)
- Expensive avionics fitment
- FANS-1/A is not ICAO-compliant, but has been accepted as a transition step
- ATN variant is not mature but will support higher reporting rates [12]
- Long latency when satellite communication link is used
- Availability not as high as other systems (not all elements are duplicated)
- Susceptibility to failure/overload at satellite earth stations
- Relatively low message delivery reliability

[11] This is the same as "FLIPCY" in the European context
[12] FANS1 standards limit reporting rates so that contracts can be supported over ACARS satellite (amongst other reasons)

6 COMPARISON

This section compares the various technologies

6.1 APPLICATIONS

PSR	**Enroute surveillance**: In the 1960s & 1970s PSR was widely used for ATC surveillance including in enroute airspace. In the late 1970s and following years many ANSPs have decided to discontinue the use of PSR in this application due to the high cost and due to mandatory requirements for SSR transponders in a lot of airspace. In many countries the use of PSR is retained for defence purposes rather than for provision of civil ATC services. The use of PSR for enroute ATS is expected to continue to decrease. **Terminal area surveillance**: PSR remains a useful tool in busy terminal areas to detect non transponder equipped aircraft and provide intruder protection of the terminal area airspace. Typically primary radars have co-mounted SSR to improve tracking performance and provide identity/altitude. In the next decades the use of primary radar is expected to commence to decrease. **Surface movement radar** application: PSR remains a significant tool in surveillance of airport surfaces. Its purpose is to detect vehicles and aircraft which are not detected by other cooperative surveillance means (eg aircraft and vehicles not equipped with transponder or equivalent). **Airborne:** no civil application.
SSR	**Enroute surveillance**: SSR only sensors often provide surveillance in enroute airspace when financially justified. In some States enroute radars rotate slowly (typically 5 rpm) and in others rotate at 16 rpm. In some regions (Europe) two SSR sensors are required to cover the airspace. In other regions, single SSR surveillance is used. **Terminal area surveillance**: SSR radars are currently critical to the effective provision of terminal area surveillance because they provide a moderate update rate of position (typically 15 rpm), identity (4 digit octal codes) and altitude. Typically a terminal area radar includes primary radar and SSR. **Precision Runway Monitor (PRM) - electronic scan**: Special SSR ground stations are used by a number of States to support precision runway approach monitoring to parallel runways. Typically these electronic scan sensors provide an update every 1 second, with an azimuth accuracy exceeding 1 milliradian. The objective of these radars is to detect divergence from the defined final approach path.

	Airborne: ACAS systems including TCAS 1, TCAS 2 and other products such as TCAD rely on SSR transmissions.
Mode S	**Terminal area & enroute surveillance** Mode S SSR sensors are being commissioned around the world to support both enroute and terminal area operations. Whilst the surveillance performance benefits (eg: resolution) of Mode S will be delivered to all Mode S equipped aircraft in the coverage of a Mode S radar, only ANSPs with updated ATC systems will be able to take advantage of many capabilities such as downlink of airborne parameters (DAP). The move away from the use of 4 digit SSR codes will be slow and driven by ATC automation changes as well as fitment of Mode S radar ground stations and transponders in aircraft. Europe's ELS/EHS mandate will speed this process in Europe and hence worldwide. Legacy ATC automation in other States will slow progress. **Airborne:** ACAS systems including TCAS 1, TCAS 2 and other products such as TCAD rely on SSR transmissions.
Multilateration	**Advanced Surface Movement Guidance and Control Systems (ASMGCS)**: Multilateration has been deployed at numerous locations for surface surveillance. Typically it supports a surface movement radar and provides highly accurate position and identity to these systems. Typically 10-20 ground stations are used to provide multilateration coverage over the whole airport surface. High update and high integrity positional data is provided for Mode S capable aircraft and for ADS-B equipped surface vehicles. Implementation requires new "transponder on" procedures to be followed by flight crew whilst taxing. Careful site selection and tuning of these systems has been found to be necessary to account for multipath, coverage obstructions and for aircraft that are not Mode S capable. Multilateration systems operate more efficiently the higher the Mode S transponder fitment rate. **Terminal area surveillance**: Multilateration shows promise for "wide area" application and a number of States have projects to deploy multilateration for this purpose. However, at this time, no ICAO approval has been obtained to use multilateration for this application. SASP is working on a proposal to use multilateration for 3 nautical mile separation. Austria is using multilateration in a specific terminal area application (Innsbruck) monitoring approaches and has authorised a 5 nautical mile separation standard. **Enroute surveillance**: Multilateration is likely to be able to be used in some "very wide area" applications. At this time, no ICAO approval has been obtained to use multilateration for this application. The Czech Republic has been using a specific type of multilateration for very wide area surveillance for some time in a search & rescue support role. "Very wide area" multilateration requires that multiple ground stations have the ability to "see" the aircraft over large areas. Typically this requires a high number of sites and hence makes multilateration a higher cost that anticipated because of site and

	data communication costs. A comprehensive site survey would be required to ensure that adequate coverage, geometry and site availability exists to meet the requirement. In States with particular requirements, a highly developed communications infrastructure, the cost of site development and data communication may be low enough for this to be preferred. Typically this may occur when terrain would prohibit cost effective radar coverage. **PRM**: Multilateration shows promise for use in PRM applications when sufficient aircraft are equipped because multilateration meets the accuracy and update requirements of PRM. However, at this time, no safety case or ICAO approval has been obtained to use Multilateration for this application. The USA and Australia envisage using multilateration for this purpose. **Airborne:** no application.
ADS-B	**Enroute surveillance**: ADS-B may be used in enroute airspace. Some States will require full ADS-B equipage whilst others will allow separation services without all aircraft being equipped largely dependent on their ATC automation system capabilities and traffic environment. ADS-B will bring safety improvements and automated safety nets where there is no surveillance today. ADS-B will be more readily used in ATC systems which can support low performance surveillance (eg voice reports) and high performance surveillance (eg radar or ADS-B) within a sector. Clearly benefits rise the higher the percentage of equipage. In many States, ADS-B will be used enroute in remote areas which have no radar surveillance. Other States will decommission enroute radars in lieu of ADS-B because of ADS-B's cost effectiveness. ICAO's SASP and OPLINK panels have agreed to the use of ADS-B to provide 5 nautical mile separation standards. The associated changes to PANS ATM doc 4444 are soon to be published. ADS-B may also be used in parallel with radar, improving overall performance by improving detection (coverage holes), improving tracking (using 24 bit code, using velocity vector), reducing latency and increasing update rate. **Terminal area surveillance**: ADS-B may be used in terminal area airspace to provide high quality surveillance data. The application of ADS-B in this domain is currently hindered by lack of equipage of ADS-B avionics. Comprehensive use in busy terminal areas will require a relatively high percentage of equipage because of the difficulties and workload associated with procedural terminal areas. However, in some States mixed equipage may be possible. ADS-B positional data accuracy and ADS-B's high integrity are major advantages as well as the better velocity vector performance of ADS-B compared to radar. No ICAO approval yet exists for the use of a 3 nautical mile separation standard using ADS-B although work is currently being progressed by SASP. **Surface movement**: ADS-B has potential for surveillance on airport surfaces. No States have yet deployed ADS-B alone for this application. However surface surveillance systems have been commissioned to provide identity and emergency flag data to surface movement displays.

	PRM: ADS-B shows promise for use in PRM applications when sufficient aircraft are equipped because ADS-B meets the accuracy, velocity vector performance and update requirements of PRM. However, at this time, no safety case nor ICAO approval has been obtained to use ADS-B for this application. **Air-Air Applications**: ADS-B shows promise for use a large number of air to air applications. A number of States are examining strategies to improve safety, efficiency and increase capacity using these applications. This feature has significant strategic impact on the choice of technology for some States. Applications include In Trail Procedure, Airborne situational awareness, Merging & Spacing etc **Airborne:** A significant number of airborne applications of ADS-B are envisaged by the international community including Air Traffic Situational awareness, In trail procedures, Merging & spacing etc. Airbourne applications are seen by FAA and Europe as key elements of the next generation of Air Traffic Management and are critical to provision of future capacity.
ADS-C	Enroute surveillance in remote or oceanic areas Due to the low update rate, the cost of ADS-C avionics and service provision, it will not be preferred when other technologies can support surveillance. However, over the ocean or remote areas, where other technologies cannot be used, ADS-C will remain as the preferred surveillance tool. ADS-B may compete in cases where ground stations can be installed, for example on islands, oil rigs etc. ADS-C does not support 3 nautical mile or 5 nautical mile separation standards. ADS-C does not support tactical ATC nor vectoring. **Airborne:** airborne equipment may be used for airline-specific communications such as systems monitoring, crew and airframe scheduling and customer care requirements.

6.2 PERFORMANCE CHARACTERISTICS

Since this document is aimed at discussing alternative technologies to be deployed in the future, the performance of new generation radars shall be assumed. This is in contrast to many comparative documents that compare existing (old) radar performance with new surveillance technologies to demonstrate that the new technology is safe.

	Range	Accuracy	Integrity	Resolution	Update period
Primary radar	S-band typically 60-80 NM L-band 160-220 NM	In range : 0.1 NM rms or 0.2 NM 2 σ In azimuth : 0.15 degrees rms or 0.3 degrees 2 σ .	No "message by message" integrity report provided. Range/Azimuth alignment can be assured through statistical comparison of SSR & primary radar reports. Alternatively special primary test units may operate like a SSR site monitor.	1 to 3 degrees in azimuth	Between 4 & 15 seconds
SSR	200 NM-250 NM	For a monopulse radar In range : 0.03 NM rms In azimuth : 0.07 degrees rms or 0.14 degrees 2 σ for random errors. [13]At 50 NM range the 0.14 degree error results in a position error of 0.12 NM. At 100 NM range : 0.24NM, At 200 NM : 0. 48 NM At 250 NM : 0.60 NM	No message by message integrity. Testing of site monitor provides integrity check in general. Downlinked data such as altitude & 4 digit identity is subject to transmission errors which are passed to controllers. Subject to mode A/C code garbling.Subject to confusion between mode A and Mode C data.	0.5 to 1 degree in azimuth	Between 4 & 15 seconds

[13] The range noise errors are 0.03 NM (1σ) and the noise errors in azimuth are 0.07 degrees (1σ). For comparison purposes, and since GPS (ADS-B) errors are expressed with respect to a positional error with 95% confidence, this paper will use 2 σ (95% assuming Gaussian distribution of errors) - namely a 0.14 degree error.
Taking into account the random noise errors only: At 50 NM the 0.14 degree error results in a position error of 0.12Nm. At 100 NM this error becomes 0. 24NM, 0.48 at 200 NM and 0.60Nm at 250 NM. In addition to these errors one must consider systematic errors of alignment. Radars can be maintained aligned accurate to +-0.05 degrees in azimuth. Azimuth errors are clearly the dominant error as range increases, and can be translated into positional errors as follows: Systematic errors of +- 0.2Nm at 250Nm from the radar also need to be considered when using Multi Radar to separate aircraft and when separating aircraft from terrain or geographical boundary.

	Range	Accuracy	Integrity	Resolution	Update period
ModeS	200 NM-250 NM	Same as SSR	No message-by-message positional data integrity. Testing of site monitor provides integrity check in general. Mode S downlinked data is subject to stringent transmission error detection algorithms virtually eliminating the risk of undetected false data.	Perfect for mode S avionics due to ability to uniquely interrogate one aircraft 1 degree in azimuth for mode A/C transponders	Between 4 & 15 seconds
ADS-B	200 NM-250 NM	Determined by the aircraft avionics and independent of range from sensor. For GPS, typically : 95% less than 0.1 NM	Position integrity guaranteed to $1*10^{-7}$ [14]due to RAIM algorithm in avionics. Integrity value is downlinked in the ADS-B message. A site monitor typically augments the integrity monitoring and often also supports GPS constellation monitoring. ADS-B downlinked data is subject to stringent transmission error detection algorithms virtually eliminating the risk of errors in the transmission medium	Perfect due to Mode S avionics unique 24 bit code and random transmission requirements	0.5 seconds from aircraft. Typically 1 second from ground station. In high density environments with significant 1090 Mhz FRUIT, the update rate may be reduced

[14] Sometimes limited to 10^{-5} to account for software assurance level

	Range	Accuracy	Integrity	Resolution	Update period
Multilateration	Determined by the geometry of the ground stations.	Determined by geometry of ground stations with respect to the aircraft. Therefore each multilateration system is designed to achieve a defined accuracy for the particular operational requirements of the service volume. Higher accuracy requires better geometry and typically more ground stations. Very high accuracy in some areas and low accuracy in others. A requirement for multilateration accuracy < 0.1 NM rms is reasonable for such a system. ie 0.2 NM at 2 σ The number and position of ground stations required to achieve this accuracy can then be determined. Processing systems need to filter received information based on geographical area and DOP of receiver system when accuracy of the report is less than that required for the operation.	Position integrity could in theory be guaranteed by reception algorithm if an overdetermined solution is available. This could operate like the RAIM algorithm in GPS. Current implementations do not require an overdetermined solution. Insistence on such a solution would require multilat systems to flag to downstream users whether or not an overdetermined solution is provided. It would also require additional ground stations and costs. Downlinked data from Mode S transponders (but not A/C transponders) is subject to stringent transmission error detection algorithms significantly reducing the risk of false data. Provision of a site monitor can provide a general system integrity check but does not provide integrity data relating to each aircraft.	Perfect for Mode S avionics due to unique 24 bit code and independence of transmission times. For Mode A/C transponders, position resolution is good due to multilateration technique. With Mode A/C avionics, aircraft at same range (and hence possibly garbled) from one ground station are not at the same range from other ground stations. Some multilateration implementations use whisper-shout techniques to resolve Mode A/C transponders.	Typically 1 second for Mode S aircraft. Typically 2.5 to 5 seconds for Mode C transponder aircraft.

	Range	Accuracy	Integrity	Resolution	Update period
ADS-C	200 NM from VHF ground station or via satellite (unrestricted except for polar regions)	Determined by the aircraft avionics. Typically 99% less than 0.2 NM	An Actual Navigation Performance (ANP) value is provided by avionics and generates FOM value to ATC. This is an "accuracy" value and no integrity measure is conveyed to the ATC centre. Downlinked data is subject to stringent transmission error detection algorithms (CRC) virtually eliminating the risk of false data.		Typically a report each 14 minutes. However, also supports event contracts which initiates unscheduled reports on occurrence of defined events.

	Availability	Typical Reliability – MTBF (Continuity) & Major factors	Maturity	Anomalies
		Reliability and availability are very specific to the deployment of concern because they depend on organisational factors, maintenance, telecoms infrastructure as well as hardware and software. Therefore the values shown are very generic.		
Primary radar	> 99% NB: Outages for routine antenna maintenance required	For duplicated system > 20,000 hours Modular and fail soft transmitter & reliance on single antenna. Relies on mechanical machinery for antenna rotation Duplicated receiver/processing	Very mature. Thousands of systems installed. Separation standards and procedures are established in PANS ATM Doc 4444	Affected by weather, “road traffic”, multipath, and ground clutter
SSR	> 99 %[15] NB: Outages for routine antenna	For duplicated system > 20,000 hours	Very mature. Thousands of systems installed Separation standards and procedures	Affected by multipath, reflections, second time around replies, plot splits, garbling, resolution loss & data corruption

[15] Eurocontrol standard document for radar surveillance in enroute airspace and major terminal areas para 7.4 : <9 hours/ year = 99.9%
Australia : Planned outages over 10 years (inc major bearing refurbishment) 52 hours/pa average plus unplanned 9 hours = 99.3%

	Availability	**Typical Reliability – MTBF (Continuity) & Major factors**	**Maturity**	**Anomalies**
	maintenance required	Reliance on single antenna. Relies on mechanical machinery for antenna rotation. Duplicated transmitter/ receiver	are established in PANS ATM Doc 4444	
ModeS	> 99% NB: Outages for routine antenna maintenance required	Same as SSR For duplicated system > 20,000 hours	Reasonably mature. Deployments have occurred in Europe, UK & New Zealand although few are operating in purely ModeS modes. Most interrogate A/C as well. Few ATC systems are operationally using Mode S downliked parameters (DAPs). Separation standards and procedures are established in PANS ATM Doc 4444 since Mode S is treated in the same way as SSR. Operational procedures are still being developed for operational use of DAPs.	Similar to SSR for processing of Mode C transponders. Significantly less impact with Mode S transponders. Some new anomalies (loss of detection) associated with some older mode C transponders.

	Availability (of Service inc GPS & avionics)	**Typical Reliability – MTBF (Continuity) & Major factors**	**Maturity**	**Anomalies**
ADS-B	> 99 % NB: Some outages as a result of pre-alerted poor GPS geometry	Duplicated system >20,000 Hours Receiver only Dependence on GPS Duplicated receiver	Maturing. Operational in at least 1 State. SASP and OPLINK panels have agreed with proposed ADS-B separation standards. Procedures have been defined for PANS ATM Doc 4444 and are expected to be published soon.	Some avionics “bugs” identified.
Multilat	>99%	Duplicated system >20,000 Hours Requires multiple sites & multiple communication links Failure of 1 receiver has geography related impact on performance. However, assume that extra ground stations provided to support any one failure	Maturing. Operational in ASMGCS (airport surface) applications worldwide. Operational as WAM in at least 1 State. SASP has development of separation standards on the work program.	Some “teething” problems identified. Careful tuning of each site used to overcome these.
ADS-C	>99% Also constrained by service guarantee by service providers.	2,000 Hours (Low reliability due non duplicated system)	Mature. Used worldwide as FANS1A. Is not an “ICAO system”. Yet to mature for ICAO/ATN variants.	FANS1A anomalies documented and managed by FANS1A Central reporting agencies (CRAs) on behalf of States in regions.

6.3 DATA PROVIDED BY EACH TECHNOLOGY

The following provides a brief overview of the information that may be received and processed by the relevant surveillance technologies

	No transponder	**Mode A/C transponder**	**Mode S transponder with DAPs**
Primary radar	Position, calculated velocity vector from these position reports	No data is able to be provided by this sensor	No data is able to be provided by this sensor
SSR	No data is able to be provided by this sensor	Position, flight level (barometric), 4 digit octal identity, calculated velocity vector	Position, flight level (barometric), 4 digit octal identity, calculated velocity vector
Mode S	No data is able to be provided by this sensor	Position, flight level (barometric), 4 digit octal identity, calculated velocity vector	Position, flight level (barometric), 4 digit octal identity, 24 bit unique code, selected altitude, Flight ID, Selected Altitude, Roll Angle, Track Angle Rate, Track Angle, Ground Speed, Magnetic Heading, Indicated Airspeed/Mach No, Vertical Rate, calculated velocity vector[16]
Mulitlat	No data is able to be provided by this sensor	Position, flight level (barometric), calculated altitude, 4 digit octal identity, calculated velocity vector	Position, flight level (barometric), 4 digit octal identity, 24 bit unique code, selected altitude, Flight ID, Selected Altitude, Roll Angle, Track Angle Rate, Track Angle, Ground Speed, Magnetic Heading, Indicated Airspeed/Mach No, Vertical Rate, calculated velocity vector

[16] Based on European Mode S mandate for Elementary & Enhanced surveillance. Additional data block have been defined in Mode S standards and could be used in the future.

ADS-B	ADS-B Requires the aircraft to be equipped with either : - A Mode S transponder capable of ADS-B message transmission (appropriate transponder product and software version), plus appropriate data to be fed to this transponder, typically a GNSS receiver or - A standalone ADS-B transmitter device (perhaps independent of the transponder) able to transmit ADS-B messages according to the standards or - A Mode C transponder able to transmit ADS-B messages according to the standards.
	If ADS-B equipped : Current aircraft : Position, flight level (barometric), position integrity, geometric altitude (GPS altitude), 24 bit unique code, Flight ID, velocity vector, vertical rate, emergency flags, aircraft type category. Fully compliant DO260A[17] will add a number of data fields.

ADS-C	ADS-C Requires the aircraft to be equipped with either a) The FANS1/A package. This includes processing, GPS, ACARS VHF and satellite datalinks b) An ICAO ATN ADS-C avionics package
	If ADS-C FANS1/A equipped : Position, altitude, flight ID, emergency flags, waypoint events, waypoint estimates, limited "intent data", limited wind speed data If ADS-C FANS1/A equipped : There are currently no aircraft providing ATN ADS-C

[17] RTCA DO260 : Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS-B)

6.4 COST

The cost to deploy and maintain surveillance systems is high. The total cost includes much more than the ground based electronic equipment itself. Consideration of the following points is required when examining the total cost of various systems.

6.4.1 Aircraft owner/operator costs

In comparing the total cost of surveillance systems, some consideration must be given to airborne equipment requirements, which may be considerable for some technologies.

The total lifecycle cost should be considered. The timing of transition to new avionics is governed by numerous factors including the expected life of the aircraft, the cost, the benefit that can be obtained, available products and mandatory avionics requirements.

In considering the various ground based surveillance technologies it can be noted that:

- Primary radar surveillance does not require avionics deployed in aircraft.
- Multilateration surveillance can operate with Mode C, Mode S or ADS-B avionics. It operates better when aircraft are Mode S or ADS-B equipped.
- Mode C based surveillance requires either Mode S or Mode C transponders on board aircraft.
- Mode S based surveillance requires Mode S transponders supporting Elementary and/or Enhanced surveillance parameters if the DAPs benefits are to be realised.
- ADS-B surveillance requires either
  - A suitable Mode S transponder (hardware/software), or
  - A mode C transponder with capability to transmit ADS-B messages, or
  - A standalone avionics package able to transmit ADS-B messages.
  - In addition it requires the transmitter to be connected to appropriate GNSS receiver (or equivalent performance position source)

The costs associated with any aircraft equipage program (for new production aircraft, as well as for retrofit) are highly variable and airframe dependent. Hundredfold cost variations to fit the same avionics to different aircraft types are not uncommon. Operating costs are also highly dependent on aircraft type, fleet size and nature of operation but include

- Engineering support costs
- Scheduled & unscheduled Maintenance
- Flight crew training costs
- Costs associated with aircraft simulator upgrades

For these reasons avionics costs associated with each surveillance technology will be very FIR (or ANSP) specific. However, the nature of the aviation industry (in particular cross FIR and international operations, fleet turnover and the prevalence of aircraft leasing) mean that it is impossible – and unhelpful – to attribute the total cost of avionics equipage to any one FIR, ANSP or surveillance system. It must be noted that some of the avionics required to support surveillance – in particular ADS-B and ADS-C – have other applications and hence benefits to operators.

The current status (2007) of avionics equipage is :

	Mode S	**Mode C**	**ADS-B**
International air transport	Almost all aircraft are equipped with Mode S; ACAS equipped aircraft have Mode S transponders. A large percentage of aircraft that operate in and transit Europe are also equipped with DAP capability	Almost all are equipped with Mode C capability Most new aircraft delivered in the last 5 to10 years are equipped with GPS and most of these have the capability to output HPL integrity data for ADS-B. This is particularly true in Asia Pacific region with its new fleets.	A large percentage of new aircraft manufactured in the last 2 years are equipped. Many legacy aircraft are being equipped at the same time as the European Mode S mandate is implemented.
Domestic major airline air transport	Almost all aircraft are equipped with Mode S; ACAS equipped aircraft have Mode S transponders	Almost all are equipped with Mode C capability. Many aircraft are equipped with GPS and most of these have the capability to output HPL integrity data for ADS-B	New aircraft from Boeing & Airbus are equipped. Many legacy aircraft are not equipped.
Regional aircraft	Many regional aircraft are equipped with Mode S	Almost all are equipped with Mode C capability Many aircraft are equipped with GPS but only some have the capability to output HPL integrity data for ADS-B	Very few are equipped with ADS-B capability because Regional Airliner OEMs have not embraced ADS-B
General aviation	Few general aviation aircraft are equipped with Mode S	Many are equipped with Mode C capability. Many aircraft are equipped with GPS but few with capability to output HPL integrity data for ADS-B	A few are equipped with ADS-B capability using a single GA product. There is insufficient choice in ADS-B products available today for this market.

Taking the above into account, it is very difficult to allocate a cost to equip with any avionics type. Clearly the transition to ADS-B equipage is the most significant and expensive of the alternatives in terms of aircraft equipage).

The APANPIRG meeting report of 2006 states that

> *"IATA noted that much of the business case is complicated by the problems of quantifying the cost of ADS-B avionics fitment by airlines. In this regard, IATA recommended that APANPIRG should simply assume that all aircraft will be equipped as a consequence of the worldwide move towards ADS-B OUT and Mode S Enhanced Surveillance."*

6.4.2 ANSP costs

ANSP costs include:

- Equipment purchase
- Installation costs and system testing
- Project costs including planning, procurement activities etc
- Site costs including
    - land
    - environment impact statement preparation
    - power provision
    - UPS and batteries
    - airconditioning
    - roads
    - shelters
    - racks in which to install main and ancillary equipment
    - towers
    - fencing
    - land clearing
    - security
    - telecommunication lines
- Operating costs
    - Engineering support costs
    - Scheduled and unscheduled Maintenance
    - Power and airconditioning running costs
    - Telecommunication operating costs

Taking the above factors into account and using experience of the technologies to date, the cost of surveillance to support enroute and TMA airspace is shown in the following table.

This table assumes that the selected sites are **NOT** "Greenfield" sites and hence do not include land purchase, environmental clearance, shelter and road building costs.

The table does NOT include avionics costs.

	Major cost factors	**Cost for TMA (60NM radius) $ Australian**	**Cost for Enroute (200NM radius) $ Australian**
Primary radar	Site costs, capital cost, ongoing maintenance & management costs, large UPS & power supply especially for antenna. No avionics required.	$8M	$10-14M

	Major cost factors	Cost for TMA (60NM radius) $ Australian	Cost for Enroute (200NM radius) $ Australian
SSR	Site costs, capital cost, large UPS & power supply especially for antenna, ongoing maintenance & management costs. SSR Mode C avionics required. In some regions the majority are required to be Mode C equipped.	$6M	$6M
Mode S	Same as SSR. Most vendors offer ModeS radars as "standard" at a similar price to SSR. Mode S avionics required.. Air transport already have Mode S to support ACAS in most parts of the world.	$6M	$6M
ADS-B	Apart from avionics installation, major items are site related costs and ongoing telecommunication costs. ADS-B avionics fitment is not included in estimate here because of difficulty in attribution of cost especially for international aircraft where the fitment supports surveillance in all ADS-B capable FIRs/ANSPs. Major airframe manufacturers fit ADS-B in the factory. IATA has recommended at APANPIRG that APANPIRG members ignore fitment costs be ignored in business case development.	$380K	$380K
Mulitlat	Major items are site related costs and ongoing telecommunication costs. If the operational requirement does not demand coverage extended range coverage (eg say coverage is only required to 40 nautical miles) then multilateration is a stronger competitor. Ie: it may not be warranted paying the extra costs for long range performance provided by radar . Of course each individual case must be considered because the costs are highly dependent on the environment, cost and infrastructure in the country of deployment. Multilateration is a stronger competitor against radar when the required area of coverage is small. Use of Greenfield sites could dramatically increase costs due to development and possibly the number of sites required. Site development costs can easily exceed equipment costs. At least SSR Mode C avionics are required but Mode S avionics are required for best performance.	>$1-$3 M	$2M - $5M

	Major cost factors	**Cost for TMA (60NM radius) $ Australian**	**Cost for Enroute (200NM radius) $ Australian**
ADS-C	No sensor cost. Minimal setup cost for ANSP. Large cost of FANS1/A avionics and associated equipment for new aircraft (and very large for retrofit)..	N/A	N/A

Some further details are provided in **Appendix A**

7 ISSUES IN CHOICE OF SURVEILLANCE TECHNOLOGY

In the deployment of ATC surveillance technologies care is required to match the chosen technology to the operational need and environment. In some cases a clear choice will emerge for a particular State. In other cases a mixed solution may be best.

Some factors to consider are as follows :

7.1 COST

The cost of surveillance systems can be a major determinant of whether surveillance is deployed, and if it is deployed, which technology is chosen. In many States the availability of lower cost surveillance (compared to radar) has allowed surveillance to be provided in areas where surveillance was previously uneconomical.

In States where there is significant traffic, the operational need and the ability to use funds from airways charges will determine the deployment of surveillance.

The lowest cost surveillance to meet the particular operational needs in the particular environment will be chosen.

The issue of who bears the cost and who benefits also needs to be considered.

> For example : Safety benefits may be provided to the whole community. Efficiency benefits may be provided to the airlines and their customers. Costs of surveillance system delivery are usually borne by the ANSP and sometimes passed to airspace users in charges. If new avionics are needed to be fitted to aircraft consideration of who pays for that equipment is required. In some cases the ANSP may be able to subsidise some segments of the industry to equip their fleet. In other cases airlines and aircraft owners bear the entire equipment cost.

Cost is further examined in Paragraph 6.4 as well as in Appendix 1.

7.2 MARKET SEGMENT MIX

The nature of the aircraft to be subject to surveillance is a determinant of the best technology to use

- non cooperative aircraft (targets) can only be detected by primary radar
- cooperative air transport aircraft can be expected to have Mode S or ADS-B equipment and hence ADS-B or SSR/Mode S may be the most appropriate technology
- If general aviation aircraft are to be detected, SSR or ADS-B avionics may need to be installed in those aircraft. This issue can become problematic if a large general aviation fleet operates in the State. If the general aviation fleet is small, it may be cost effective to use ADS-B and pay to fit the small number of aircraft with ADS-B.

In some States the market mix, and which part of the market would pay for avionics fitment is a critical issue.

Equipage of military aircraft can be problematic. However, each State needs to consider the role of the ANSP in the provision of surveillance facilities to support the military.

7.3 Airspace segregation

In some States, airspace can be segregated so that equipped aircraft are able to access defined airspace whilst non equipped aircraft are permitted to operate in different airspace.

7.4 GEOGRAPHY

The decision making needs to consider the obstacles to radio propagation for all relevant technologies. In some cases the geography may favour radar, in other cases it may favour multilateration.

SSR/Mode S radar has a long range capability from a single site due to its high gain antenna. It is well tailored for upper airspace detection up to 250 NM if the geographical location is free from close obstacles.

Multilateration is particularly effective in areas of constrained line of sight situations, due to its ability and adaptability to fill smaller specific area of surveillance. Ie: in places where the benefits of long range radar performance cannot be realised.

The choice of ADS-B is not really affected by geographic considerations because it achieves coverage as good as either multilateration or radar from fewer sites.

In the case of very remote or oceanic regions, there may be no choice apart from ADS-C.

7.5 EXISTING TELECOMMUNICATIONS INFRASTRUCTURE

In cases where there is comprehensive telecommunications infrastructure it will be more easy (and hence less expensive) to install ADS-B and multilateration ground station sites. When telecommunications infrastructure does not exist it can be costly to establish.

7.6 EXISTING SURVEILLANCE & ATC AUTOMATION INFRASTRUCTURE

There are significant benefits of a homogeneous surveillance infrastructure. If one technology (and one vendor) is chosen there are savings in engineering support, training, documentation management and system planning. This can impact on the choice to support additional or new technologies.

The ATC system used by a State may need to be upgraded to support any or all of the technologies listed in this paper. The cost of performing these upgrades needs to be considered. There may also be lower overall costs if the ATC automation system only needs to support the one surveillance technology, although there are operational advantages if the ATC system can support multiple surveillance technologies.

Some ATC systems and associated operational procedures can support ADS-B use, including delivery of separation services, when there is partial aircraft ADS-B equipage. Typically such systems support the graphical display of ADS-B, radar and flight plan tracks.

Other ATC systems and/or operational procedures require complete equipage for ADS-B use to be viable.

7.7 REQUIRED FUNCTIONALITY

Depending on the State’s functional needs, different technologies may be chosen. Each technology has different functional capabilities beyond detection and provision of position and altitude data. Eg: Mode S is able to provide readout of selected altitude; some multilateration systems are able to provide a precise position report independent of GPS; ADS-B is able to provide a high update of high accuracy velocity vector.

Some States require the use of primary radars to support Defence needs rather than Air Traffic Management requirements.

7.8 ABILITY TO MANDATE EQUIPAGE

The choice of SSR, Mode S, multilateration or ADS-B may depend on the State's ability to mandate that aircraft operating in the airspace must be equipped with the required avionics. The State's ability to issue a mandate may depend on many factors.

7.9 AIRSPACE CAPACITY REQUIREMENTS

The capacity of airspace can be increased through the provision of high quality surveillance. This is achieved through the application of reduced separation standards.

At this time ICAO recognises that 3 nautical mile and 5 nautical mile separation standards may be used using primary radar, SSR, and Mode S radar. Changes to ICAO documents are about to be published recognising ADS-B use to support 5 nautical mile separation standards. SASP is working on proposals to allow 3 nautical mile separation standards using ADS-B and also on the use of multilateration to support both 3 and 5 nautical mile separation standards.

ADS-C is unlikely to ever support 3 and 5 nautical mile separation standards. However it is used to support 30/30 and 50/50 nautical mile procedures used in some regions.

7.10 STRATEGIC NATURE OF TRANSITION TO ADS-B

It is widely recognised that ADS-B will eventually become the preferred surveillance technology worldwide, although this will take time.

ICAO, at ANC11 resolved that

"*ICAO and States recognize ADS-B as an enabler of the global ATM operational concept bringing substantial safety and capacity benefits*"

Therefore decision making by States will consider the long term enabling of ADS-B balanced against short term requirements.

For some States it may be too difficult to fit enough aircraft with ADS-B avionics and radar or multilateration may be necessary until ADS-B fitment occurs.

Some States may view the benefits of ADS-B as so large that strategically they move to this technology as soon as possible. Typically this is because in the long term, once aircraft are equipped, ADS-B has strong performance in numerous areas :

- lowest cost of additional surveillance coverage
- **allows air-air surveillance benefits**
- allows low cost surveillance for 3rd party applications (flying schools, Search & Rescue…)

The issue of enabling air-air surveillance is significant since it has the potential to change the way in which ATM is performed. The ability for aircraft pilots to electronically "see" nearby aircraft changes the risks encountered in certain airspace compared to today's practice where pilots use the human eye. ADS-B technology has the potential to significantly influence airspace classification, ATC procedures and system efficiency.

For the airline community, the future air-air applications promise increased capacity, functionality, reduced cost. Some see that they will only be able to cope with future air traffic needs by using aircraft centric – network enabled aircraft. ADS-B is a key component of such a vision. The airline UPS is pioneering considerable work in this area along with the work of the FAA-Eurocontrol Requirements Focus Group.

It is interesting to review the views of a major ANSP customer IATA. The meeting report of APANPIRG 2006 states :

> *"IATA noted that much of the business case is complicated by the problems of quantifying the cost of ADS-B avionics fitment by airlines. In this regard, IATA recommended that APANPIRG should simply assume that all aircraft will be equipped as a consequence of the worldwide move towards ADS-B OUT and Mode S Enhanced Surveillance."*
>
> *It was also informed that as indicated in its CNS/ATM road map published in 2005, IATA supported to mandate the use of ADS-B OUT from 2010 and simultaneously avoid the installation of new or replacement ATC radar facilities where there are demonstrated operational and cost benefits"*

7.11 VERIFICATION OF ADS-B

Some commentators have promoted the use of multilateration as a means of ensuring the validity of received ADS-B data. Technically this is possible. Radar could also be used to verify the integrity of ADS-B data. If radar and/or multilateration in **all** areas of ADS-B coverage is required, then the most advantages of ADS-B are significantly diminished and the ADS-B deployment becomes unlikely. Verification could perhaps be achieved at major airport hubs aimed at detecting non compliant avionics and triggering corrective action – perhaps in the same manner as Mode S and RVSM monitoring stations.

Periodic verification could perhaps be performed by ramp check units in the same manner as SSR transponder verification.

It must be recognised that integrity monitoring of ADS-B positional data is performed by the GPS integrity monitoring function within the aircraft avionics. This is the same monitoring function used to ensure that aircraft may safely conduct non precision landings with GPS – and associated "separation" from terrain.

The only envisaged integrity check for ADS-B air to air applications will be to monitor the ADS-B integrity data transmitted with the ADS-B message.

Regulations can require that aircraft owners provide high quality ADS-B data together with the appropriate integrity qualifiers. In the same way that airworthiness authorities ensure that Mode C data is trustworthy, authorities need to ensure that ADS-B data is trustworthy. Verification of ADS-B data using radar or multilateration is neither required nor justified in most States.

7.12 ADS-B MULTILATERATION MIXED SOLUTION

In some environments a mixed solution may be appropriate whereby multilateration is used to provide coverage in a "central" area, typically at an airport, for both equipped and non ADS-B equipped aircraft. In addition, each multilateration ground station supports ADS-B only coverage to a larger coverage volume surrounding the "central" area.

In this environment. the central area could be a Terminal Manoeuvring Area (TMA) where both airlines and general aviation co-exist at lower flight levels. Outside this area, services are only provided to ADS-B equipped aircraft outside coverage of multilateration.

A number of existing ASMGCS systems using multilateration are able to support this mixed technology solution.

8 SURVEILLANCE INTEGRATION

There are a number of ways that surveillance data from different sensors can be incorporated into an ATC system. Typically these can be :

- A separate display for each technology, although this approach is not desireable it has been used in a number of cases for demonstration or to build operational experience before further integration is performed.

- A priority system whereby one technology (or data from a particular site) is displayed and other data sources discarded whilst the priority source provides useable data

- A fully fused position calculation whereby data from different technologies are used to calculate a best estimate of aircraft position,

All solutions need to consider how best to present the data including consideration of the following :

- What position symbols will be presented?

- Will different symbols be used to indicate data quality or data source

- Will the data be used for situational awareness or for execution of ATC separation services?
- Will a prediction system advise users of potential radar, multilateration or ADS-B outages
- Will coasting of positional data be used? Will “smoothed” data be presented?
- What update rate is displayed to the user ? Is the update synchronised to a particular sensor or is independent of any sensor input?
- How is alignment maintained and monitored between various position sensors?
- Does the controller have the ability to select/deselect a sensor or technology?

9 SURVEILLANCE TECHNOLOGY SELECTION

This section outlines some indicative cases where the environment may suggest particular solutions. It needs to be clear that the total environment including available funding, politics, and numerous other factors also impact on the choice of technology, therefore the solutions presented can only be indicative :

	Solution	Reason
State has a large fleet equipped with Mode C ATC transponders and surveillance is needed in the near term. Intruder protection not required	Multilat (WAM) with ADS-B capability to support future ADS-B equipage	Near term requirement makes it difficult to fit many aircraft with ADS-B
State requires surveillance on a busy airport surface. Detection of vehicles is also required	Multilat and primary radar. ADS-B as part of multilat could used to detect & identify vehicles some of which are itinerant	Effective multilat surveillance with good accuracy and provides identity. Primary radar used for vehicles without transmitters
State has requirement for surveillance of air transport aircraft (small GA fleet) and has an ATC system able to support ADS-B mixed equipage.	ADS-B only with optional fitment.	Percentage of air transport aircraft that are equipped is rising. Could encourage ADS-B equipage by giving improved services & priority to equipped aircraft. Allows non equipped aircraft to operate. ANSP could purchase ADS-B avionics for small fleet.
State has requirement for surveillance of air transport aircraft (minimal GA aircraft) and does not have an ATC system able to support ADS-B mixed equipage.	ADS-B only but equipage mandatory in designated airspace	Percentage of air transport aircraft that are equipped is rising. Can mandate ADS-B in relevant airspace to provide surveillance at minimum cost to ANSP
State provides ATM services to a large number of operators that are unable to fit ADS-B, but already have SSR transponders – surveillance is required enroute	SSR only sensors	Cost of equipping a large number of air transport carriers may be cost prohibitive to Industry

Surveillance needed in relatively small geographical area – without concern of non transponder equipped intruder aircraft, but Air transport also operate into area with ADS-B. GA aircraft that may operate into area not able to be fitted with ADS-B	Multilat (WAM) with ADS-B capability	Multilat can serve the small area with the benefits of ADS-B delivered for air transport operating in a larger area of coverage.
High density airport with need for airspace intruder protection (ie: to detect violations of controller airspace)	Primary & co-mounted Mode S radar	Primary radar for intruder protection. Mode S to maximise resolution and position display performance and to maximise benefits of investment in SSR – even if ATC system cannot yet process Mode S DAPS
Surveillance needed for small GA domestic fleet plus some international carriers. Limited funds available.	ADS-B only but perhaps subsidise fitment of GA if required. Mandate ADS-B equipage	Subsidy cost may be less than cost of multilat or radar
State requires surveillance for a very large airspace and has minimal funds available and there is no surveillance today	ADS-B only	Most effective solution.
State requires surveillance over an ocean without islands for radar or ADS-B stations.	ADS-C	Only alternative
State requires surveillance at an FIR boundary but has no site for radar or ADS-B – and has limited capital funds – typically for FIR boundary safety.	Service provider provision of ADS-B surveillance or If adjacent FIR has surveillance negotiate an agreement for data sharing	Cost effective surveillance without capital cost
State has coverage requirements that are complicated by terrain restrictions that would have previously required multiple radars to solve – and has good physical and telecommunications infrastructure	WAM multilat with ADS-B support	Cost of site preparation and installation and support of radars would be cost prohibitive. Multilat and/or ADS-B offers the only cost effective solution to meet the requirement. Good infrastructure allows multilateration to be deployed cost effectively.

CONCLUSION

The optimum choice of surveillance technology depends on the operational requirements and environment.

As recognised by ICAO at ANC11, ADS-B is a technology of the future. States will work towards its deployment but will consider alternative technology, when cost effective.

ADS-B is the only technology which supports future applications of air to air surveillance. Some states see this as a decisive strategic factor in moving towards ADS-B.

1 APPENDIX A : Cost comparison multilateration and radar

The following examines the costs of radar and multilateration in two scenarios; one where surveillance coverage is needed in an area of radius of 200 NM and another when coverage is needed for a 40 MN radius.

Case 1 : Area of 200 NM radius

In this short analysis it is **assumed** that only 9 multilateration ground stations are required to achieve a coverage of 200 NM in accord with a NLR report[18]

The NLR report presented a 9 ground station multilateration solution designed to provide 200NM coverage (125,663 sq NM) to approximate a 250 NM (196,349 sq NM) coverage of a radar.

It is far from clear whether a realistic multilateration system can be built to support a 200 NM radius area with 9 ground stations. Such a "paper design" does not examine the issues of terrain, site availability and product availability with high power interrogators. Of course the operational coverage needs would also need to be considered, and it is likely that coverage at lower flight levels would bring the need for additional multilateration sites.

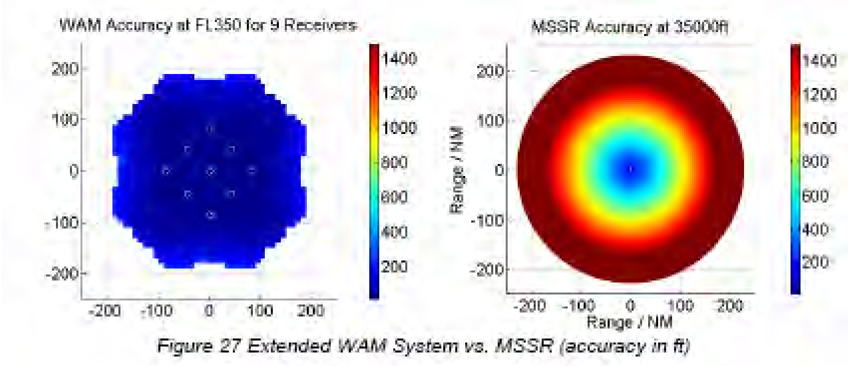

Figure 27 of NLR report

This analysis has been conducted using very approximate estimates of costs.

	Multilat system Assume 9 sites (4 tx/rx, 5 rx)	Radar
Equipment cost	$1.05M	$6M
Tower and antenna mounting[19]	$0.36M	included
Power supply and backup if required	$180K	included
Telecommunications establishment	$90K	$10K

18 National Aerospace Laboratory NLR report prepared for Eurocontrol : NLR-CR-2004-472 "Wide Area Multilateration Report on EATMP TRS 131/04 Version 1.1 August 2005 available at http://www.eurocontrol.int/surveillance/gallery/content/public/documents/WAM_study_report_1_1.pdf Used with permission of Eurocontrol.

19 Tower expected to achieve maximum line of sight and minimise number of sites

Telecommunications ongoing costs ($15K/pa = assume 10 years)	$1.35M	$150K
Installation activity (planning, travel, testing)	$90K	$20K
TOTALS	**$3,120K**	**$6,190K**
For maximum range radius of	200 NM	250NM

If one assumes that an enroute WAM is based on a set of 9 ground stations using existing sites (as described above) then the cost per square nautical mile of coverage is

C(mlat) = $3,120/125,663 = $24.82 per square NM

C(radar) = $6,190,000 / 196,349 = $31.52 per square NM

It must be remembered that these estimates are highly dependent on the environment, cost and infrastructure in the country of deployment. However, these figures indicate that multilat could approach or even exceed the cost of radar in some environments.

If “greenfield sites”[20] are assumed the comparison moves in favour of radar.

	Multilat system(9*)	Radar
Land purchase or lease	$90K	
Environmental impact study/ statement/clearances	$720K	$200K
Shelters or building including fencing & security	$450K	$50K
New road cost if required (very site dependent).	9 * M$x	M$x
TOTAL	**$1260K + road**	**$250K + road**

[20] sites that do not have a building, road, shelter or other infrastructure

Case 2 : Area of 200 NM radius

If the coverage requirement is for a terminal area of say 40 Nautical miles radius then less multilateration ground stations would be required. Lower power interrogation units would be required.

Assuming a more realistic 7 sites (in a location without terrain issues) and the analysis could look like

	Multilat system Assume 7 sites (3 tx/rx, 4 rx)	Radar
Equipment cost	\$0.86M	\$6M
Tower and antenna mounting[21]	\$0.28M	included
Power supply and backup if required	\$140K	included
Telecommunications establishment	\$70K	\$10K
Telecommunications ongoing costs (\$15K/pa = assume 10 years)	\$1.05M	\$150K
Installation activity (planning, travel, testing)	\$70K	\$20K
TOTALS	**\$2,426K**	**\$6,190K**
For maximum range radius of	40 NM	250NM

In this case, if the operational requirement does not demand coverage beyond 40 nautical miles it does not warrant paying the extra costs for a radar (even if it provides 250 NM.

Of course each individual case must be considered because the costs are highly dependent on the environment, cost and infrastructure in the country of deployment. Multilateration is a stronger competitor against radar when the required area of coverage is small.

21 Tower expected to achieve maximum line of sight and minimise number of sites

THE SECOND AMENDMENT TO THE AIGD

(Insert new subparagraph 5.8.2 into the AIGD as follows)

5.8.2 It should be noted that independent operations of Mode S transponder and ADS-B may not be possible in all aircraft (e.g. where ADS-B is solely provided by 1090 MHz extended squitter emitted from the transponder). Additionally, some desirable but optional features of ADS-B transmitters may not be fitted in some aircraft. Controller training on this issue, as it relates to the following examples of radio telephony and/or CPDLC phraseology is recommended.

5.8.2.1 STOP ADSB TRANSMISSION or STOP SQUAWK

Issue: In most commercial aircraft a common “transponder control head” is used for SSR transponder, ACAS and ADS-B functionality. In this case, a pilot who complies with the instruction to stop operation of one system will also need to stop operation of the other systems – resulting in a loss of surveillance not intended or expected by the controller.

ATC need to be aware that an instruction to “Stop ADS-B Transmission” may require the pilot to switch off their transponder that will then stop all other functions associated with the transponder operations (such as ACARs etc). Pilots need to be aware of their aircraft’s equipment limitations, the consequences of complying with this ATC instruction, and be aware of their company policy in regard to this. As with any ATC instruction issued, the pilot should advise ATC if they are unable to comply.

Recommendation: It is recommended that the concatenated phrases STOP ADSB TRANSMISSION, SQUAWK (code) ONLY or STOP SQUAWK, TRANSMIT ADSB ONLY are used. It is recommended that controller training highlights the possible consequences of **issuing** these instructions and that pilot training highlights the consequences of **complying** with this instruction. It is also recommended that aircraft operators have a clearly stated policy on procedures for this situation. Should a pilot respond with UNABLE then the controller should consider alternative solutions to the problem that do not remove the safety defences of the other surveillance technologies. This might include manual changes to flight data, coordination with other controllers and/or change of assigned codes or callsigns.

5.8.2.2 STOP ADSB ALTITUDE TRANSMISSION [WRONG INDICATION or reason] and TRANSMIT ADSB ALTITUDE

Issue: Some aircraft may not have separate control of ADSB altitude transmission. In such cases compliance with the instruction may require the pilot to stop transmission of all ADSB data – resulting in a loss of surveillance not intended or expected by the controller.

Recommendation: It is recommended that, should the pilot respond with UNABLE, the controller should consider alternative solutions to the problem that do not remove the safety defences of other surveillance data. This might include a procedure that continues the display of incorrect level information but uses pilot reported levels with manual changes to flight data and coordination with other controllers.

5.8.2.3 TRANSMIT ADSB IDENT

Issue: Some aircraft may not be capable or the ADSB SPI IDENT control may be shared with the SSR SPI IDENT function.

Recommendation: It is recommended that controllers are made aware that some pilots are unable to comply with this instruction. An alternative means of identification that does not rely on the ADSB SPI IDENT function should be used.

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BASELINE ADS-B SERVICE PERFORMANCE PARAMETERS

The following table provides guidelines for various performance requirements of ADS-B Category (Tier) 1, 2 or 3 services that States may consider when acquisition of an ADS-B managed service agreement with a service provider:

Service Parameter	**Category 1 (Tier 1)** **5nm separation capable commensurate with Radars (separation/vectoring/high performance with reliability, integrity & latency)**	**Category 2 (Tier 2)** **Situational awareness similar to ADS-C (safety net alerts, SAR, supports procedural separation without voice, not 5nm separation)**	**Category 3 (Tier 3)** **Position Reporting with Enhanced Flight Operation**
Aircraft Updates	1 second < Rate < 5 seconds as Operationally required	1 second < Rate < 20 seconds as Operationally required	1 second < Rate < 60 seconds as Operationally required
Network Latency	95%: < 2 seconds of ground-station output	95%: < 15 seconds of ground-station output	95%: < 60 seconds of ground-station output
Reliability 1	2 autonomous ground-stations including antenna, each providing data, no common point of failure	1 unduplicated ground-station including antenna	1 unduplicated ground-station including antenna
Reliability 2 - MTBF	Each ground-station including antenna to have MTBF >10,000 hrs	Each ground-station including antenna to have MTBF >10,000 hrs	Each ground-station including antenna to have MTBF >10,000 hrs
Reliability – Communications Infrastructure	Completely duplicated, no common point of failure	Unduplicated, MTBF > 400 hrs	Unduplicated, MTBF > 200 hrs
Reliability – Total ADS-B Service	Total Service MTBF > 50,000 hrs	Total Service MTBF > 400 hrs	Total Service MTBF > 200 hrs
Availability – Total ADS-B Service	Total Service Availability > .999	Total Service Availability > .95	Total Service Availability > .90
Integrity – Ground Station	Site monitor, including GPS RAIM, monitored by RCMS	Site monitor, including GPS RAIM, monitored by RCMS	Site monitor, including GPS RAIM, monitored by RCMS
Integrity – Data Communications & Processing	All systems up to ATM system, errors < 1 x 10E-6	All systems up to ATM system, errors < 1 x 10E-6	All systems up to ATM system, errors < 1 x 10E-6

The choice of category (tier) could be based upon a number of factors including the following,

a) The desired service
b) The available budget
c) The available ATC automation system & its capabilities and/or interim display systems
d) ATC training and ratings
e) Availability of appropriately tailored ATC procedures

States could initially choose one level and transition to another at a later time. For example, Category (Tier) 2 could be used to add additional safety nets/situational awareness and gain operational experience during the initial stage, moving later to a full separation service using Category (Tier) 1.

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INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE

Draft

Multilateration (MLAT) Concept of Use

Version 0.9

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MULTILATERATION (MLAT) CONCEPT OF USE

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List of Acronyms

ADS-B	automatic dependent surveillance — broadcast
ADS-C	automatic dependent surveillance — contract (also known as ADS or ADS-A)
ADSP	ADS Panel (of ICAO)
AIGD	ADS-B Implementation and Operations Guidance Document
AIRSCENE	Trade name for Rannoch Multilateration
AIS	aeronautical information services
APANPIRG	Asia-Pacific Air Navigation Planning and Implementation Regional Group
APW	area proximity warning
ASAS	airborne separation assistance system
ASDE	airport surface detection equipment
ASM	airspace management
ATC	air traffic control
ATFM	air traffic flow management
ATM	air traffic management
ATMCP	Air Traffic Management Operational Concept Panel
CAP	controller access parameters
CDTI	cockpit display of traffic information
CNS	communications, navigation and surveillance
CPDLC	controller-pilot data link communications
DLIC	data link initiation capability
ELT	emergency locator transmitter
ETA	estimated time of arrival
FANS	future air navigation systems
F&CM	flow and capacity management
FIS-B	flight information service — broadcast

FMS	flight management system
GNSS	global navigation satellite system
GPW	ground proximity warning
HF	high frequency
HMI	human-machine interface
IAF	initial approach fix
ICAO	International Civil Aviation Organization
IFR	instrument flight rules
MDS	Multistatic Dependent Surveillance: Sensis trade name for multilateration
MLAT	Multilateration
MSAW	minimum safe altitude warning
MTCD	medium term conflict detection
OPLINKP	ICAO's Operational Data Link Panel
PSR	primary surveillance radar
RPT	regular passenger transport
SAR	search and rescue
SARPs	Standards and Recommended Practices
SASP	ICAO's separation and airspace safety panel
SMC	surface movement control
SSR	secondary surveillance radar
STCA	short term conflict alert
TCAS	Traffic alert and collision avoidance system
TIS-B	traffic information service — broadcast
VFR	visual flight rules
VMC	visual meteorological conditions
WAM	Wide Area Multilateration

Foreword

1.1. This document presents the Multilateration Surveillance (MLAT) concept of use and therefore provides a description of MLAT systems and their detailed role as an application enabling important changes to the future communications, navigation, and surveillance/air traffic management (CNS/ATM) system.

1.2. The description of the role of MLAT takes into account the heterogeneous and evolving situation with respect to the available ground infrastructure, aircraft capabilities, airspace regimes, the coincidence with Automatic Dependent Surveillance – Broadcast (ADS-B) systems, and interface with legacy surveillance systems.

1.3. Wide Area Multilateration (WAM) implementations are an opportunity to provide useful ATC surveillance where it is required and concurrently introduce ADS-B for partial use. This forms a graduated transition from the current global environments to a future ADS-B based system.

1.4. The MLAT concept of use is described to show potential use in the wide area and airport surface operations, and that it is able to be considered both as an independent system and as complementary to other enablers such as secondary surveillance radar (SSR), SSR Mode S, ADS-B or ADS-C.

1.5 The impacts on operational and organizational levels arising from the introduction of MLAT systems is noted for consideration.

Glossary of Terms

In this document:

ADS-B IN means the reception of ADS-B position reports by an aircraft.

ADS-B OUT means the transmission of ADS-B position reports.

Surveillance System means an airborne or ground system used for monitoring the positions of aircraft and other objects for the purpose of air traffic management.

Chapter 1. Introduction

1.1. Purpose and scope

1.1.1. The purpose of this document is to develop a concept of use for MLAT. This technology is being developed, tested and is also used operationally in several areas of the world. However, international standards to incorporate MLAT into the future global CNS/ATM system have not yet been completely developed. This document is a step in this ICAO process.

1.1.2 The work to develop SARPs and guidance material for ADS-B was based upon a concept of use for the technology, as agreed by the 11th Air Navigation Conference in 2003. Since that time a major conceptual change has occurred with the term “radar” now being replaced in many ICAO documents with the term “ATS Surveillance System” and an associated performance-based definition; a recognition that ADS-B and other technologies can provide ‘radar-like’ services.

1.1.3 APANPIRG has chosen to follow a similar procedure to that successfully used for ADS-B; to develop a Concept of Use so observers and participants have a common understanding, and then to update the ADS-B Implementation and Operational Guidelines Document (AIGD) to include MLAT. The scope of this document is restricted to the concept of use portion of the task. It does not contain specific operational requirements, although its contents will lead naturally to the development of operational practices for MLAT.

1.2. Background

1.2.1. In the early 1990’s, ICAO approved the concept of the Future Air Navigation System (FANS) based on satellite and datalink technology, which later became known as CNS/ATM. It was recognised that the traditional ATC surveillance system has limitations that constrained its capabilities in the existing and future ATM environment.

The limitations identified include the following:

- *limited or no conventional surveillance* - including non-equipped continental areas, low altitudes, non-continental areas, surface movements, silence cones, blind areas, antenna screening, etc. In some cases (e.g. oceanic areas), this will result in the need for procedural control, using voice position reports;
- *electro-mechanical rotation of the classical radar antennas*, not only with high power demand and RF output, but also inefficient scanning periods and limited ability to adapt the reporting rate to suit ATC needs. *(Note: E-SCAN antennas may offer an alternative in this case);*
- *radar garbling, fruit and splitting*;
- *unavailability of aircraft derived data*, beyond the Mode A/C identification and altitude data;
- *non-homogeneous operation*, caused by the current existence of a diversity of systems with different performance and capabilities;

- increasingly some regions have a *shortage of Mode A codes* (a maximum of 4096 available) requiring frequent changes of code during the flight or duplicate use which can create identification ambiguities;
- *lack of capability to fully support future airborne situation awareness* applications, because the corresponding surveillance data are not available to the aircrew; and
- *lack of capability to fully support airport surface surveillance* applications.

1.2.2. Due to constraints like these and to a large extent driven by cost, the necessary levels of capacity, flexibility and efficiency required to meet the future predicted air traffic growth, will not be met by the traditional surveillance systems alone. Various surveillance technologies have been developed to address these limitations. These include Mode S secondary surveillance radar (SSR) with enhanced services, ADS-contract (ADS-C), ADS-broadcast (ADS-B), and Multilateration (MLAT).

1.3. Concept overview

1.3.1. ICAO Global ATM Operational Concept (Doc 9854) describes the services that will be required to operate the global air traffic system up to and beyond 2025. The operational concept addresses what is needed to increase user flexibility and maximize operating efficiencies in order to increase system capacity and improve safety levels in the future air traffic management system. The extensive work which has taken place or is currently underway has convinced ICAO that ADS-B functionality has the potential to be one of the key elements necessary in achieving these operational concept goals.

1.3.2. Early implementations of ADS-B have been supported by the developed ICAO standards for airborne equipment and for ATC separation. Where ADS-B OUT performance is readily achievable for the majority of aircraft, the benefits of this surveillance are quickly achieved. MLAT is a related alternative technology that will suit many States' surveillance needs for the medium term. The receipt and processing of ADS-B as part of an MLAT system encourages progressive installation of ADS-B avionics and thereby increases the benefits achievable with ADS-B.

1.3.3. The ADS-B Concept of Use document describes the role of ADS-B as one of the enablers of this future global CNS/ATM system. This MLAT Concept of Use is supplementary to that document, indicating the place of Multilateration usage.

1.3.4. The description of MLAT in this context is addressed in Chapter 2. It includes functionality, the role of MLAT and ADS-B in ATM, operational improvements, and typical applications. The applications can support all phases of flight gate-to-gate.
Chapter 4 addresses important issues for consideration, and Chapter 5 addresses implementation considerations for States.

1.3.5. During the development of the MLAT concept of use, considerations were made for other co-existing enablers (*inter-alia* ADS-B, ADS-C, TIS-B and CPDLC) in order to identify their complementary roles in the various operational scenarios.

1.3.6. The overall objective is to develop a common understanding of terms, definitions and possible uses of MLAT in the future environment. A secondary objective is to do this early enough in the various stages of development to assist efforts to influence and facilitate that development.

Chapter 2. Concept for Surveillance Using Multilateration

2.1. General

2.1.1 Surveillance is used in civil aviation for many purposes, including ATM, weather reporting, terrain avoidance, and search and rescue. A variety of technologies are used to provide surveillance data for ATM, but for full independence (of the targets under surveillance - which may include aircraft, vehicles and a variety of other “traffic”) the techniques available are visual acquisition, primary surveillance radar (PSR), and millimetric PSR (for debris, animals, birds).

2.1.2 All other techniques, including MLAT, SSR, ADS-C, ADS-B, CPDLC and voice position reporting, require varying degrees of cooperation from the target and the carriage of serviceable equipment to facilitate the exchange of data. For example, both voice and CPDLC position reporting mandate the use of specific communication equipment and are “dependent” on the 4-D navigation data determined by the avionics.

2.1.3 Multilateration is a co-operative system also, but one which can utilise data received from an aircraft that may be transmitted in response to different technologies. The minimum level of avionics to enable Multilateration with interrogation is a Mode A/C transponder. SSR Mode S or ADS-B avionics will enhance the performance of the system and may remove the need for interrogation.

2.1.4 While ADS-B transmissions contain the position data and may be received directly by other aircraft, MLAT surveillance data is processed by the ground system and typically provided only to an ATS facility, although rebroadcast to ADS-B equipped aircraft within a TIS-B service volume is potentially possible.

2.2. MLAT functionality

2.2.1 MLAT is a surveillance application that accurately establishes the position of transmissions, matches any identity data (octal code, aircraft address or flight identification) that is part of the transmission and sends it to the ATM system

2.2.2 Like SSR, MLAT is considered to be a co-operative surveillance technique, combining a dependence on target-derived data for identification and altitude with ground based calculation of position. MLAT can achieve a higher update rate than a typical rotating radar, determined by the intervals between aircraft transmissions (responses).

2.2.3 An MLAT system consists of the following components:

- A transmitting subsystem that includes interrogation message generation and transmission function;

- An optional Intelligent Interrogation process that determines whether an MLAT interrogation is required (in an area being interrogated by TCAS and SSR systems)
- A receiving antenna array subsystem that receives the transmissions from the target and timestamps receipt at each antenna; and
- A central processor that calculates and outputs the MLAT (and ADS-B) tracks.

Note - Having an interrogation transmitter ensures regularity of responses from the target aircraft/vehicle. The target aircraft/vehicle/obstacle must have a subsystem that will respond to an interrogation OR is automatically generating a transmission on the 1090MHz frequency.

2.2.4. The fitment of transponders in target aircraft or vehicles is essential for SSR Mode A/C/S radar, Multilateration, and ADS-B systems. The types can be summarised as follows:
2.2.4.1. Mode A/C Transponder - needs interrogation from radar, a multilat System, or TCAS. Special processing is used to manage matching of individual replies when received at multiple ground stations.
2.2.4.2. Mode S transponder - transmits DF11 download format automatically without radar interrogation and allows unique matching of messages received at all ground stations. Mode S provides error free mode C data.
2.2.4.3. ADS-B transmitter - transmits DF17/18 download formats automatically without radar interrogation and allows unique matching of messages received at all ground stations. Mode S provides error free mode C data

2.2.5. The airborne sources of the position, navigation or intent data in ADS-B and Mode S transmissions are not considered to be part of the MLAT system. Mode A/C transponder standards are the minimum applicable for MLAT surveillance.

2.3 The role of MLAT in Air Traffic Management (ATM)

2.3.1 ATM is described in the ICAO Global ATM operational Concept (Doc 9854) as the dynamic, integrated management of air traffic and airspace in a safe, economical and efficient manner through the provision of facilities and seamless services in collaboration with all parties. The operational concept also describes a system that provides ATM through the collaborative integration of humans, information, technology, facilities and services, supported by air, ground and/or space-based communications, navigation and surveillance.

2.3.2 This operational concept identifies seven interdependent components of the future ATM system. They comprise:
a) airspace organization and management;
b) aerodrome operations;
c) demand and capacity balancing;
d) traffic synchronization;
e) conflict management;
f) airspace user operations; and
g) ATM service delivery management.

2.3.3 Inherent to this concept are the characteristics of scalability and adaptability, according to the specific needs and operational environment of each State and region.

MLAT shares these characteristics in that specific applications of the technology may be implemented according to need.

2.3.4 MLAT is an enabling technology that will enhance the provision of ATM in a variety of applications, from "radar-like" air traffic control purposes to enhanced situational awareness of surface movements. MLAT offers most advantages in situations where other surveillance systems (eg radar) are not available. It can also be combined with other surveillance systems, such as radar and ADS-B, to improve the total surveillance picture.

2.3.5 MLAT applications will have a direct effect upon aerodrome operations, traffic synchronization, airspace user operations, and conflict management. These effects will then influence the nature of airspace organization and management, demand and capacity balancing, and ATM service delivery management.

2.4. ATM improvements and benefits

2.4.1. MLAT applications, particularly when combined with ADS-B, are expected to provide important operational improvements by addressing some of the limitations of the traditional radar surveillance system, optimize the controller workload and provide benefits in the areas of safety, capacity, efficiency and environmental impact, thus contributing to the overall CNS/ATM objectives. These benefits include the following:

a) low cost extension of the surveillance coverage for low altitudes (below existing radar coverage) and areas where no radar coverage currently exists, leading to more efficient use of airspace;
b) enabling airports to obtain surface and local surveillance including general aviation and military operations;
c) use of aircraft-derived data in a variety of systems e.g. ground-based conflict alert, minimum safe altitude warning, danger area proximity warning, automated support tools, surveillance data processing and distribution.
d) increasing airport safety and capacity, especially under low visibility conditions, by providing airport surface surveillance and, at the same time, protecting against runway incursions by aircraft and vehicles.
e) changes to airspace sectorization and route structure resulting from improved surveillance should provide more efficient routing;
f) reduced infrastructure costs in airspace in which MLAT coverage is provided. It may be possible to decommission some radar equipment. Where multiple surveillance coverage is presently required, optimization of the surveillance infrastructure should be achieved by the implementation of the most efficient mix of radar sensors, MLAT and ADS-B; and
g) cost savings achieved from the implementation of an MLAT and ADS-B based surveillance system rather than the life cycle expenses associated with installing, maintaining, and extending existing radar-based surveillance systems.

2.4.2. Valid reasons exist for a State having some SSR and PSR or other technologies for civil air traffic surveillance coverage. For example, Mode S enhanced surveillance, ADS-C and other systems can also be used to deliver some of the above benefits.

2.5. MLAT applications

2.5.1 Overview

In an effort to provide the operational improvements identified above, a number of applications are already developed and being operated.

2.5.2. MLAT ATM Applications

Broadly speaking, the air traffic control application of MLAT fall under the following headings:

- Airport surface surveillance applications for ground and aerodrome control
- Area and Approach surveillance in airspace with radar coverage;
- Area and Approach surveillance in airspace without radar coverage;
- ATM system technical improvements including sampling of RVSM performance and sampling ADS-B performance.

2.5.3. MLAT Specific Use Applications

- Airport surface surveillance; and aircraft derived data for ground-based ATM tools.
- Situational awareness
- Airport Low Visibility Operations (e.g. CATIIIB)
- Parallel Runway Approach Monitoring
- Other applications Ramp control/gate management
- Noise monitoring data provision
- Airport usage data (for Billing)
- Airways usage data (for Billing)
- Flight following (for AOC, flying schools)
- Enhanced ATS situational awareness (tagging obstacles, restricted areas)
- Enhanced overall flight data for improved SAR activity

2.5.4. Ground-based surveillance applications

4.5.4.1 This application provides a source of airport surveillance information for safer and more efficient ground movement management at airports. Relevant airport ground vehicles need to also be equipped and displayed, together with aircraft, on a situation display.

4.5.4.2 MLAT supports ground conflict detection by providing frequent updates of aircraft and vehicle positions, enabling the monitoring of aircraft and vehicles to protect against runway incursions, and to monitor taxiing operations in low visibility operations such as CATIIIB minima conditions. It is an essential part of some A-SMGCS systems.

2.5.5. Other uses

2.5.5.1 ATC surveillance for airspace where there is no radar coverage, or where radar coverage exists, as a backup and possible replacement for SSR.

2.5.5.2 The higher update rate available with MLAT reports, in combination with other capabilities, may enhance surveillance services and allow the application of reduced separation standards. ICAO's Separation and Airspace Safety Panel (SASP) is currently examining the introduction of MLAT separation standards, and at least one State already provides ATC separation services with MLAT.

2.5.5.3. This application can support ATC surveillance currently provided by radar, in Terminal or wider airspace. An example is the case of surveillance in areas where single radar coverage is provided. Where SSR is used, MLAT can provide a backup system and supplement radar position updates through additional position reports. Where PSR is used MLAT can provide additional data, such as aircraft identification.

2.5.5.4. ATC surveillance in airspace without radar coverage. This application will provide ATC surveillance in non-radar areas, (e.g. remote approach control areas). While ADS-B alone could provide surveillance coverage from “gate-to-gate”, MLAT will be able to ensure the surveillance of aircraft equipped only with SSR transponders in those areas closer to the airport where traffic levels justify ATC surveillance, but radar is not feasible or affordable.

2.5.5.5. Other MLAT applications being considered or used to varying degrees include:

- monitoring of aircraft to ensure that flight trajectories comply with noise sensitive environments (e.g. curfew);
- facilitating the collection of data for the issuing of aviation charges in remote areas where this may be applicable;
- enabling the display of temporary obstacles — e.g. a construction crane equipped with a transponder or ADS-B emitter;
- validation of ADS-B transponder performances; and
- Search and rescue (SAR) and emergency response.

Chapter 3. Operational Deployments

3.1 Description of MLAT potential benefits

3.1.1 The operational environments in which MLAT will be used may include any of the following characteristics:

- varying infrastructure capabilities, ranging from the lack of any surveillance means up to the co-existence of ADS-B and MLAT with different types of conventional data sources such as primary and secondary surveillance radars. Some MLAT vendors can deliver a pseudo rotational ‘radar like’ ASTERIX Cat 1 / 48 output to minimise the initial setup adaptation required. It is expected that a variety of other technologies such as ADS-C and CPDLC will play a complementary role in the provision of ATC service;
- mixed aircraft equipage levels, at least in the transition period;
- varying airspace types (e.g. different traffic density levels);
- varying flight phases, e.g. airport surface, TMA, en-route, non-continental, continental; and
- varying types of application/services in different environments.

3.1.2. MLAT can detect ADS-B reports generated and also manipulate report rates by the transmission rate of interrogations, and in processing to output at a rate that suits the communications network and ATM system.

3.1.3. Compared to radar sensors, an MLAT system for an aerodrome surface application or for a local area around an aerodrome is less than half the cost. A Dual ADS-B location

with power and communications is about half to two-thirds the cost of a full MLAT system, excluding the cost of transponder upgrades.
Other than cost, another important advantage of both ADS-B and MLAT are the degrees of redundancy which a single radar does not have.
An MLAT system configuration can allow staged degradation before the system would become unusable.

3.2 Users of MLAT

The users of MLAT will primarily be in ATC roles, from gate to gate. Here are some examples:

3.2.2 ATC Ground

Ground Tower and Surface Movement controllers will use MLAT for surface surveillance of aircraft and vehicles on the apron and or manoeuvring area. This is most desirable when the airport layout is complex (assessed by the configuration of buildings, the number of runways and taxiways) and where airports are capable of conducting operations out of visual range of the air traffic controller responsible (CAT II and III ILS operations and vertically-guided GNS approaches to similar minima are likely to fall in this category).

3.2.3 ATC Aerodrome

Aerodrome controllers will utilise the surveillance to assist with runway utilisation, and confirm that traffic is following instructions to and from the runway. Final approach monitoring using the high update available from an MLAT system providing more precision to discern whether an aircraft is lining up to land on the wrong runway, and to automate the alerting of such a situation. For departing flights in an environment where Tower initiated departures applies, the high update rate will provide a smoother and instantaneous turn of a lead aircraft as observed on the display so minimising waiting time for a following departure.

3.2.4 ATC Approach

MLAT for approach control will be useful in ATM system software to smooth the turns of displayed tracks, and can be used for Terminal area ATC surveillance in place of SSR or as a backup to SSR.

3.2.5 ATC Area control

Wide Area Multilateration (WAM) can extend beyond the Terminal area, depending on the configuration of the sensors. In this respect MLAT can provide a backup for SSR for a specific area, as a fill in to a specific airspace where surveillance is required and aircraft equipped only with Mode A/C transponders are common, in both cases the benefit of ADS-B data being received from each single site greatly improve the coverage for suitably equipped aircraft.

Chapter 4. Issues

4.1 Issues to consider

There are many issues associated with the introduction of MLAT to the air traffic management operational concept. The following are technical and operational issues to consider during development and implementation of MLAT. This list is not exhaustive, but serves as a guide for States considering MLAT systems for their surveillance needs.

4.2 Technical issues

4.2.1 Technical standards

4.2.1.1 As 1090MHz Extended Squitter (also known as 1090ES or Mode S data link) ADS-B and MLAT technology matures, the technical standards for the airborne as well as the ground systems are being refined. This leads to the need to potentially upgrade these systems to meet new national and international requirements. Efforts are underway within ICAO to ensure global interoperability.

4.2.1.2. Multiple Sites each require power and data communication paths. Site access, land rental or ownership, and technical maintenance capability to add multiple sites are issues to consider.

4.2.1.3 VHF coverage of the airspace may be coincident with a MLAT interrogation site to ensure best coverage. As with ADS-B the preferred situation is for the responsible controller to have reliable radio access to any flights within the controlled airspace.

4.2.2 Aircraft installation

Various types of aircraft have different installation certification and integration requirements. Consequently there are differences in costs. Antenna placement in relation to ground system sensors is a similar consideration as for SSR. Where ADS-B data received by the MLAT system is to be used alone, the issues regarding transponders and the GNSS systems must be considered. Specifically issues such as the navigation system integration to ADS-B or Mode S, compatibility with various link technologies, and cockpit controls and displays issues all have to be considered. Certification will also vary with intended function (e.g. ATC surveillance services, TIS-B situational awareness) as well as aircraft type (e.g. single engine aircraft versus heavy jet aircraft).

4.2.3 Remote ground stations

Installation, certification, and maintenance monitoring of remote MLAT ground stations to meet intended level of service raise their own issues. These include leasing agreements, power requirements, communication to a central facility (e.g. air traffic control centre), installation remote control features, accessibility and security. Remote switching and monitoring is an important consideration.

4.2.4 Automation system adaptation

Ground-based air traffic control system adaptation to facilitate the acquisition, processing and distribution of MLAT data is a significant issue. The automation’s capacity for handling the data (e.g. processing power available, local area network, data storage capacity), maintenance monitoring, correlation between various surveillance sources and integration into existing safety functions (e.g. conflict alert, minimum safe altitude warning) are a few areas to consider. Employing a Service Provider to deliver the system outputs is another option.

4.2.5 Technical Maintenance

For a new surveillance area, increased provision of Technical Maintenance support is likely to be required given the multiple remote sites inherent with MLAT configurations, and similarly maintenance for power supply and network communications personnel.

4.2.6 Security

4.2.6.1 The flexibility and versatility of the proposed MLAT systems will allow for many safety and capacity enhancing applications in the short and long term. As applications approach maturity and their requirements become more complex, they also become more sensitive to some outside interference, a risk not dissimilar to current systems using SSR Mode A/C.

4.2.6.2 1090MHz interference sources can be malicious or accidental and can occur intermittently or for an extended period. The interference can be a localized source causing for example a “co-channel interference” problem up to a military denial of airspace operation involving active jamming. The sources, causes, and effects of an interference event can be broadly categorized into several groups. There are practical limits that must be recognized due to technological, political, and fiscal reasons. Not all solutions will be technical - that is, come from a box. Some of the solutions may be procedural, legal, technical or a combination of all. In short, States will need to consider the likelihood and severity of interference by conducting appropriate hazard and safety assessments as a means of developing mitigation strategies.

4.2.7 Performance of the data link

4.2.7.1 Bandwidth and performance of the 1090 MHz data link is dependant upon the complexity of the scenarios that are envisaged and could be a significant issue in high density areas.

4.2.7.2 For example, the level of equipage (i.e. which airport vehicles and/or obstacles are fitted with transponders or ADS-B emitters), the number of aircraft involved and possible use of TIS-B to rebroadcast data from another surveillance source will need to be considered.

4.3 Operational issues

4.3.1 Human factors issues

4.3.1.1 The human factors considerations associated with surveillance systems are dependent not on the technology, but on the specific applications. That is, the issues are dependent upon the answers to questions, such as:

- what is the information to be displayed (e.g. aircraft position data or derived aircraft intent)?
- how are the input systems different and what is the appropriate way to show differences that may be important to operators?
- who (e.g. tower, ACC, airline operations) is the user of this information? Displays will need to be developed and evaluated for different applications;
- how will the information be used? The information and the way in which it is displayed must be capable of supporting the decisions that the users will make based on the MLAT information.

4.3.1.2 While the specific issues will depend on the specific applications, there are general issues that should be anticipated. These include:

- *effective integration of MLAT information into the situation display*. The position determined by MLAT can be different to the position reported by radar or other systems. When more than one input type is received, these positions will need to be reconciled so that only one position (preferably the most accurate position possible) is displayed for a single aircraft. This can be achieved by the use of a multi sensor (e.g. MLAT, ADS-B, SMR, ASR) data processor. Controllers need to know which aircraft are being tracked by which system when the type of surveillance affects how they control that aircraft, or the quality of the reported position, so that appropriate separation standards can be applied. Depending on the application and the limit of MLAT coverage, controllers may also need to know other capabilities of the displayed aircraft, such as RNP, ADS-B and CDTI. All of this adds information to be integrated into the present displays;

- *limitations of the technology*. Users will need to fully understand the limitations of the information presented and be informed of any known degradations or failures.
- *degree to which the displayed information supports the application*. The degree to which the MLAT information supports spacing and separation tasks and the degree to which flight crews and controllers are expected to successfully accomplish and integrate these tasks is being assessed in different ICAO forums. How the information is displayed is as important as the integrity of the information in supporting the user's confidence in the system. A concept under active development is to provide improvements to HFOM, for example elevating an GPS derived ADS-B position FOM that is marginal for use - by supporting MLAT FOM; and
- *effects on workload*. The effects of the additional information, and the procedures associated with specific applications, on the workload of the user need to be assessed. The information needs to be integrated so that it is unambiguous, immediately useful, and does not interfere with other critical information.

4.3.2 Procedures development, separation standards, airspace design, and training issues

In support of new operations, appropriate procedures, separation standards, airspace design, and training are being developed to effectively utilize MLAT and its applications. Controllers, pilots, and maintenance technicians, as well as others who may use MLAT or be impacted by the procedures need proper training on coverage issues, normal and failure mode operations. In addition, airspace design (e.g. size of ATC sectors) will need to be considered for the types of services provided.

4.3.3 Fleet equipage

With the availability of various ADS-B and SSR technologies and the cost of equipping or re-equipping aircraft with new avionics, it is unlikely that aircraft will have homogeneous equipment. The introduction of MLAT allows the system to have full surveillance of all transponder equipped aircraft without the hurdle of making the carriage of ADS-B transponders mandatory for a State or large airspace area.

It should be remembered that in some MLAT systems, ADS-B is an integral part, so aircraft operators should be encouraged to install ADS-B OUT capability which will benefit the whole airspace system in time, and which can benefit the operator and ATS system directly through improved coverage in areas beyond the MLAT high performance area.

The design configuration of the MLAT system may have only some or no MLAT receivers detecting ADS-B. In the cockpit, the traffic information service — broadcast (TIS-B), may evolve to be of particular importance, ensuring consistency on both air and ground traffic situation displays.

4.3.4 Transition issues

One of the main issues with regard to the impact from the transition towards an ADS-B-based surveillance system is that MLAT extends out the time when full capability of ADS-B is needed. In the foreseeable future, the systems have to be capable of coping with a heterogeneous set of aircraft capabilities, types of surveillance sensors, local system sophistication etc. and should be capable of providing the required quality of service both on the ground and on board the aircraft. This quality of service should be at least equal to that of the current system in place. MLAT is often seen as a ‘transitional technology’ that caters for legacy aircraft while also being capable of processing ADS-B transmissions.

4.3.5 Institutional
There are common types of institutional issues regardless of the State implementing MLAT. These include such things as legal issues (e.g. separation standards), radio spectrum allocation/management, and certification issues. Each State will have to resolve these, but global harmonization needs to be considered for consistency.

4.3.6 Environmental issues
4.3.6.1 With any new system, environmental issues need to be considered to include noise abatement, airspace constraints, and remote ground system installations.

4.3.6.2 The ADS-B processing capability of MLAT systems enables new or improved applications which are expected to contribute significantly to these savings by providing more direct or efficient routings, and easier access to the optimum altitudes and airspeeds.

Chapter 5. Implementation

5.1 Planning
There is a range of activity that needs to take place to bring an application from initial concept to operational use. This section documents these activity areas under the topics of collaborative planning and decision making, system compatibility and integration, while the second section of this chapter provides a checklist to assist States with the management of MLAT implementation activities.

5.1.2 Implementation team to ensure international coordination
5.1.2.1 From the ICAO perspective, when a State decides to implement a new technology it benefits the wider ATM community if they consult and advise the wider ATM community of plans and implementation issues encountered. Moreover, the implementation should also be coordinated between States and Regions as appropriate, in order to achieve maximum benefits for airspace users and service providers.

5.1.2.2 An effective means of coordinating the various demands of the affected organizations is to establish an implementation team. Team composition may vary by State or Region, but the core group responsible for MLAT implementation planning should include members with operational expertise in aviation disciplines, with access to other specialists as may be required. Where both MLAT and ADS-B services are being introduced at the same time, or being considered, a single team should seek a harmonised approach for both systems.

5.1.2.3 Ideally, such a team should comprise representatives from the ATS providers, regulators and airspace users, as well as other stakeholders likely to be influenced by the introduction of MLAT and ADS-B, including manufacturers and military authorities. All identified stakeholders should participate as early as possible in this process so that demands are identified prior to the making of schedules or contracts.

5.1.2.4 The role of the implementation team is to consult widely with stakeholders, identify operational needs, resolve conflicting demands and make recommendations to the various stakeholders managing the implementation. To this end, the implementation team should have high-level access to the decision-makers.

5.1.3 System compatibility

5.1.3.1 ADS-B has potential use in almost all environments and operations and is likely to become a mainstay of the future ATM system. MLAT is able to fill in the gaps for areas where surveillance is needed, but where targets / aircraft have only Mode A/C or Mode S short squitter transponders. Engineering and operational trials of both systems have been conducted and operational implementations have occurred, and ADS-B now has a comprehensive set of internationally accepted standards. Generally first applications are in niche areas where radar surveillance is not available or possible. ICAO Regional cooperation and alignment are important.

5.1.3.2 Given the international nature of aviation, special efforts should be taken to ensure harmonization though compliance with ICAO Standards and Recommended Practices (SARPs). The choice of actual technologies to implement MLAT (and ADS-B) should consider not only the required performance of individual components, but also their compatibility with other CNS systems.

5.1.3.3 The future concept of ATM encompasses the advantages of interoperable and seamless transition across flight information region (FIR) boundaries and MLAT/ADS-B implementation teams should include simulations, trials and cost/benefit analysis to support these objectives.

5.1.4 Integration

5.1.4.1 MLAT implementation plans will include the development of both business and safety cases. The adoption of any new CNS system has major implications for service providers, regulators and airspace users and special planning should be considered for the integration into the existing and foreseen CNS/ATM systems. The following briefly discusses each element.

5.1.4.2 The communication system is an essential element within CNS. An air traffic controller can now monitor an aircraft using MLAT and ADS-B in non-radar areas where previously only voice position reports were available. However, a communication system that will support the new services resulting from the improved surveillance will be necessary.

5.1.4.3 Where MLAT is being introduced to perform A-SMGCS or PRM functions, consideration must be given to the supporting navigational systems such as ILS, GLS, airport lighting, taxiway markings, etc

5.1.4.4 MLAT and ADS-B may be used to supplement existing surveillance systems or as the principal source of surveillance data. Ideally, surveillance systems will incorporate all available data to provide a coherent picture that improves both the amount and utility of surveillance data to the user. The choice of the optimal mix of data sources will be defined on the basis of operational demands, available technology, safety and cost-benefit considerations.

5.1.4.4.2 MLAT is dependent on the aircraft having at least a Mode A/C transponder. It can receive identity through correlation of a code with the flight plan, or the flight identification transmitted by ADS-B or Mode S transponder

5.2. Implementation checklist

5.2.1 The purpose of this implementation checklist is to document the range of activities that need to take place to bring an MLAT application from an initial concept to operational use. This checklist may form the basis of the terms of reference for an MLAT implementation team, although some activities may be specific to individual stakeholders. *Note - When completed, the MLAT/ADS-B Implementation and Operations Guidance Document will be more prescriptive of these headings.*

5.2.2 The activities are listed in an approximate sequential order. However, each activity does not have to be completed prior to starting the next activity. In many cases, a parallel and iterative process should be used to feed data and experience from one activity to another. It should be noted that not all activities will be required for all applications.

5.2.3 Concept phase

construct operational concept for the airport or airspace:

- define the purpose of MLAT and ADS-B;
- operational environment;
- ATM functionality that will be affected
- ATM system modifications necessary (and cost estimates)
- infrastructure;
- identify benefits:
- safety enhancements;
- efficiency;
- capacity;
- environmental;
- physical and electronic (remote control) access; and
- other metrics (e.g. predictability, flexibility, usefulness);
- identify constraints:
- pair-wise equipage; need for exclusive airspace;
- required coverage
- required configuration /ground infrastructure;
- RF spectrum;
- define airspace area within which MLAT accuracy is acceptable
- integration with existing technology; and
- technology reliability / availability (system, communications, power);
- contingency systems / procedures
- prepare business case:
- cost benefit analysis; and
- demand and justification.

5.2.4 Design phase

identify operational requirements:

- security;

- systems interoperability;
- identify human factors issues:
- human-machine interfaces;
- training development, delivery and license validation;
- workload demands;
- role of automation vs. role of human;
- crew coordination/pilot decision-making interactions; and
- ATM collaborative decision-making;
- identify technical requirements:
- site selection
- standards development;
- data required;
- functional processing;
- functional performance; and
- required certification levels;
- equipment development, test, and evaluation:
- prototype systems built to existing or draft standards/specifications;
- methodology required by the ANSP safety management system
- developmental bench and flight tests if sufficient data not already provided;
- select technology;
- develop procedures:
- pilot and controller actions and responsibilities;
- phraseologies;
- separation/spacing criteria and requirements;
- controller's responsibility to maintain a monitoring function, if appropriate;
- identify any controller issues for operations at the transition between types of surveillance.
- contingency procedures; and
- emergency procedures;
- prepare design phase safety case:
- safety rationale;
- safety budget and allocation; and
- functional hazard assessment.

5.2.5 Implementation phase

prepare implementation phase safety case;

- Obtain acceptance as necessary of safety case
- Include any safety mitigation that is required into system design or procedures.

Prepare the sites:

- communication, power and physical preparation for remote and central equipment sites;

conduct operational test and evaluation:

- flight deck and ATC validation simulations; and
- flight tests and operational trials;
- obtain systems certification:
- aircraft equipment performance checks; and
- ground system deployment and checking;
- obtain regulatory approvals: flight operations; and air traffic;
- implementation transition:
- continue data collection and analysis;

- continue feedback into standards development processes; and
- performance monitoring to ensure agreed performance is maintained.

5.2.5.1 Once the implementation phase is complete, the ongoing maintenance and upgrading of both MLAT and ADS-B operations and infrastructure should continue to be monitored, measured and reported on – both internally and externally, through the appropriate forums.

THE RESULTS OF READINESS SURVEY

	Equipment	Yr 2007	Yr 2008	Yr 2009	Yr 2010	Yr 2011	Yr 2012	Beyond 2012	Remark
Australia	No. of major airports with A-SMGCS (with ADS-B)	0	3	3	3	3	3	8	
	No. of major airports with A-SMGCS (without ADS-B)	1	0	0	0	0	0		
	No. of major airports without A-SMGCS	7	5	5	5	5	5		
	No. of ADS-B stations* ready for operational use	5	20	28	48	48	48	?	
	No. of automation systems ready to process ADS-B data (standalone system)	0	6	6	8	10	12		Towers
	No. of automation systems ready to process ADS-B data (integrated system)	2	2	6	6	6	6	6	
	No. of automation systems not ready to process ADS-B data	4	4	0	0	0	0	0	
	Completion of controller training for ADS-B operations	2007							
Cambodia	No. of major airports with A-SMGCS (with ADS-B)	0	0	0	0	0	0	0	
	No. of major airports with A-SMGCS (without ADS-B)	0	0	0	0	0	0	0	
	No. of major airports without A-SMGCS	0	0	0	0	0	0	0	
	No. of ADS-B stations* ready for operational use	0	0	0	0	0	0	0	
	No. of automation systems ready to process ADS-B data (standalone system)	0	0	0	0	0	0	0	
	No. of automation systems ready to process ADS-B data (integrated system)	0	0	0	0	0	0	0	
	No. of automation systems not ready to process ADS-B data	0	0	0	0	0	0	0	
	Completion of controller training for ADS-B operations	NA							
China	No. of major airports with A-SMGCS (with ADS-B)	1	1						
	No. of major airports with A-SMGCS (without ADS-B)	3	7						
	No. of major airports without A-SMGCS	7	3						
	No. of ADS-B stations* ready for operational use								
	No. of automation systems ready to process ADS-B data (standalone system)	0	1						
	No. of automation systems ready to process ADS-B data (integrated system)	3	3						
	No. of automation systems not ready to process ADS-B data	35	32						
	Completion of controller training for ADS-B operations	??							

	Equipment	Yr 2007	Yr 2008	Yr 2009	Yr 2010	Yr 2011	Yr 2012	Beyond 2012	Remark
Hong Kong China	No. of major airports with A-SMGCS (with ADS-B)	1							
	No. of major airports with A-SMGCS (without ADS-B)	0							
	No. of major airports without A-SMGCS	0							
	No. of ADS-B stations* ready for operational use								
	No. of automation systems ready to process ADS-B data (standalone system)	1							
	No. of automation systems ready to process ADS-B data (integrated system)	0							
	No. of automation systems not ready to process ADS-B data	1							
	Completion of controller training for ADS-B operations	2012							
Fiji Islands	No. of major airports with A-SMGCS (with ADS-B)	0							
	No. of major airports with A-SMGCS (without ADS-B)	0							
	No. of major airports without A-SMGCS	2	2	2	2	2	2	2	
	No. of ADS-B stations* ready for operational use	0	0	8					
	No. of automation systems ready to process ADS-B data (standalone system)	0	0	1					
	No. of automation systems ready to process ADS-B data (integrated system)	0	0						
	No. of automation systems not ready to process ADS-B data	1							
	Completion of controller training for ADS-B operations	2009							
France (New Celedonia and French Polynesia)	No. of major airports with A-SMGCS (with ADS-B)	0							
	No. of major airports with A-SMGCS (without ADS-B)	0							
	No. of major airports without A-SMGCS	2							
	No. of ADS-B stations* ready for operational use			2					
	No. of automation systems ready to process ADS-B data (standalone system)	0	0	1					
	No. of automation systems ready to process ADS-B data (integrated system)	0	1	1					
	No. of automation systems not ready to process ADS-B data	2	1	0					
	Completion of controller training for ADS-B operations	2009							

	Equipment	Yr 2007	Yr 2008	Yr 2009	Yr 2010	Yr 2011	Yr 2012	Beyond 2012	Remark
India	No. of major airports with A-SMGCS (with ADS-B)	1							
	No. of major airports with A-SMGCS (without ADS-B)	0							
	No. of major airports without A-SMGCS								
	No. of ADS-B stations* ready for operational use	0	0	0	0	0	0	0	
	No. of automation systems ready to process ADS-B data (standalone system)	0							
	No. of automation systems ready to process ADS-B data (integrated system)	0							
	No. of automation systems not ready to process ADS-B data	2							
	Completion of controller training for ADS-B operations	NA							
Indonesia	No. of major airports with A-SMGCS (with ADS-B)	0	0	1					
	No. of major airports with A-SMGCS (without ADS-B)	0	0	0					
	No. of major airports without A-SMGCS	23	23	22					
	No. of ADS-B stations* ready for operational use	0	2	3					
	No. of automation systems ready to process ADS-B data (standalone system)	0	1						
	No. of automation systems ready to process ADS-B data (integrated system)	1							
	No. of automation systems not ready to process ADS-B data	4							
	Completion of controller training for ADS-B operations	2010							
Japan	No. of major airports with A-SMGCS (with ADS-B)	0							
	No. of major airports without A-SMGCS (with ADS-B)	0	0	1	2				
	No. of major airports without A-SMGCS	0							
	No. of ADS-B stations* ready for operational use	0							
	No. of automation systems ready to process ADS-B data (standalone system)	0							
	No. of automation systems ready to process ADS-B data (integrated system)	0							
	No. of automation systems not ready to process ADS-B data	9							
	Completion of controller training for ADS-B operations	??							

	Equipment	Yr 2007	Yr 2008	Yr 2009	Yr 2010	Yr 2011	Yr 2012	Beyond 2012	Remark
Malaysia	No. of major airports with A-SMGCS (with ADS-B)	0	0	1					
	No. of major airports with A-SMGCS (without ADS-B)	1							
	No. of major airports without A-SMGCS	4	4	4	4	4	4	4	
	No. of ADS-B stations* ready for operational use	0	0	1					
	No. of automation systems ready to process ADS-B data (standalone system)	0	1	2	2	2	2	2	
	No. of automation systems ready to process ADS-B data (integrated system)	0	0	0	1	1	1	2	
	No. of automation systems not ready to process ADS-B data	3	3	3	2	2	2	1	
	Completion of controller training for ADS-B operations	2009							
Maldives	No. of major airports with A-SMGCS (with ADS-B)	0							
	No. of major airports with A-SMGCS (without ADS-B)	1							
	No. of major airports without A-SMGCS	1							
	No. of ADS-B stations* ready for operational use	0							
	No. of automation systems ready to process ADS-B data (standalone system)	0							
	No. of automation systems ready to process ADS-B data (integrated system)	0							
	No. of automation systems not ready to process ADS-B data	0							
	Completion of controller training for ADS-B operations	??							
Nepal	No. of major airports with A-SMGCS (with ADS-B)	0	0	0	0				
	No. of major airports with A-SMGCS (without ADS-B)	0	0	0	0				
	No. of major airports without A-SMGCS	1	1	1	1				
	No. of ADS-B stations* ready for operational use	0	0	0	1				
	No. of automation systems ready to process ADS-B data (standalone system)				1				
	No. of automation systems ready to process ADS-B data (integrated system)								
	No. of automation systems not ready to process ADS-B data	1	1	1	1				
	Completion of controller training for ADS-B operations	2010							

	Equipment	Yr 2007	Yr 2008	Yr 2009	Yr 2010	Yr 2011	Yr 2012	Beyond 2012	Remark
Pakistan	No. of major airports with A-SMGCS (with ADS-B)	0	0	0	3				
	No. of major airports with A-SMGCS (without ADS-B)								
	No. of major airports without A-SMGCS	5	5	5	2				
	No. of ADS-B stations* ready for operational use			1	1	3			
	No. of automation systems ready to process ADS-B data (standalone system)			1					
	No. of automation systems ready to process ADS-B data (integrated system)				1				
	No. of automation systems not ready to process ADS-B data	3	3	3	2				
	Completion of controller training for ADS-B operations	2009							
Philippines	No. of major airports with A-SMGCS (with ADS-B)	0	0	0					
	No. of major airports with A-SMGCS (without ADS-B)	0	0	0					
	No. of major airports without A-SMGCS	4	4	4					
	No. of ADS-B stations* ready for operational use	0	0	0					
	No. of automation systems ready to process ADS-B data (standalone system)	0	0						
	No. of automation systems ready to process ADS-B data (integrated system)	0	0						
	No. of automation systems not ready to process ADS-B data	1	1						
	Completion of controller training for ADS-B operations	5 years after ADS-B installation							
Republic of Korea	No. of major airports with A-SMGCS (with ADS-B)	0	1						
	No. of major airports with A-SMGCS (without ADS-B)	2	1						
	No. of major airports without A-SMGCS	5							
	No. of ADS-B stations* ready for operational use		2						
	No. of automation systems ready to process ADS-B data (standalone system)	0	0						
	No. of automation systems ready to process ADS-B data (integrated system)		1						
	No. of automation systems not ready to process ADS-B data	7	6						
	Completion of controller training for ADS-B operations	2008							

	Equipment	Yr 2007	Yr 2008	Yr 2009	Yr 2010	Yr 2011	Yr 2012	Beyond 2012	Remark
Singapore	No. of major airports with A-SMGCS (with ADS-B)	1	1	1	1	1	1	1	
	No. of major airports with A-SMGCS (without ADS-B)	0	0	0	0	0	0	0	
	No. of major airports without A-SMGCS	0	0	0	0	0	0	0	
	No. of ADS-B stations* ready for operational use	0	0	1	1	1	1	1	
	No. of automation systems ready to process ADS-B data (standalone system)	0	0	0	0	0	0	0	
	No. of automation systems ready to process ADS-B data (integrated system)	0	0	0	1	1	1	1	
	No. of automation systems not ready to process ADS-B data	1	1	1	0	0	0	0	
	Completion of controller training for ADS-B operations	2010							
Sri Lanka	No. of major airports with A-SMGCS (with ADS-B)	0	0	0					
	No. of major airports with A-SMGCS (without ADS-B)	0	0	0					
	No. of major airports without A-SMGCS	1	1	1	1	2	2	2	
	No. of ADS-B stations* ready for operational use								
	No. of automation systems ready to process ADS-B data (standalone system)	0	0	0	≥1	≥1	≥1	≥1	
	No. of automation systems ready to process ADS-B data (integrated system)								Not decided
	No. of automation systems not ready to process ADS-B data	0	2	2	≥2	≥2	≥2	≥2	
	Completion of controller training for ADS-B operations	2011							
Thailand	No. of major airports with A-SMGCS (with ADS-B)	1	1	1					
	No. of major airports with A-SMGCS (without ADS-B)	0	0	0	0				
	No. of major airports without A-SMGCS	3	3	3	3				
	No. of ADS-B stations* ready for operational use	0	22	22	22	22	22	22	
	No. of automation systems ready to process ADS-B data (standalone system)	0	0	0	0				
	No. of automation systems ready to process ADS-B data (integrated system)	0	4	4	4	4	4	4	
	No. of automation systems not ready to process ADS-B data								
	Completion of controller training for ADS-B operations	2008							

	Equipment	Yr 2007	Yr 2008	Yr 2009	Yr 2010	Yr 2011	Yr 2012	Beyond 2012	Remark
USA	No. of major airports with A-SMGCS (with ADS-B)	20	24	32	40				
	No. of major airports with A-SMGCS (without ADS-B)	20	16	8	0				
	No. of major airports without A-SMGCS	0	0	0	0				Top 40 airports
	No. of ADS-B stations* ready for operational use	300	300	400	500				
	No. of automation systems ready to process ADS-B data (standalone system)	1	2	4	65	80			
	No. of automation systems ready to process ADS-B data (integrated system)	1	2	4	65	80			
	No. of automation systems not ready to process ADS-B data	79	78	76					
	Completion of controller training for ADS-B operations	Completed							
Vietnam	No. of major airports with A-SMGCS (with ADS-B)								
	No. of major airports with A-SMGCS (without ADS-B)	0	0	2					
	No. of major airports without A-SMGCS	22	22	20					
	No. of ADS-B stations* ready for operational use								
	No. of automation systems ready to process ADS-B data (standalone system)								
	No. of automation systems ready to process ADS-B data (integrated system)								
	No. of automation systems not ready to process ADS-B data	2							
	Completion of controller training for ADS-B operations								

STRATEGY FOR THE IMPLEMENTATION OF SURVEILLANCE SYSTEMS IN THE ASIA/PACIFIC REGION

Considering that:

1. States are implementing CNS/ATM systems to gain safety and efficiency benefits, and have endorsed the move toward satellite and data link technologies;

2. Regional planning is key to timely and successful implementation of a seamless global air traffic management system;

3. Safety and efficiency will be increased through harmonisation of technology and applications;

4. The 11th Air Navigation Conference endorsed the use of ADS-B as an enabler of the global air traffic management concept and encouraged states to support cost-effective early implementation of ADS-B applications;

5. APANPIRG has decided to use the 1090MHz Extended Squitter data link for ADS-B air-ground and air-air applications in the Asia/Pacific Region, noting that in the longer term an additional link type may be required;

6. SSR and ADS-C will continue to meet many critical surveillance needs for the foreseeable future ;

7. ACAS acts as situational awareness tool and last resort for safety conflict resolution;

8. Initial SARPs, PANS and guidance material for the use of ADS-B have been developed;

9. ADS-B avionics and ground systems are available;

10. ADS-B aircraft-based surveillance applications are under study in the region;

11. Multilateration is a technology that can supplement SSR and ADS-B;

12. Availability of guidance on technical requirements for Mode S and Extended Squitter provided in ICAO Doc 9871 ‘Technical Provisions for Mode S Services and Extended Squitter. Draft Edition 2006’

13. The future air traffic environment will require increased use of aircraft derived surveillance information for the implementation of a seamless automated air traffic flow management system; and

14. The process of achieving civil-military interoperability in the surveillance domain is to consider the requirements, identify existing capabilities and harmonize surveillance strategies.

THE GENERAL STRATEGY FOR THE IMPLEMENTATION OF SURVEILLANCE SYSTEMS IN THE ASIA/PACIFIC REGION IS TO:

1. Minimise the reliance upon pilot position reporting, particularly voice position reporting, for surveillance of aircraft;

2. Reduce the dependence on Primary Radar for area surveillance;

3 Provide maximum contiguous ATS surveillance coverage of international air routes using 1090MHz Extended Squitter ADS-B and Mode S SSR;

4. Maximise the use of ADS-B on major air routes and in terminal areas, giving consideration to the mandatory carriage of ADS-B Out as specified in Note 1 and use of ADS-B for ATC separation service;

5. Make full use of SSR Mode S capabilities where radar surveillance is used and reduce reliance on 4 digit octal codes;

6. Make use of ADS-C where technical constraint or cost benefit analysis does not support the use of ADS-B, SSR or Multilateration;

7. Make use of Multilateration for surface, terminal and area surveillance where appropriate as an alternative or supplement to other surveillance systems;

8. Increase the effectiveness of surveillance and collision avoidance systems through mandatory use of pressure altitude reporting transponders;

9. Improve safety through sharing of ATS surveillance data across FIR boundaries;

10. Ensure provision of communication, navigation, and data management capabilities necessary to make optimal use of surveillance systems;

11. Enhance ATM automation tools and safety nets through the use of aircraft derived data such as flight identification, trajectories and intentions; and

12. Closely monitor the implementation of ADS-B and multilateration in order to verify their impact on civil-military interoperability.

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Associated GPI 19 and GPI 17

Note 1:

a) *Version 0 ES as specified in Annex 10, Volume IV, Chapter 3, Paragraph 3.1.2.8.6 (up to and including Amendment 82 to Annex 10) and Chapter 2 of draft* Technical Provisions for Mode S Services and Extended Squitter *(ICAO Doc 9871) (Equivalent to DO260) to be used till at least 2020.*

b) *Version 1 ES as specified in Chapter 3 of draft* Technical Provisions for Mode S Services and Extended Squitter *(ICAO Doc 9871) (Equivalent to DO260A); Or*

SADIS STRATEGIC ASSESSMENT TABLES:
CURRENT AND PROJECTED DATA VOLUMES 2007-2011.

SUMMARY

Note. – 1 octet = 1 byte = 1 character

Table 1. OPMET data volumes per day (in K bytes)

Region	*Current 2007*	*Projected 2008*	*Projected 2009*	*Projected 2010*	*Projected 2011*
ASIA	**1013**	**1046**	**1085**	**1124**	**1163**

Table 2. BUFR data volumes per day (in K bytes)

Region	*Current 2007*	*Projected 2008*	*Projected 2009*	*Projected 2010*	*Projected 2011*
ASIA	**0**	**40**	**40**	**40**	**40**

Table 3. AIS data volumes per day (in K bytes)

Region	*Current 2007*	*Projected 2008*	*Projected 2009*	*Projected 2010*	*Projected 2011*
ASIA	**0**	**20**	**20**	**20**	**20**

SADIS STRATEGIC ASSESSMENT TABLES CURRENT AND PROJECTED DATA VOLUMES 2007-2011

Note.— 1 octet = 1 byte = 1 character.

Table 1. ASIA— OPMET data volumes

OPMET data	*Current 2007*	*Projected 2008*	*Projected 2009*	*Projected 2010*	*Projected 2011*
ALPHANUMERIC DATA					
Number of **FC bulletins** issued per day	302	325	350	375	400
Number of **FT bulletins** issued per day	250	255	260	265	270
Number of **SA bulletins** issued per day	1711	1750	1800	1850	1900
Number of **SP bulletins** issued per day	35	40	45	50	55
Number of **SIGMET** bulletins issued per day	36	40	45	50	55
BINARY DATA					
Number of other bulletins issued per day	0	0	0	0	0
TOTALS					
Total number of OPMET bulletins per day	2334	2410	2500	2590	2680
Average size of OPMET bulletin (bytes)	434	434	434	434	434
Total estimated OPMET data volume per day (in K bytes)	**1013**	**1046**	**1085**	**1124**	**1163**

Note.— No provision is being made for the distribution of BUFR-coded OPMET data. Capacity for this data may need to be included depending on its issuance in the region.

Table 2. ASIA — BUFR data volumes

Graphical information in the BUFR code form	*Current 2007*	*Projected 2008*	*Projected 2009*	*Projected 2010*	*Projected 2011*
TOTALS					
Total number of BUFR messages per day	0	2	2	2	2
Average size of messages (bytes)	0	20000	20000	20000	20000
Total estimated volume of BUFR messages per day (in K bytes)	**0**	**40**	**40**	**40**	**40**

Provision is made for the distribution of BUFR encoded VAG starting from the year 2007.

Table 3. ASIA — AIS data volumes

AIS data	*Current 2007*	*Projected 2008*	*Projected 2009*	*Projected 2010*	*Projected 2011*
ALPHANUMERIC AIS DATA (NOTAM related to volcanic ash, ASHTAM) Number of ASHTAM bulletins issued per day	0	2	2	2	2
Number of NOTAM bulletins issued per day	0	2	2	2	2
TOTALS Total number of AIS bulletins per day	0	4	4	4	4
Average size of AIS bulletin (byte)	0	5000	5000	5000	5000
Total estimated volume of AIS data per day (in K bytes)	**0**	**20**	**20**	**20**	**20**

Note.— Provision is made for the distribution of ASHTAMs and NOTAMs related to volcanic ash.

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VIETNAM	**Duong Lien Chau**	
	Tel: 011-844-824-7002 Fax: 011-844-825-4278 E-Mail: dlchau@fpt.vn	Viet Nam Hydrometeorological Service, 4 Dang Thai Than Street, Hanoi, Viet Nam
WALLIS ISLAND	**Gilles Montesquieu**	
	Tel: 687-27-93-20 Fax: 687-27-93-27 E-Mail: Gilles.Montesquieu@meto.fr	Meteo France Aeroport de Hihifo BP 2 -Mata-Utu, 98600 UVEA Wallis Island

SUMMARY OF RECENT AND FORTHCOMING DEVELOPMENTS TO THE WAFS

(Information presented by WAFC London and WAFC Washington at CNS/MET SG/11 Meeting)

1 RECENT DEVELOPMENTS

1.1 WAFS Output performance indicators

WAFSOPSG Conclusion 2/11 invited the WAFCs to implement a number of measures that would quantify the accuracy and availability of specified WAFS products. In response to this conclusion, both WAFCs are pleased to report that web pages containing output performance indicator and timeliness statistics have been implemented. Each WAFC maintains a separate web site. The statistics are updated monthly.

WAFC London performance indicators are available for viewing from the following URL: http://www.metoffice.gov.uk/icao/index.html.

WAFC Washington performance indicators are available from the following URL: http://www.emc.ncep.noaa.gov/gmb/icao/ncep_scores.html.

These pages provide RMS vector wind errors and RMS temperature errors at 250hPa (FL340) for 6 geographic regions: North Atlantic, Asia, North Pacific, Northern Hemisphere, Tropics, and Southern Hemisphere. Timeliness of transmission for selected GRIB and BUFR bulletins are also made available.

1.2 WAFS Change Notice Board

WAFSOPSG Conclusion 2/4 invited the WAFCs to develop a 'tracking system' for inclusion on the WAFSOPSG web site. The WAFCs are pleased to report that such a facility became available in May 2005 and is available as a link from the WAFSOPSG website via URL: www.icao.int/anb/wafsopsg/. This 'Notice Board' is updated on a regular basis by the WAFCs.

1.3 WAFC Backup tests

The WAFCs have continued to carry out a series of backup tests since the last regional MET SG meeting. The intention of these tests is to confirm the resilience and effectiveness of the current backup plan, which now includes BUFR encoded and PNG formatted SIGWX products. A backup test schedule and chronology of recent tests are available to view as links from the WAFSOPSG website via URL: www.icao.int/anb/wafsopsg/. The backup tests have continued to be largely transparent to end users.

1.4 WAFS gridded forecasts of icing, turbulence and convective clouds

For a number of years, regional guidance on where aircraft might encounter icing and turbulent conditions has been provided by WAFC forecasters in the graphical form of SIGWX charts and (more recently) BUFR data. In April 2003, WAFC London began developing software that would allow the Centre to produce global forecasts relating to icing and turbulence in the form of gridded numerical data. Since 25 October 2006, WAFC London gridded forecasts of icing, turbulence and convective cloud have been available for approved users to access on a *trial and evaluation basis* from the SADIS FTP service. WAFC Washington has also been developing equivalent products, and these are expected to become available on SADIS FTP around mid-2007.

2 FUTURE DEVELOPMENTS

2.1 Advancement of the lead time of issuance of WAFS SIGWX forecasts

In order to meet the needs of long-haul flights, the WAFS Provider States were invited, by the 3rd meeting of the WAFSOPSG, to advance the lead time of issuance of WAFS SIGWX forecasts. At present, BUFR and PNG formatted WAFS SIGWX products are issued at approximately 13.5 hours ahead of validity. In time for WAFSOPSG/4 (February 2008), the WAFCs will advance the lead time of issuance of SIGWX forecasts in the BUFR code form to:

a) 17 hours for high levels (SWH); and
b) 16 hours for medium levels (SWM).

Furthermore, PNG formatted SIGWX products (SWH and SWM) will be issued with a lead time of 16 hours. During periods of WAFC backup, the WAFCs will be required to issue the SIGWX forecasts with a lead time of 15 hours.

WAFS users will be advised six months before the implementation of this change on the WAFSOPSG website (Change Implementation Notice Board), via URL: http://www.icao.int/anb/wafsopsg/. Administrative messages will also be broadcast over SADIS and ISCS services notifying users of the intended implementation date. End-user workstation systems that automatically schedule the generation of products based on the WAFS SIGWX forecasts may require an upgrade in readiness for this change

2.2 Update to the depiction of features on WAFS SIGWX charts

In line with WAFSOPSG Conclusion 3/3, the WAFS Provider States have been invited to:

a) adopt the use of revised text in the legend boxes of WAFS SIGWX charts;
b) ensure that the thunderstorm symbol (TS) is not used on WAFS SIGWX forecasts; and
c) ensure that explicit flight levels be displayed for jet depths and tropopause heights on WAFS SIGWX forecasts, even when these are outside of the bounds of the forecast concerned.

For b) and c), the WAFCs have already introduced these into standard working practices. For a), the revised legend box text will be introduced at the same time that Amendment 74 to ICAO Annex 3 takes effect (07 November 2007). An example of the revised legend box text is now provided:

ISSUED BY WAFC .....
FIXED TIME PROGNOSTIC CHART
ICAO AREA H SIGWX
FL 250-630
VALID XX UTC XX XXX XXXX

CB IMPLIES TS, GR, MOD OR SEV TURB AND ICE

UNITS USED: HEIGHTS IN FLIGHT LEVELS

CHECK SIGMET, ADVISORIES, ASHTAM AND NOTAM FOR VOLCANIC ASH

These changes affect the BUFR-encoded format and PNG formatted WAFS SIGWX products. End-users who utilise the BUFR data may require a software upgrade to accommodate the changes outlined.

2.3 **Amendment 74 changes to ICAO Annex 3**

State Letter AN 10/1.1-07/11 outlined the adoption by the Council of Amendment 74 to the *International Standards and Recommended Practices, Meteorological Service for International Air Navigation* (Annex 3 to the Convention on International Civil Aviation). The principle components of this amendment to Annex 3, with respect to WAFS provision, are:

a) elimination of the need to amend significant weather (SIGWX) forecasts and the introduction of altitude of the standard WAFC flight levels;
b) introduction of the requirement to provide WAFS charts for standard ICAO areas of coverage;
c) upgrading the provisions in order to foster the use of WAFS forecasts;
d) elimination of surface fronts, convergence zones and clouds other than CB and TCU from the high- and medium-level SIGWX forecasts;
e) prioritisation of plotting volcanoes, tropical cyclones and radiation symbols on WAFS SIGWX charts; and
f) advancement of the lead time of issuance of SIGWX forecasts;

A number of other (non-WAFS related) changes are planned, and users are encouraged to refer to the State Letter detailed above for clarification. The Council has decided that Amendment 74 will become applicable on 07 November 2007, except for the provision outlined at f) above, and the extension of the validity period of an aerodrome forecast and other amendments related to aeronautical meteorological codes which will become applicable on 05 November 2008.

2.4 **PNG formatted SIGWX charts**

In accordance with WAFSOPSG Conclusion 3/9, the WAFS Provider States have been invited to continue the provision of PNG formatted SIGWX charts at least until 2010, *as a backup to* BUFR encoded SIGWX forecasts – this is in case of any missing or corrupt BUFR data, and also so that a definitive standard of the SIGWX forecasts exists for compliancy testing purposes.

2.5 **WAFS gridded forecasts of icing, turbulence and convective cloud**

In accordance with WAFSOPSG Conclusion 3/13, WAFSOPSG members from IATA, IFALPA and user States have been invited to evaluate these trial products, with a view to fostering their future implementation.

Initial guidelines and models for the visualisation of these gridded forecasts are expected to be reviewed at WAFSOPSG/4 (February 2008), in view of their future inclusion in Annex 3. ICAO, in co-ordination with WMO, will prepare a plan for convening regional seminars on the use of these gridded forecasts in order to assist States and WAFS users to implement the new provisions, to be presented at WAFSOPSG/4.

2.6 **Migration plan to GRIB2 code form**

The WAFS Provider States, in co-ordination with WMO, have been invited to develop a detailed implementation plan for the transition from GRIB1 to GRIB2 code form within the WAFS, for endorsement by the WAFSOPSG/4 meeting. The current expectation is that the WAFS Provider States will begin parallel broadcasts of WAFS forecasts in GRIB2 code form in 2009 or 2010. The parallel broadcasts are necessary to afford WAFS workstation vendors and users the opportunity to upgrade their workstations to receive and successfully process the GRIB2 data. On overlap period of at least 2 years is currently anticipated, and any decision to cease production of GRIB1 data will be agreed at subsequent WAFSOPSG meetings based on feedback from all members.

2.7 **Improvements in the spatial and temporal resolution of WAFS upper-air forecasts**

The WAFSOPSG member from IATA**,** in co-ordination with the WAFS Provider States, is soon to begin an analysis of the WAFC costs and benefits to aviation that would be realised by improvements in the vertical, horizontal and temporal resolutions of WAFS upper-air forecasts. At present, the benefits of moving to higher resolution data are not yet fully understood, and the WAFSOPSG/3 meeting agreed that further work should be done in this area. The results of this analysis are expected to be reviewed by the WAFSOPSG/4 meeting.

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Status of States' Implementation of SADIS 2G in Asia/Pacific (July 2007)

State/Territory	SADIS 2G Implemented (Y/N)	Planned Date for Implementation
Bangladesh	No response	
China	N	End 2007
Hong Kong, China	N	Mid 2007
Macao, China	N	End 2007
D.P.R. of Korea	No response	
India	N	12/2007
Lao P.D.R.	N	Plan subject to availability of grant aid
Malaysia	N	No plan
Maldives	N	2008
Mongolia	N	06/2007
Myanmar	No response	
Nepal	Y	
Pakistan	N	12/2007
Republic of Korea	Y	
Sri Lanka	Y	
Thailand	Y	
Viet Nam	Y	

ASIA/PAC WAFS Implementation Plan and Procedures

10~~9~~th Edition - July 200~~6~~7

ASIA/PAC WAFS Implementation Plan and Procedures

~~9th~~ 10th Edition - July ~~2006~~2007

Introduction

1. The Asia/Pacific WAFS Implementation Plan and Procedures has been revised to take account of progress already made and in recognition of the impact of the migration to GRIB and BUFR.

The Implementation of WAFS

2. This plan is based on the understanding that the implementation of WAFS in the Asia/Pacific Region involves:

a. Production and dissemination by the WAFCs of global forecast winds, temperatures, tropopause height, tropopause temperature and humidity in GRIB format.

b. The implementation of a communication system/s for the distribution of WAFS products in the Asia/Pacific Region, to all the States that require the products in support of international air navigation. This will be achieved via satellite broadcast (SADIS and ISCS/2). States may need to use an alternative distribution system.

c. The production and distribution (via satellite broadcast) by the WAFCs, of Global, quality controlled SWH (FL 250 - 630) in BUFR format and in PNG format for the ICAO standard areas.

d. The production and distribution (via satellite broadcast) by the WAFCs of quality controlled SWM (FL 100 - 250) in BUFR format and in PNG format over limited geographical areas where required by PIRGs.

e. The capability of States to convert current BUFR and GRIB messages to graphical products on an operational basis.

f. Transition from SADIS 1G to SADIS 2G service.

g. Development and utilization of gridded forecasts of icing, turbulence and convective clouds.

h. Transition from GRIB1 to GRIB2 WAFS data.

SIGWX ~~Chart~~Forecasts

3. ~~The table below shows the status of the SIGWX charts and responsible WAFCs.~~

~~4.~~ There will be an ongoing requirement for NMSs to monitor the quality of WAFC products.

4~~5~~. Action required to be taken by States to adhere to the provision of Annex 3 to ensure the relevant advisories for tropical cyclones, volcanic ash, the accidental release of radioactive material and SIGMETs are made available to the WAFCs in a timely manner. The WAFS Implementation Task Force will coordinate with the ICAO Secretariat and the VAACs in the Region to also make available ASHTAMs and NOTAMs for VA to the WAFCs in a timely manner.

~~6~~5. The SIGWX forecast~~chart~~s produced by WAFC Washington are also available on the US NWS Aviation Weather Center Internet site at: http://www.nws.noaa.gov/iscs. All WAFC London and WAFC Washington products are available on the internet-based SADIS FTP server, together with appropriate GRIB and BUFR decoding facilities (Note: not including the visualization software).

6~~7~~. States are encouraged to provide inputs to the surveys on the operational efficacy of SADIS and ISCS/2 for the purpose of improving the quality of service and to send comments to the WAFCs about the quality and accuracy of SIGWX on a frequent and regular basis. Contact details for comments are:

WAFC Washington

i. NWS/Aviation Weather Center
Attention: Mr Larry Burch
Deputy Director
7220 NW 101st Terrace
Kansas City, Missouri
USA 64153-2371

ii. E-mail addressed to: larry.burch@noaa.gov

iii. Fax number: 1 816 880 0650

WAFC London

i. The Met. Office
Attention: Mr. Nigel Gait
International Aviation Manager
Fitzroy Road
Exeter
Devon EX1 3PB
United Kingdom

ii. E-mail addressed to: nigel.gait@metoffice.com

iii. Fax number: +44 (1392) 885 681

Distribution of WAFS Products

~~8~~7. The two WAFCs distribute by satellite broadcast global forecast winds, temperatures, tropopause height, tropopause temperature and humidity in GRIB format, global quality controlled SWH and quality controlled SWM for limited geographical areas in ~~T4 facsimile~~PNG and BUFR formats. Suitable decoding and visualization software is required by States in the Asia/Pacific Region to operationally construct graphical SIGWX from the BUFR messages. ~~It is planned that t~~The provision of PNG ~~T4 facsimile~~ formatted SIGWX charts is expected to continue at least until 2010~~will be removed from the satellite broadcasts on 30 November 2006~~.

Transition from SADIS 1G to SADIS 2G service

~~9.~~8. On 12 November 2004, WAFC London launched the SADIS 2G service that was required as a result of SADISOPSG Conclusion 9/15. This new service is available to new and current SADIS users. The current SADIS 1G service will continue to be available in addition to the SADIS 2G service until 31 December 2008. States should arrange for the procurement of the necessary hardware, and as necessary, compliant visualization software for transition to the SADIS 2G service in time. Guidance material for users accessing the SADIS 2G broadcast is available at the SADIS web site – http://www.metoffice.gov.uk/sadis/index.html.

Indicative Timetable for Implementation of WAFS

9~~10~~. The table given in Attachment 1 provides an indicative timetable for the implementation of WAFS within the Asia/Pacific Region.

Volcanic Ash Advisory Centres (VAACs)

10~~1~~. The VAACs are encouraged to monitor WAFS SIGWX ~~chart~~forecasts that cover their areas of responsibility, and to advise the appropriate WAFC to ensure the accurate inclusion of the volcanic ash symbol.

Tropical Cyclone Advisory Centres (TCAC)

11~~2~~. The TCACs are encouraged to monitor WAFS SIGWX forecast~~chart~~s that cover their areas of responsibility, and to advise the appropriate WAFC to ensure the accurate inclusion of the tropical cyclone symbol.

12. The operational contact points in the WAFCs for coordination with the VAACs and TCACs are:

WAFC Washington

i. NWS/Aviation Weather Center
7220 NW 101st Terrace
Kansas City, Missouri

USA 64153-2371
ii. Tel: TBD

WAFC London

i. The Met. Office
Attention: WAFC London Forecaster
Fitzroy Road
Exeter
Devon EX1 3PB
United Kingdom
ii. Tel: 00-44-1392-884926 or 00-44-1392-884908

ASIA/PAC WAFS Implementation Plan and Procedures **Attachment 1**

Indicative Timetable for Implementation of WAFS

Item	Task/Stage of Implementation of WAFS	Anticipated Date
1	WAFC London products on access controlled internet site	C~~c~~ompleted
2	The establishment of back-up distribution arrangements for WAFS products	C~~c~~ompleted
3	Training in the operational conversion of GRIB forecasts to Wind / Temp charts	C~~c~~ompleted
4	All states that receive GRIB products capable of converting GRIB forecasts to Wind / Temp charts	C~~c~~ompleted
5	Removal of T4 Facsimile Wind / Temp charts from the satellite broadcast	C~~c~~ompleted
6	Training in the operational conversion of BUFR to SIGWX charts	C~~c~~ompleted
7	States having the ability to operate the decoding software to convert BUFR SIGWX messages into graphical format	~~2006~~Completed
8	The satellite distribution by the two WAFCs of global SWH and of SWM for limited geographical areas in BUFR format	Completed
9	Launch of SADIS 2G service	~~12 November 2004~~Completed
10	SADIS 2G seminar for ASIA/PAC States	Completed
11	Removal of T4 Facsimile SIGWX products from the satellite broadcast	~~30 November 2006~~Completed
12	Procurement of SADIS 2G hardware by SADIS user States	E~~e~~arly 2008
13	Termination of the SADIS 1G service	1 January 2009

Item	**Task/Stage of Implementation of WAFS**	**Anticipated Date**
14	Launch of trial gridded forecasts of icing, turbulence and convective clouds	25 October 2006 (WAFC London) Mid-2007 (WAFC Washington)
15	Regional seminars on the use of the gridded forecasts	2008 and 2009
16	WAFCs begin parallel broadcast of WAFS forecasts in the GRIB2 code form	November 2009
17	Broadcast of forecasts in the GRIB 1 code form ceases	November 2011

ASIA/PAC WAFS IMPLEMENTATION TASK FORCE

1. Terms of Reference

Expedite the implementation of the World Area Forecast System (WAFS) in the Asia and Pacific Regions.

2. Work Programme

The work to be addressed by the ASIA/PAC WAFS Implementation Task Force (WAFS/I TF) includes:

(a) ~~Coordinating the replacement of SIGWX charts in T4 facsimile format by BUFR encoded products in the Asia and Pacific Regions.~~

~~(b)~~ Coordinating the migration of SADIS 1G service to 2G service in the Asia and Pacific Regions.

(b) Coordinating the arrangement of training and providing user's feedback on the utilization of gridded forecasts of icing, turbulence and convective clouds.

(c) Coordinating the migration of GRIB1 to GRIB2 WAFS data.

(d~~c~~) Coordinating the provision of assistance to States to ensure that WAFS can be effectively implemented in the Asia and Pacific Regions.

(e~~d~~) Providing inputs (via the CNS/MET SG) to APANPIRG on the regional planning and development of WAFS for coordination with the WAFSOPSG.

(f~~e~~) Keeping the ASIA/PAC WAFS Implementation Plan and Procedures up to date.

The work is expected to be carried out primarily by correspondence.

3. Composition

The Task Force is composed by experts from:

Australia; Hong Kong, China (Chairman); India; Japan; New Zealand; Singapore; Thailand; United Kingdom; United States and IATA.

SADISOPSG/12-IP/5
Appendix

APPENDIX

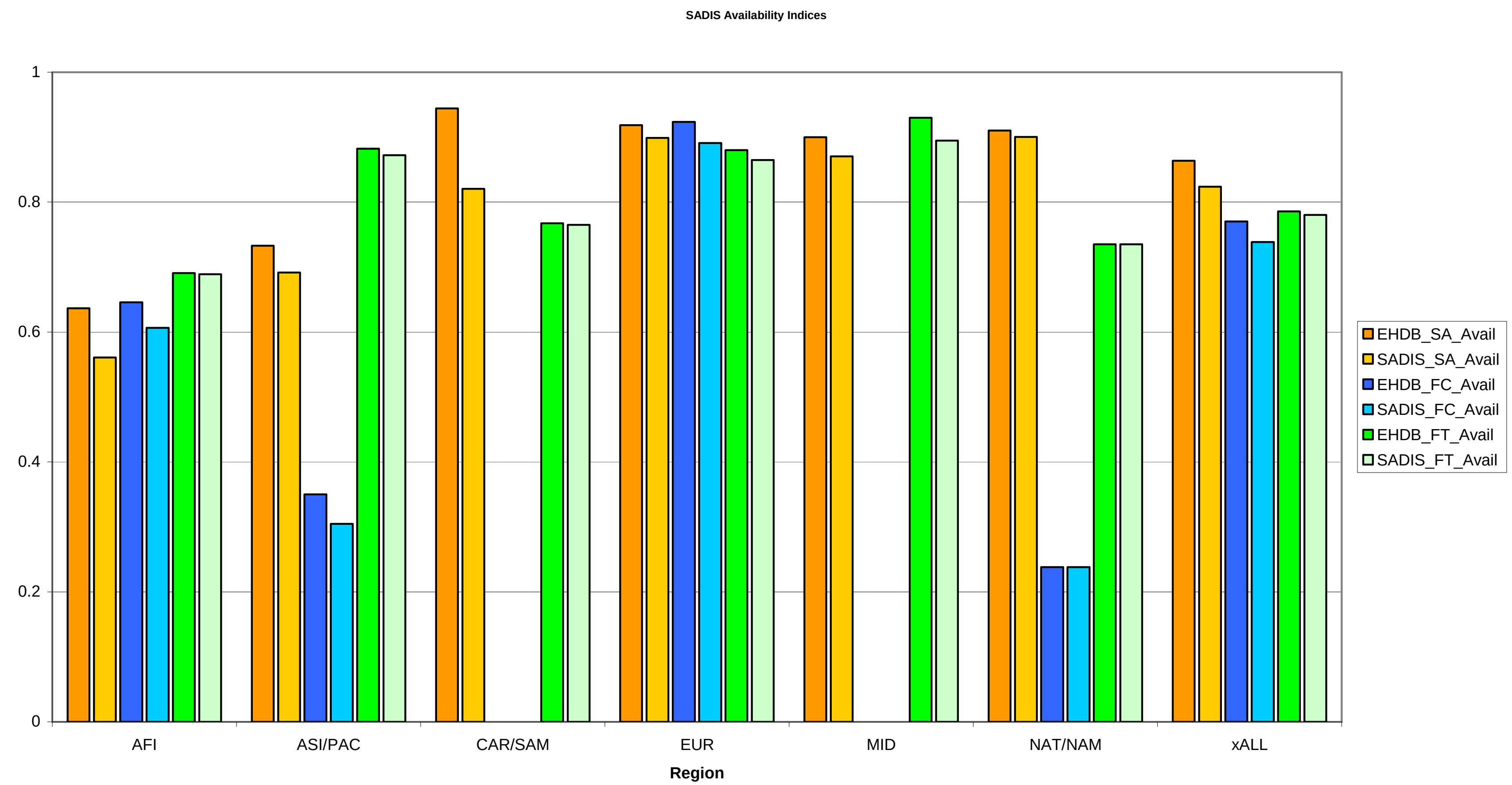


Figure 1: February 2007 SADIS Availability

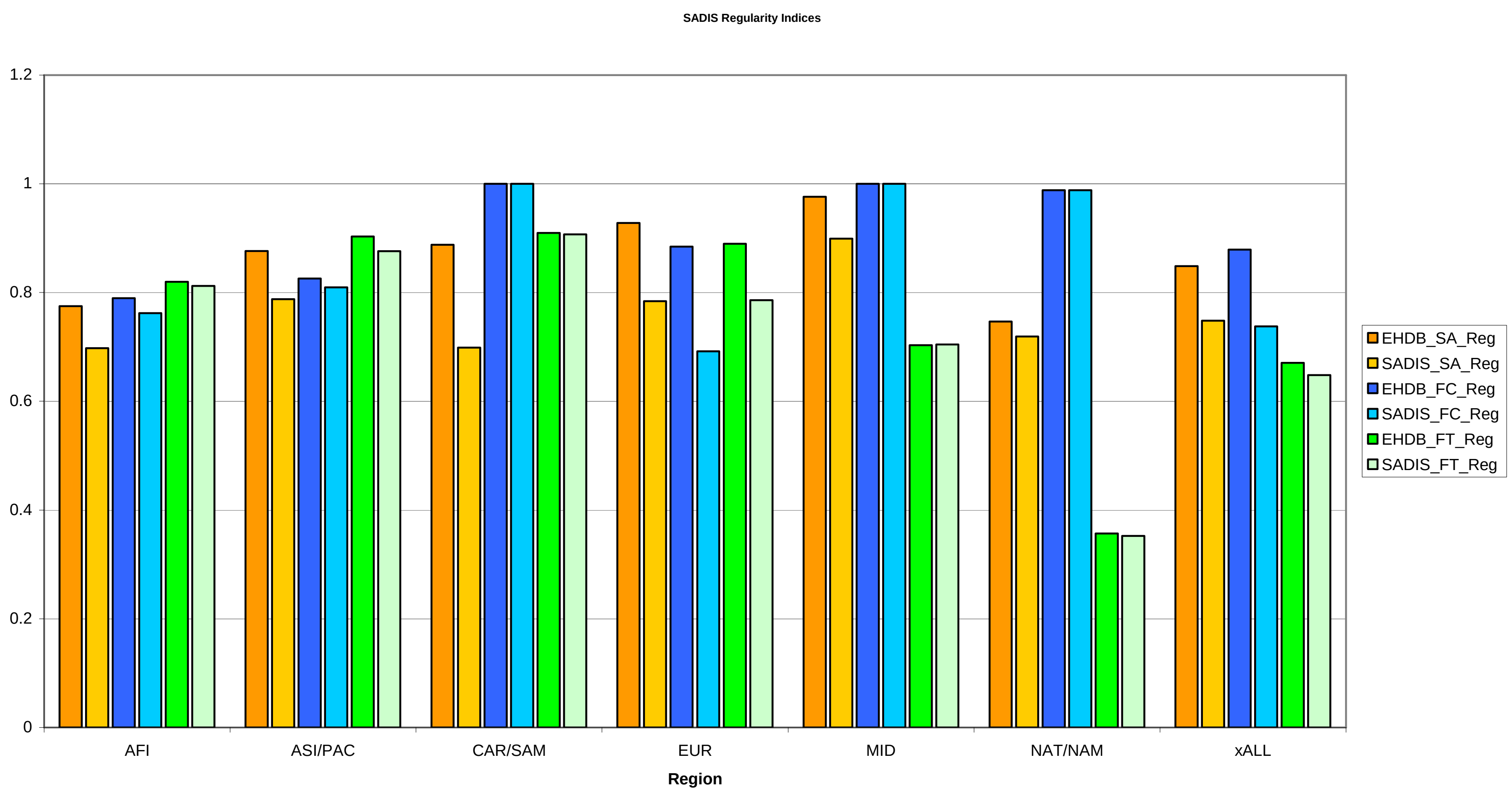


Figure 2: SADIS Regularity February 2007

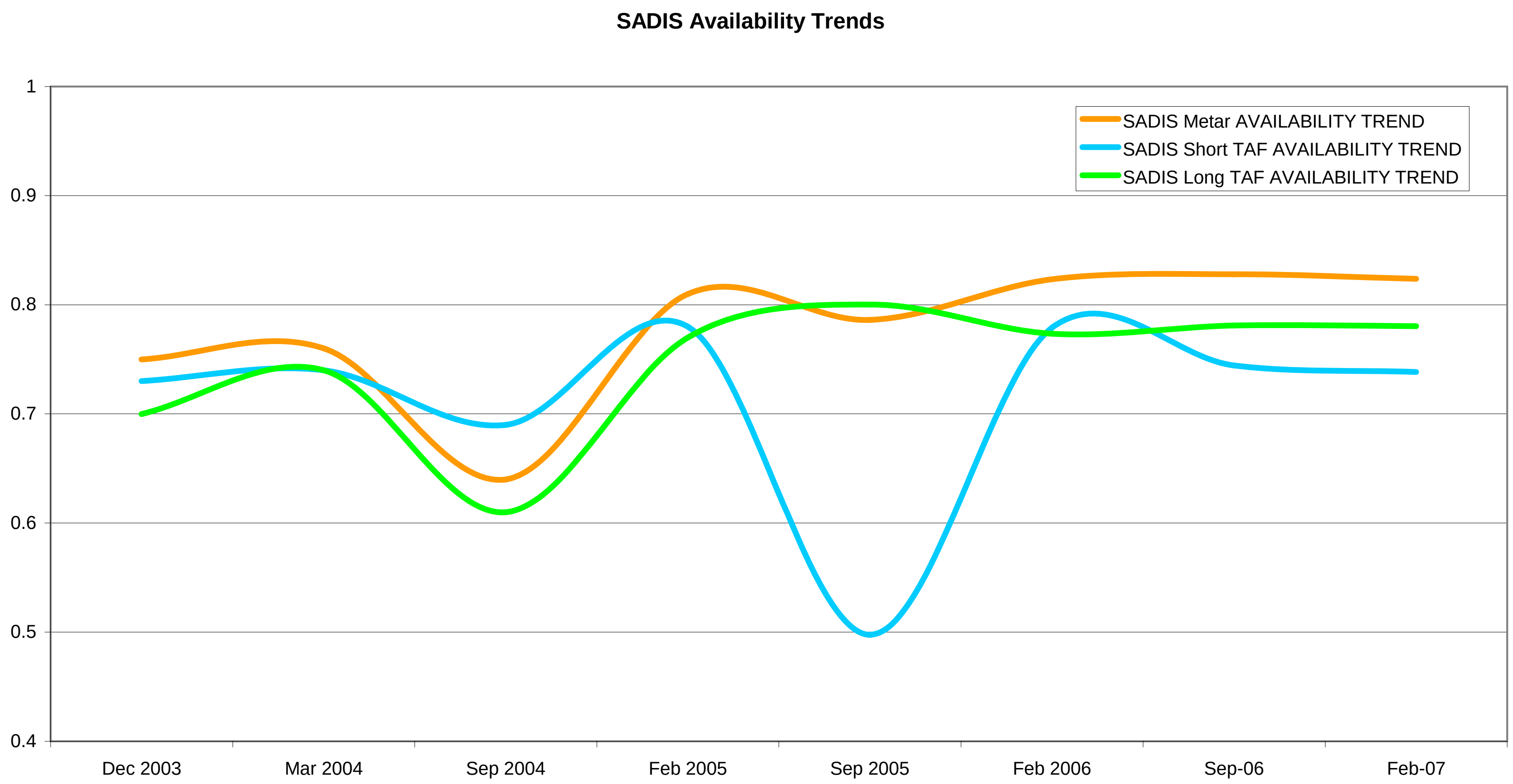


Figure 3: SADIS Availability Trends

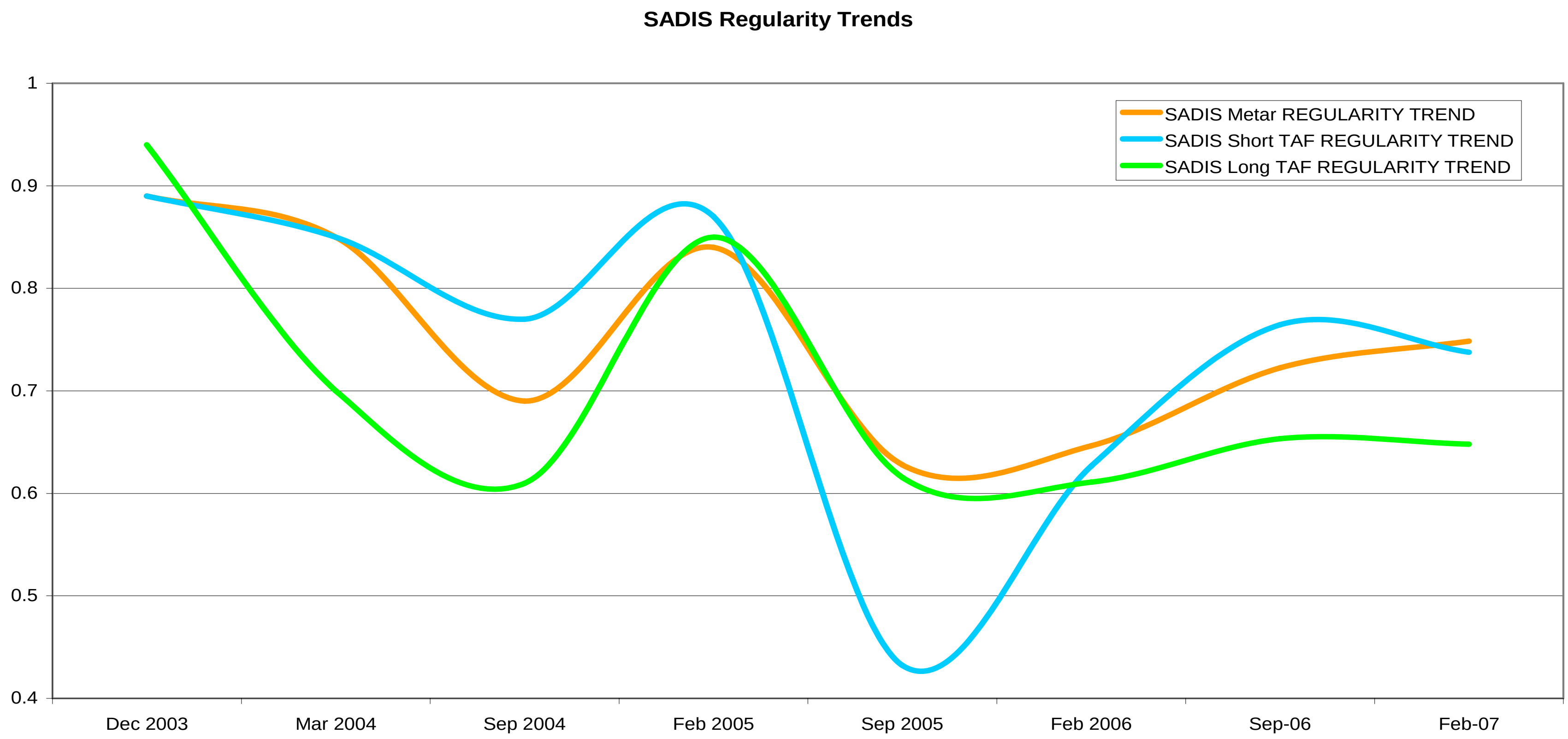


Figure 4: SADIS Regularity Trends

PERFORMANCE INDICES FOR SCHEDULED OPMET DATA RECEIVED AT SINGAPORE RODB

RESULTS - PI Measurements at aerodrome level

The following tables show values of PIs for the ASIA/PAC aerodrome reports between 16 and 31 May 07:

1. METAR (SA) Bulletins

SA Bltns	CCCC	Compliance Index	Regularity Index	Availability Index
SANZ31	NZAA	0.98	1.00	1.00
SANZ31	NZWN	0.98	0.94	1.00
SANZ31	NZCH	0.99	0.94	1.00
SAPK31	OPKC	1.00	0.94	1.00
SAPK31	OPLA	0.99	0.88	1.00
SAPK31	OPNH	0.99	0.81	1.00
SAPK31	OPRN	0.99	0.88	1.00
SAJP31	RJAA	1.00	1.00	1.00
SAJP31	RJBB	1.00	1.00	1.00
SAJP31	RJTT	1.00	1.00	1.00
SAJP31	RJOO	1.00	1.00	1.00
SAJP31	ROAH	1.00	1.00	1.00
SAJP31	RJGG	1.00	1.00	1.00
SAJP32	RJFF	1.00	1.00	1.00
SAJP32	RJCC	1.00	1.00	1.00
SAJP32	RJFK	1.00	1.00	1.00
SAJP32	RJFU	1.00	1.00	1.00
SAJP32	RJCH	1.00	1.00	1.00
SAJP32	RJOA	1.00	1.00	1.00
SAJP32	RJFT	1.00	1.00	1.00
SAJP32	RJSN	1.00	1.00	1.00
SAJP32	RJFO	1.00	1.00	1.00
SAJP32	RJOB	1.00	1.00	1.00
SAJP32	RJSS	1.00	1.00	1.00
SAJP32	RJOT	1.00	1.00	1.00
SAKO31	RKSI	1.00	1.00	1.00
SAKO31	RKSS	1.00	1.00	1.00
SAKO31	RKPC	1.00	1.00	1.00
SAKO31	RKPK	1.00	1.00	1.00
SAKO31	RKTU	1.00	1.00	1.00
SAKO31	RKNY	1.00	1.00	1.00
SAKO31	RKTN	1.00	1.00	1.00
SAAE31	VTBS	1.00	1.00	1.00
SAAE31	VTBD	0.99	1.00	1.00
SAAE31	VTCC	0.98	0.81	1.00
SAAE31	VTBU	0.89	0.81	1.00
SAAE31	VTSS	0.99	0.94	1.00
SAAE31	VTSP	0.95	0.94	1.00

SA Bltns	CCCC	Compliance Index	Regularity Index	Availability Index
SAAE31	VLVT	0.88	0.94	1.00
SAAE31	VYYY	0.80	0.56	1.00
SAAE31	VVTS	0.99	0.94	1.00
SAAE31	VVNB	1.00	0.81	1.00
SAAE31	VDPP	0.65	0.81	1.00
SAAE31	VVDN	0.98	0.75	1.00
SAAE31	VYMD	0.51	1.00	1.00
SAAE31	VDSR	1.00	0.81	1.00
SAIN31	VAAH	0.90	0.88	1.00
SAIN31	VABB	0.95	1.00	1.00
SAIN31	VANP	0.92	0.88	1.00
SAIN31	VOHY	0.75	1.00	1.00
SAIN31	VOMM	0.99	1.00	1.00
SAIN31	VOTR	0.76	0.75	1.00
SAIN31	VOTV	0.62	1.00	1.00
SAIN32	VIDP	0.88	0.63	1.00
SAIN32	VILK	0.91	0.69	1.00
SAIN32	VIAR	0.78	0.81	1.00
SAIN32	VIBN	0.62	0.81	1.00
SAIN32	VIJP	0.68	0.81	1.00
SAIN33	VECC	0.88	0.88	1.00
SAIN33	VEPT	0.40	0.94	1.00
SAIN33	VGEG	0.77	0.81	1.00
SAIN33	VGZR	0.71	0.69	1.00
SAIN33	VNKT	0.70	0.50	1.00
SAHK31	VHHH	1.00	1.00	1.00
SAHK31	RCTP	1.00	1.00	1.00
SAHK31	RCKH	1.00	0.94	1.00
SAHK31	RCSS	1.00	1.00	1.00
SAHK31	VMMC	1.00	1.00	1.00
SAHK31	RPLL	0.99	0.88	1.00
SAHK31	RPVM	0.89	0.63	1.00
SAHK31	RPMD	1.00	0.88	1.00
SAHK31	RPLB	0.90	1.00	1.00
SAHK31	RPLI	1.00	0.94	1.00
SAHK31	RPMZ	1.00	0.94	1.00
SAID31	WIII	1.00	0.90	1.00
SAID31	WIHH	0.65	0.88	1.00
SAID31	WIMM	0.91	0.94	1.00
SAID31	WAAA	0.84	0.63	1.00
SAID31	WADD	0.86	0.94	1.00
SAID31	WARR	0.47	1.00	1.00
SAID31	WABB	0.06	1.00	0.44
SAID31	WIDD	0.28	0.75	0.88
SAID32	WIPT	0.32	0.94	1.00
SAID32	WIPP	0.87	0.81	1.00
SAID32	WIBB	0.00	NA	0.00
SAID32	WAOO	0.05	NA	0.31
SAID32	WALL	0.58	0.94	1.00

SA Bltns	CCCC	Compliance Index	Regularity Index	Availability Index
SAID32	WAMM	0.00	NA	0.00
SAID32	WIPK	0.11	NA	0.75
SAID33	WARS	0.21	NA	1.00
SAID33	WARJ	0.38	NA	1.00
SAID33	WARQ	0.22	NA	0.81
SAID33	WICC	0.19	NA	1.00
SAMS31	WBGG	0.99	1.00	1.00
SAMS31	WBKK	1.00	1.00	1.00
SAMS31	WBSB	1.00	0.94	1.00
SAMS31	WMKK	1.00	1.00	1.00
SAMS31	WMKP	1.00	1.00	1.00
SAMS31	WSSL	1.00	1.00	1.00
SAMS31	WSSS	1.00	1.00	1.00
SAMS38	WBGB	0.99	1.00	1.00
SAMS38	WBGR	0.97	0.94	1.00
SAMS38	WBGS	0.98	0.94	1.00
SAMS38	WBKL	0.97	0.94	1.00
SAMS38	WBKS	0.98	1.00	1.00
SAMS38	WBKW	0.97	0.88	1.00
SAMS38	WMKD	0.98	1.00	1.00
SAMS38	WMKL	0.96	0.88	1.00
SAMS38	WMKM	0.98	0.94	1.00
SANG31	AYPY	0.11	NA	0.56
SANG31	AYWK	0.04	NA	0.44
SANG31	AYVN	0.07	NA	0.50
SANG31	AYNZ	0.00	NA	0.00
SANG31	AYMH	0.00	NA	0.00
SANG31	AYGN	0.02	NA	0.19
SANG31	AYMO	0.03	NA	0.44
SANG31	AGGH	0.74	0.63	0.94
SABN31	OBBI	1.00	0.94	1.00
SABN31	OEDF	1.00	1.00	1.00
SABN31	OEDR	0.97	0.75	1.00
SABN31	OTBD	0.97	0.88	1.00
SABN31	OKBK	1.00	1.00	1.00
SABN32	OMAA	1.00	1.00	1.00
SABN32	OMAL	0.98	1.00	1.00
SABN32	OMDB	0.99	1.00	1.00
SABN32	OMFJ	0.98	0.94	1.00
SABN32	OMRK	0.98	0.88	1.00
SABN32	OMSJ	1.00	0.75	1.00
SABN32	OOMS	1.00	0.94	1.00
SABN32	OOSA	0.90	0.63	1.00
SAAU31	YSSY	1.00	0.94	1.00
SAAU31	YMML	1.00	0.69	1.00
SAAU31	YBBN	1.00	1.00	1.00
SAAU31	YPAD	0.99	0.81	1.00
SAAU31	YBCS	0.98	0.88	1.00
SAAU31	YPDN	1.00	0.88	1.00
SAAU31	YPPH	1.00	0.94	1.00

SA Bltns	CCCC	Compliance Index	Regularity Index	Availability Index
SAAU31	YBAS	1.00	1.00	1.00
SAAU31	YPLM	1.00	0.81	1.00
SAAU31	YBTL	0.98	0.75	1.00
SAAU31	YPCC	0.98	1.00	1.00
SAAU31	YPXM	0.49	0.94	1.00
SAAU31	YPTN	1.00	1.00	1.00
SAAU31	YPKU	1.00	0.94	1.00
SAAU32	YSCB	1.00	1.00	1.00
SAAU32	YBCG	1.00	1.00	1.00
SAAU32	YMAV	0.95	0.56	1.00
SAAU32	YBRK	1.00	1.00	1.00
SAAU32	YPKG	0.99	0.94	1.00
SAAU32	YPPD	0.99	0.94	1.00
SAAU32	YBRM	0.99	0.69	1.00
SAAU32	YSNF	1.00	1.00	1.00
SAAU32	YSDU	0.50	0.94	1.00
SAAU32	YSRI	0.99	0.94	1.00
SAAU32	YWLM	0.99	0.88	1.00
SAAU32	YMLT	0.96	0.94	1.00
SAAU32	YMHB	0.97	0.94	1.00
SAAU32	YPEA	0.99	1.00	1.00
SAAU32	YCIN	1.00	1.00	1.00
SAAU32	YFRT	0.98	1.00	1.00
SAAU32	YPGV	0.98	1.00	1.00
SAAU32	YAMB	0.99	0.94	1.00
SAAU32	YBHM	0.99	1.00	1.00
SAAU32	YBMA	0.99	0.81	1.00
SACI31	ZBAA	1.00	1.00	1.00
SACI31	ZBSJ	0.99	0.88	1.00
SACI31	ZBTJ	1.00	0.94	1.00
SACI31	ZBYN	1.00	0.94	1.00
SACI31	ZGGG	1.00	0.94	1.00
SACI31	ZSHC	1.00	0.94	1.00
SACI31	ZSPD	1.00	0.94	1.00
SACI31	ZSSS	1.00	0.94	1.00
SACI31	ZWWW	1.00	0.94	1.00
SACI31	ZYTL	0.96	0.94	1.00
SACI31	ZYTX	0.99	1.00	1.00
SACI31	ZWSH	0.79	1.00	1.00
SACI32	ZGKL	0.99	1.00	1.00
SACI32	ZGNN	0.98	0.94	1.00
SACI32	ZGOW	0.97	1.00	1.00
SACI32	ZGSZ	1.00	1.00	1.00
SACI32	ZLXY	0.99	1.00	1.00
SACI32	ZMUB	0.96	0.69	1.00
SACI32	ZPPP	1.00	1.00	1.00
SACI32	ZSAM	0.99	0.94	1.00
SACI32	ZSQD	1.00	1.00	1.00
SACI32	ZUUU	1.00	1.00	1.00

SA Bltns	CCCC	Compliance Index	Regularity Index	Availability Index
SACI41	ZBHH	1.00	1.00	1.00
SACI41	ZGHA	0.99	1.00	1.00
SACI41	ZHHH	1.00	0.94	1.00
SACI41	ZJHK	1.00	1.00	1.00
SACI41	ZJSY	1.00	1.00	1.00
SACI41	ZLLL	1.00	1.00	1.00
SACI41	ZSNJ	1.00	0.94	1.00
SACI41	ZSOF	1.00	1.00	1.00
SACI41	ZUCK	1.00	1.00	1.00
SACI41	ZYCC	1.00	1.00	1.00
SACI41	ZYHB	1.00	0.94	1.00
SACI41	ZHCC	1.00	1.00	1.00
SASB31	VCBI	0.98	0.94	1.00
SASB31	VRMM	0.82	0.94	1.00
SATH31	VTPB	0.01	NA	0.06
SATH31	VTCT	0.59	0.81	1.00
SATH31	VTCL	0.17	NA	1.00
SATH31	VTCN	0.16	NA	0.75
SATH31	VTCP	0.19	NA	1.00
SATH31	VTCH	0.14	NA	1.00
SATH31	VTPH	0.48	NA	1.00
SATH31	VTPM	0.01	NA	0.06
SATH31	VTPP	0.64	1.00	1.00
SATH31	VTPO	0.39	NA	1.00
SATH31	VTPT	0.01	NA	0.19
SATH32	VTSB	0.53	1.00	1.00
SATH32	VTSM	0.62	0.88	1.00
SATH32	VTSC	0.16	0.88	1.00
SATH32	VTSK	0.00	NA	0.00
SATH32	VTST	0.17	NA	1.00
SATH32	VTSR	0.03	NA	0.31
SATH32	VTSG	0.20	0.31	1.00
SATH32	VTSF	0.45	1.00	1.00
SATH32	VTSE	0.01	NA	0.25
SATH33	VTUD	0.62	0.60	1.00
SATH33	VTUI	0.21	NA	1.00
SATH33	VTUK	0.63	1.00	1.00
SATH33	VTUU	0.97	1.00	1.00
SATH33	VTUL	0.03	NA	0.56
SATH33	VTUO	0.03	NA	0.25
SATH33	VTUW	0.10	NA	0.88
SATH33	VTUQ	0.00	NA	0.00
SATH33	VTUV	0.13	NA	1.00
SATH33	VTUJ	0.00	NA	0.00
SATH33	VTBO	0.40	0.81	0.88
SAIR31	OIII	1.00	0.88	1.00
SAIR31	OIFM	1.00	1.00	1.00
SAIR31	OISS	1.00	0.94	1.00
SAIR31	OIZH	1.00	0.75	1.00
SAIR31	OIKB	1.00	1.00	1.00

SA Bltns	CCCC	Compliance Index	Regularity Index	Availability Index
SAIR31	OIMM	1.00	0.75	1.00
SAIR31	OIAW	1.00	1.00	1.00
SAIR31	OITT	1.00	1.00	1.00
SAIR31	OIKK	1.00	0.94	1.00
SASD31	OEDF	0.98	0.94	1.00
SASD31	OEDR	0.98	0.88	1.00
SASD31	OEJN	0.98	0.88	1.00
SASD31	OEMA	0.99	1.00	1.00
SASD31	OERK	0.99	0.94	1.00
SASD31	OERY	0.96	0.75	1.00
SASD31	OYSN	0.98	0.94	1.00
SAPS31	NCRG	0.95	0.75	1.00
SAPS31	NFFN	0.97	0.94	1.00
SAPS31	NFSU	0.00	NA	0.00
SAPS31	NGFU	0.65	0.44	1.00
SAPS31	NGTA	0.00	NA	0.00
SAPS31	NIUE	0.84	0.81	1.00
SAPS31	PLCH	0.00	NA	0.00
SAPS32	NFTF	0.84	0.94	1.00
SAPS32	NFTL	0.43	0.81	1.00
SAPS32	NFTV	0.51	0.81	1.00
SAPS32	NLWW	0.40	0.69	0.88
SAPS32	NSAP	0.00	NA	0.00
SAPS32	NSMA	0.00	NA	0.00
SAPS32	NVVV	0.56	0.75	0.88
SAPS32	NVSS	0.17	0.75	0.94

2. Long TAF (FT) Bulletins

FT Bltns	CCCC	Compliance Index	Regularity Index	Availability Index
FTAE31	VTBS	0.98	1.00	1.00
FTAE31	VTBD	0.98	1.00	1.00
FTAE31	VTBU	0.89	1.00	1.00
FTAE31	VTCC	0.98	1.00	1.00
FTAE31	VTSS	0.91	1.00	1.00
FTAE31	VTSP	1.00	1.00	1.00
FTAE31	VGZR	0.95	1.00	1.00
FTAE31	VLVT	0.69	1.00	1.00
FTAE32	VDPP	0.70	1.00	1.00
FTAE32	VVTS	0.97	1.00	1.00
FTAE32	VVNB	0.97	1.00	1.00
FTAE32	VVDN	0.97	1.00	1.00
FTAE32	VYYY	0.92	1.00	1.00
FTAE32	VYMD	0.38	1.00	0.94
FTAE32	VDSR	0.73	1.00	1.00
FTNZ31	NZAA	1.00	1.00	1.00
FTNZ31	NZWN	1.00	1.00	1.00
FTNZ31	NZCH	1.00	1.00	1.00
FTPK31	OPLA	1.00	1.00	1.00
FTPK31	OPNH	1.00	1.00	1.00
FTPK31	OPRN	0.97	1.00	1.00
FTPK31	OPPS	0.91	1.00	1.00
FTPK31	OPKC	1.00	1.00	1.00
FTJP31	RJAA	1.00	1.00	1.00
FTJP31	RJBB	1.00	1.00	1.00
FTJP31	RJTT	1.00	1.00	1.00
FTJP31	RJOO	0.75	1.00	1.00
FTJP31	ROAH	1.00	1.00	1.00
FTJP31	RJCH	0.75	1.00	1.00
FTJP31	RJSS	0.75	1.00	1.00
FTJP32	RJFF	1.00	1.00	1.00
FTJP32	RJGG	1.00	1.00	1.00
FTJP32	RJCC	1.00	1.00	1.00
FTJP32	RJFK	0.75	1.00	1.00
FTJP32	RJSN	0.75	1.00	1.00
FTJP32	RJFU	0.75	1.00	1.00
FTJP32	RJFT	0.75	1.00	1.00
FTJP32	RJOA	0.75	1.00	1.00
FTJP32	RJOB	0.75	1.00	1.00
FTJP32	RJOT	0.75	1.00	1.00
FTJP32	RJFO	0.75	1.00	1.00
FTJP32	RJNT	0.75	1.00	1.00
FTJP32	RJNK	0.75	1.00	1.00
FTJP32	RJFR	0.75	1.00	0.50
FTKO31	RKSI	1.00	1.00	1.00
FTKO31	RKSS	1.00	1.00	1.00
FTKO31	RKPC	1.00	1.00	1.00

FT Bltns	CCCC	Compliance Index	Regularity Index	Availability Index
FTKO31	RKPK	1.00	1.00	1.00
FTKO31	RKTU	1.00	1.00	1.00
FTKO31	RKNY	1.00	1.00	1.00
FTKO31	RKTN	1.00	1.00	1.00
FTIN31	VAAH	1.00	1.00	1.00
FTIN31	VABB	1.00	1.00	1.00
FTIN31	VANP	1.00	1.00	1.00
FTIN31	VECC	1.00	1.00	1.00
FTIN31	VEPT	1.00	1.00	1.00
FTIN31	VIAR	1.00	1.00	1.00
FTIN31	VIBN	1.00	1.00	1.00
FTIN31	VIDP	1.00	1.00	1.00
FTIN31	VIJP	1.00	1.00	1.00
FTIN31	VILK	1.00	1.00	1.00
FTIN32	VCBI	1.00	1.00	1.00
FTIN32	VNKT	0.30	1.00	0.88
FTIN32	VOCI	1.00	1.00	1.00
FTIN32	VOCL	1.00	1.00	1.00
FTIN32	VOHY	1.00	1.00	1.00
FTIN32	VOMM	1.00	1.00	1.00
FTIN32	VOTR	0.75	1.00	1.00
FTIN32	VOTV	1.00	1.00	1.00
FTIN32	VRMM	0.94	1.00	1.00
FTHK31	VHHH	1.00	1.00	1.00
FTHK31	RCTP	1.00	1.00	1.00
FTHK31	RCKH	1.00	1.00	1.00
FTHK31	RCSS	1.00	1.00	1.00
FTHK31	VMMC	1.00	1.00	1.00
FTHK31	RPLL	1.00	1.00	1.00
FTHK31	RPVM	1.00	1.00	1.00
FTHK31	RPLB	1.00	1.00	1.00
FTHK31	RPMD	1.00	1.00	1.00
FTHK31	RPLI	1.00	1.00	1.00
FTHK31	RPMZ	1.00	1.00	1.00
FTSR31	WSSS	1.00	1.00	1.00
FTSR31	WSAP	1.00	1.00	1.00
FTSR31	WAAA	0.80	0.69	0.94
FTSR31	WABB	0.41	0.37	0.88
FTSR31	WADD	0.97	0.85	1.00
FTSR31	WARR	0.98	0.95	1.00
FTSR31	WIHH	0.95	0.85	1.00
FTSR31	WIII	1.00	1.00	1.00
FTSR31	WIMM	1.00	1.00	1.00
FTSR32	WMKJ	1.00	1.00	1.00
FTSR32	WMKK	1.00	1.00	1.00
FTSR32	WMKP	1.00	1.00	1.00
FTSR32	WMSA	1.00	1.00	1.00
FTSR32	WMKL	1.00	1.00	1.00
FTSR32	WMKM	1.00	1.00	1.00

FT Bltns	CCCC	Compliance Index	Regularity Index	Availability Index
FTSR33	WBSB	1.00	1.00	1.00
FTSR33	WBGG	1.00	1.00	1.00
FTSR33	WBKK	1.00	1.00	1.00
FTSR33	WBGB	1.00	1.00	1.00
FTSR33	WBGR	1.00	1.00	1.00
FTSR33	WBGS	1.00	1.00	1.00
FTSR33	WBKL	1.00	1.00	1.00
FTSR33	WBKS	1.00	1.00	1.00
FTSR33	WBKW	1.00	1.00	1.00
FTAU31	YSSY	1.00	1.00	1.00
FTAU31	YPAD	1.00	1.00	1.00
FTAU31	YBBN	1.00	1.00	1.00
FTAU31	YMML	1.00	1.00	1.00
FTAU31	YBCS	0.98	1.00	1.00
FTAU31	YPPH	1.00	1.00	1.00
FTAU31	YPDN	1.00	1.00	1.00
FTAU31	YBAS	1.00	1.00	1.00
FTAU31	YPTN	1.00	1.00	1.00
FTAU31	YPXM	1.00	1.00	1.00
FTAU31	YBRM	1.00	1.00	1.00
FTAU31	YMLT	0.98	1.00	1.00
FTAU31	YMHB	0.95	1.00	1.00
FTAU32	YSCB	0.97	1.00	1.00
FTAU32	YBCG	1.00	1.00	1.00
FTAU32	YMAV	0.92	1.00	1.00
FTAU32	YBRK	1.00	1.00	1.00
FTAU32	YPLM	1.00	1.00	1.00
FTAU32	YPKG	1.00	1.00	1.00
FTAU32	YPPD	1.00	1.00	1.00
FTAU32	YPEA	1.00	1.00	1.00
FTAU32	YPCC	1.00	1.00	1.00
FTAU32	YSRI	0.98	1.00	1.00
FTAU32	YBTL	1.00	1.00	1.00
FTAU32	YWLM	0.98	1.00	1.00
FTAU32	YFRT	0.98	1.00	1.00
FTCI31	ZBAA	1.00	1.00	1.00
FTCI31	ZBSJ	1.00	1.00	1.00
FTCI31	ZBTJ	1.00	1.00	1.00
FTCI31	ZBYN	1.00	1.00	1.00
FTCI31	ZGGG	1.00	1.00	1.00
FTCI31	ZSHC	1.00	1.00	1.00
FTCI31	ZSPD	1.00	1.00	1.00
FTCI31	ZSSS	1.00	1.00	1.00
FTCI31	ZWWW	1.00	1.00	1.00
FTCI31	ZYTL	1.00	1.00	1.00
FTCI31	ZYTX	1.00	1.00	1.00
FTCI31	ZWSH	0.98	1.00	1.00
FTCI32	ZGKL	1.00	1.00	1.00
FTCI32	ZGNN	1.00	1.00	1.00
FTCI32	ZGOW	1.00	1.00	1.00

FT Bltns	CCCC	Compliance Index	Regularity Index	Availability Index
FTCI32	ZGSZ	1.00	1.00	1.00
FTCI32	ZLXY	1.00	1.00	1.00
FTCI32	ZMUB	1.00	1.00	1.00
FTCI32	ZPPP	1.00	1.00	1.00
FTCI32	ZSAM	1.00	1.00	1.00
FTCI32	ZSQD	1.00	1.00	1.00
FTCI32	ZUUU	1.00	1.00	1.00
FTCI41	ZBHH	1.00	1.00	1.00
FTCI41	ZGHA	1.00	1.00	1.00
FTCI41	ZHHH	1.00	1.00	1.00
FTCI41	ZJHK	1.00	1.00	1.00
FTCI41	ZJSY	1.00	1.00	1.00
FTCI41	ZLLL	1.00	1.00	1.00
FTCI41	ZSNJ	1.00	1.00	1.00
FTCI41	ZSOF	1.00	1.00	1.00
FTCI41	ZUCK	1.00	1.00	1.00
FTCI41	ZYCC	1.00	1.00	1.00
FTCI41	ZYHB	1.00	1.00	1.00
FTCI41	ZHCC	1.00	1.00	1.00
FTTH31	VTCT	0.98	1.00	1.00
FTTH31	VTCL	0.50	1.00	1.00
FTTH31	VTCN	0.50	1.00	1.00
FTTH31	VTCP	0.50	1.00	1.00
FTTH31	VTCH	0.48	1.00	1.00
FTTH31	VTPM	0.50	1.00	1.00
FTTH31	VTPP	0.50	1.00	1.00
FTTH31	VTPT	0.50	1.00	1.00
FTTH31	VTPO	0.50	1.00	1.00
FTTH31	VTPB	0.47	1.00	1.00
FTTH31	VTPH	0.00	NA	0.00
FTTH32	VTSB	0.47	1.00	1.00
FTTH32	VTSM	0.47	1.00	1.00
FTTH32	VTSC	0.52	1.00	1.00
FTTH32	VTSK	0.47	1.00	1.00
FTTH32	VTST	0.44	1.00	1.00
FTTH32	VTSF	0.47	1.00	1.00
FTTH32	VTSG	0.94	1.00	1.00
FTTH32	VTSE	0.47	1.00	1.00
FTTH32	VTSH	0.45	1.00	1.00
FTTH32	VTSR	0.44	1.00	1.00
FTTH33	VTUU	0.92	1.00	1.00
FTTH33	VTUD	0.48	1.00	1.00
FTTH33	VTUI	0.48	1.00	1.00
FTTH33	VTUJ	0.48	1.00	1.00
FTTH33	VTUK	0.48	1.00	1.00
FTTH33	VTUL	0.48	1.00	1.00
FTTH33	VTUO	0.48	1.00	1.00
FTTH33	VTUQ	0.48	1.00	1.00
FTTH33	VTUV	0.48	1.00	1.00

FT Bltns	CCCC	Compliance Index	Regularity Index	Availability Index
FTTH33	VTUW	0.48	1.00	1.00
FTBN31	OBBI	0.98	1.00	1.00
FTBN31	OEDF	1.00	1.00	1.00
FTBN31	OEDR	1.00	1.00	1.00
FTBN31	OTBD	0.94	1.00	1.00
FTBN31	OKBK	1.00	1.00	1.00
FTBN32	OMAA	1.00	1.00	1.00
FTBN32	OMAL	1.00	1.00	1.00
FTBN32	OMDB	1.00	1.00	1.00
FTBN32	OMSJ	1.00	1.00	1.00
FTBN32	OMRK	1.00	1.00	1.00
FTBN32	OMFJ	1.00	1.00	1.00
FTBN32	OOMS	0.94	1.00	1.00
FTBN32	OOSA	0.97	1.00	1.00
FTIR31	OIII	1.00	1.00	1.00
FTIR31	OIFM	1.00	1.00	1.00
FTIR31	OISS	1.00	1.00	1.00
FTIR31	OIZH	1.00	1.00	1.00
FTIR31	OIKB	0.97	1.00	1.00
FTIR31	OIMM	1.00	1.00	1.00
FTIR31	OIAW	0.98	1.00	1.00
FTIR31	OITT	0.95	1.00	1.00
FTIR31	OIKK	1.00	1.00	1.00
FTNG31	AYPY	0.80	1.00	0.94
FTNG31	ANYN	1.00	1.00	1.00
FTNG31	AGGH	1.00	1.00	1.00
FTSD31	OEDF	1.00	1.00	1.00
FTSD31	OEDR	1.00	1.00	1.00
FTSD31	OEJD	1.00	1.00	1.00
FTSD31	OEMA	1.00	1.00	1.00
FTSD31	OERK	1.00	1.00	1.00
FTSD31	OYSN	1.00	1.00	1.00

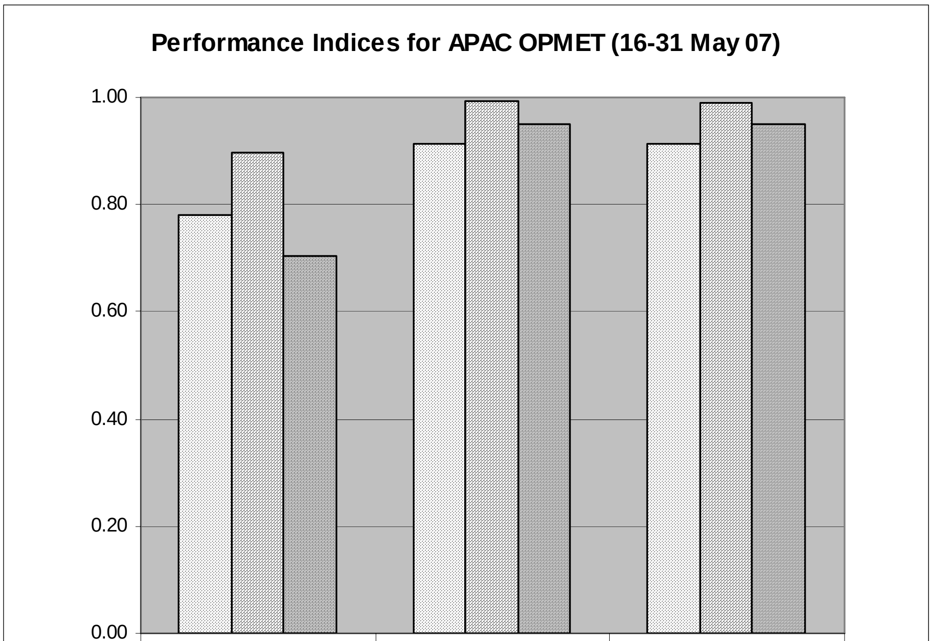
3. Short TAF (FC) Bulletins

FC Bltns	CCCC	Compliance Index	Regularity Index	Availability Index
FCAE31	VTBS	0.95	0.88	1.00
FCAE31	VTBD	0.95	0.88	1.00
FCAE31	VTCC	0.98	0.81	1.00
FCAE31	VTUU	0.83	0.75	1.00
FCAE31	VTSS	0.92	1.00	1.00
FCAE31	VTSP	0.12	NA	0.25
FCAE31	VTCT	0.98	0.81	1.00
FCAU31	YSNF	0.47	0.94	1.00
FCAU31	YSDU	0.43	0.88	1.00
FCAU31	YBHM	0.40	0.75	1.00
FCAU31	YBMA	0.46	0.75	1.00
FCAU31	YAMB	0.39	1.00	1.00
FCAU31	YPGV	0.38	0.63	1.00
FCAU31	WPDL	0.35	0.81	1.00
FCCI31	ZBAA	1.00	1.00	1.00
FCCI31	ZGGG	1.00	1.00	1.00
FCCI31	ZGSZ	1.00	1.00	1.00
FCCI31	ZHHH	0.98	0.88	1.00
FCCI31	ZJSY	1.00	1.00	1.00
FCCI31	ZLLL	0.78	0.75	1.00
FCCI31	ZPPP	1.00	1.00	1.00
FCCI31	ZSPD	0.99	0.94	1.00
FCCI31	ZSSS	1.00	1.00	1.00
FCCI31	ZWWW	0.98	1.00	1.00
FCCI31	ZYTX	0.99	1.00	1.00
FCHK31	VHHH	1.00	1.00	1.00
FCHK31	RCTP	1.00	1.00	1.00
FCHK31	RCKH	1.00	1.00	1.00
FCHK31	RCSS	1.00	1.00	1.00
FCHK31	VMMC	0.99	0.94	1.00
FCHK31	RPLL	1.00	1.00	1.00
FCHK31	RPVM	1.00	1.00	1.00
FCIN31	VAAH	0.44	0.94	1.00
FCIN31	VABB	0.50	1.00	1.00
FCIN31	VECC	0.50	1.00	1.00
FCIN31	VIDP	0.50	1.00	1.00
FCIN31	VOCI	0.48	1.00	1.00
FCNG31	AYNZ	0.24	0.88	0.88
FCNG31	AYMD	0.43	0.88	0.88
FCNG31	AYWK	0.45	0.88	0.88
FCNG31	AYVN	0.38	0.88	0.88
FCNG31	AYGA	0.35	1.00	0.81
FCNG31	AYMH	0.35	1.00	0.81
FCNG31	AYMO	0.38	0.94	0.94
FCNG31	AYDU	0.23	1.00	0.75
FCNG31	AYGN	0.18	1.00	0.63

FC Bltns	CCCC	Compliance Index	Regularity Index	Availability Index
FCNG31	AYHK	0.23	1.00	0.81
FCNG31	AYKV	0.29	1.00	0.88
FCNG31	AYMS	0.19	1.00	0.69
FCNG31	AYTK	0.27	1.00	0.88
FCNG31	AYKI	0.23	1.00	0.69
FCNG32	AGGM	0.26	0.94	0.94
FCNG32	AGGK	0.41	0.94	0.94
FCNG32	AGGL	0.52	0.88	0.94
FCJP31	RJAA	1.00	1.00	1.00
FCJP31	RJBB	1.00	1.00	1.00
FCJP31	RJTT	1.00	1.00	1.00
FCJP31	RJOO	0.75	1.00	1.00
FCJP31	ROAH	1.00	1.00	1.00
FCJP31	RJCH	0.76	1.00	1.00
FCJP31	RJSS	0.75	1.00	1.00
FCJP32	RJFF	1.00	1.00	1.00
FCJP32	RJGG	1.00	1.00	1.00
FCJP32	RJCC	1.00	1.00	1.00
FCJP32	RJFK	0.76	1.00	1.00
FCJP32	RJSN	0.76	1.00	1.00
FCJP32	RJFR	0.45	0.44	0.50
FCJP32	RJFU	0.75	1.00	1.00
FCJP32	RJFT	0.76	1.00	1.00
FCJP32	RJOA	0.75	1.00	1.00
FCJP32	RJOB	0.76	1.00	1.00
FCJP32	RJOT	0.75	1.00	1.00
FCJP32	RJFO	0.76	1.00	1.00
FCJP32	RJNT	0.76	1.00	1.00
FCJP32	RJNK	0.75	1.00	1.00
FCSR31	WSSS	1.00	1.00	1.00
FCSR31	WSAP	1.00	1.00	1.00
FCSR31	WMKK	1.00	1.00	1.00
FCSR31	WIII	1.00	1.00	1.00
FCSR31	WIHH	1.00	0.94	1.00

4. Graphical representation of the results

The graph below shows the average of the three indices during the sixteen day monitoring period (16-31 May 07) :



	Compliance Index	Regularity Index	Availability Index
SA	0.78	0.91	0.91
FT	0.90	0.99	0.99
FC	0.70	0.95	0.95

Implementation Issues Identified by the ASIA/PAC SIGMET Seminar

The ASIA/PAC SIGMET Seminar held from 11 to 13 July 2007 at the ICAO Regional Office, Bangkok, provided feed-back on common issues in regard to implementation of SIGMET provision. The 11th meeting of the CNS/MET Sub-group of APANPIRG agreed that these issues should be brought to the attention of an appropriate ICAO body for consideration and provision of additional guidance to States and/or amendment to SIGMET SARPs as necessary. These issues are summarized as follows:

- In the volcano name in VA SIGMET, “MT” should be optional – not all volcanoes are mountains; the name should be taken from VA advisory;

- For VA SIGMET, additional guidance is necessary for reporting multiple layers, as well as, procedures for reporting more than one eruption within FIR (e.g., one ceasing and one new eruption);

- In VA SIGMET, when the VA cloud crosses the FIR boundary the description of the VA cloud should not be limited to the FIR boundaries because this may be misleading information for pilots;

- In TC SIGMET: align the TC SIGMET format with the changes to the format of TC advisory in Amendment 74 in regard to: the use of 16 compass points for the direction of movement of TC centre; use of “NIL” in the TC name field;

- It was considered necessary to have a provision for including the time of forecast: FCST [nnnnZ];

- Enable the use of “SFC” in reporting layer, i.e., SFC/FLnnn;

- Reporting of more than one area in the FIR affected by the same meteorological phenomenon – current provision require separate SIGMET. This was considered not efficient and creating additional work load, as well as information load on systems, such as VOLMET. It was proposed to use “AND” which would enable the description of two geographical areas for the same phenomenon, e.g., TS;

- It was requested that the use of sequence numbers be clarified. The SIGMET Guide currently recommends that separate SIGMETs should be issued for different phenomena affecting the same FIR, and for keeping more than one SIGMETs at a time valid for the FIR concerned, different series of sequence number could be used, e.g. series A1, A2, … for “phenomenon A” and B1, B2, … for “phenomenon B”. However, Annex 3 currently specifies that “The sequence number referred to in the template in Table A6-1 shall correspond with the number of SIGMET messages issued for the flight information region since 0001 UTC on the day concerned. Separate series of sequence numbers shall be used for “SIGMET” and “SIGMET SST” messages”. It therefore appears that the current Annex 3 provisions do not expect separate series of sequence numbers for different phenomenon affecting the same FIR. It is also unclear whether separate series of sequence numbers should be used for WS, WC and WA SIGMETs;

- It was requested that the examples provided in Annex 3, Appendix 6, Table A6-1 should encompass more “difficult” cases;

- The participants emphasized that training events like the ASIA/PAC SIGMET Seminar were extremely useful and necessary for the Region. It was suggested that they should be organized every 2 to 3 years in order to assist States in the implementation of the ICAO provisions.

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INTERNATIONAL CIVIL AVIATION ORGANIZATION

ASIA/PACIFIC REGIONAL SIGMET GUIDE

FOURTH EDITION — JULY 2007

RECORD OF AMENDMENTS AND CORRIGENDA

Amendments			
No.	Date of issue	Date entered	Entered by

Corrigenda			
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PART 1. INTRODUCTION

1.1 General

1.1.1 The main purpose of this document is to provide guidance for standardization and harmonization of the procedures and formats related to the aeronautical meteorological warnings for hazardous en-route meteorological phenomena, known as SIGMET information. The guidance is complementary to the Annex 3 standards and recommended practices regarding SIGMET and to the SIGMET related provisions of the ASIA/PAC Basic ANP and FASID, ICAO Doc 9673.

1.1.2 ICAO provisions concerning the issuance and dissemination of SIGMET information are contained in:

- Annex 3 - *Meteorological Service for International Air Navigation*, Part I, Chapter 3, 3.4 – 3.7, Chapter 7, 7.1, and Part II, Appendix 6;
- ASIA/PAC Basic ANP, Part VI, and ASIA/PAC FASID Table MET 1B, MET 3A and MET 3B;
- Annex 11 - *Air Traffic Services*, Chapter 4, 4.2.1 and Chapter 7, 7.1;
- PANS – *Air Traffic Management*, Doc 4444, Chapter 9, 9.1.3.2;
- Regional Supplementary Procedures, Doc 7030, Part 1, 11.2.

Additional guidance on the SIGMET procedures is contained in the *Manual of Aeronautical Meteorological Practice* (Doc 8896), and the *Manual on Coordination between Air Traffic Services, Aeronautical Information Services and Aeronautical Meteorological Services* (Doc 9377).

1.1.3 The SIGMET Guide is intended mainly to assist the MWOs in the Asia/Pacific Region in preparing and disseminating SIGMET information. It provides detailed information on the format of SIGMET messages as specified by Annex 3. The explanations of the format are accompanied by examples based on region-specific meteorological phenomena. The guide also provides information regarding the necessary coordination between the MWOs, the ATS units and the pilots, and their respective responsibilities.

1.1.4 This document is prepared by the ICAO ASIA/PAC Regional Office. It is reviewed and updated regularly in order to be kept in line with the relevant ICAO SARPs and regional procedures. This current version incorporates the changes to SIGMET-related provisions included in Amendment 74 to Annex 3 which was approved by ICAO Council on 21 February 2007.

PART 2. RESPONSIBILITIES AND COORDINATION

2.1 General

2.1.1 SIGMET is warning information, hence it is of highest priority among other types of meteorological information provided to the aviation users. The primary purpose of SIGMET is for in-flight service, which requires timely transmission of the SIGMET messages to pilots by the ATS units and/or through VOLMET and D-VOLMET.

2.1.2 Airlines are the main users of the SIGMET information. They contribute to the effectiveness of the SIGMET service through issuance of special air-reports reported by pilots to the ATS units. Special air-reports are among the most valuable sources of information for the Meteorological Watch Offices (MWO) in the preparation of SIGMET. The ATS units receiving special air-reports should forward them to the associated MWOs without delay.

2.1.3 In view of the foregoing, it should be well understood that the effectiveness of the SIGMET service depends strongly on the level of collaboration between the MWOs, ATS units and pilots. That is why, close coordination between these parties, as well as mutual understanding of their needs and responsibilities, are essential for the successful implementation of the SIGMET service.

2.1.4 For the special cases of SIGMET for volcanic ash and tropical cyclones, the MWOs are provided with advisories from the volcanic ash advisory centres (VAAC), and tropical cyclone advisory centres (TCAC) designated in the Regional ANP.

2.1.5 Another use of SIGMET is for the flight planning. This requires global dissemination of SIGMET through the international OPMET data banks and the satellite broadcasts: ISCS and SADIS. SIGMET should also be distributed to the World Area Forecast Centres (WAFC) London and Washington for use in the preparation of the significant weather (SIGWX) forecasts.

2.1.6 In the next paragraphs, the main responsibilities and coordination links, related to the provision of SIGMET information, are described.

2.2 Meteorological Watch Office - responsibilities and procedures related to SIGMET

2.2.1 SIGMET information should be issued by the meteorological watch offices (MWO) in order to provide timely warning for occurrence or expected occurrence of specified en-route weather phenomena, affecting the safety of the flight operations in the MWO’s area of responsibility (AOR). SIGMET provides information concerning the location, extent, intensity and expected evolution of the specified phenomena.

2.2.2 Information about the provision of SIGMET service, including details on the designated MWO(s), should be included in the State’s Aeronautical Information Publication (AIP) as specified in Annex 15, Aeronautical Information Service, Appendix 1, GEN 3.5.8.

2.2.3 All designated MWOs in ASIA/PAC Region are listed in the FASID Table MET 1B of the ASIA/PAC FASID, which is reproduced as Appendix A to this Guide.

2.2.4 If, for some reason, a State is not able to meet its obligations for establishing MWO(s) and for provision of SIGMET for the FIR(s) or control area(s) the State is providing air traffic services, arrangements should be made between the meteorological authorities of the States concerned, that another

MWO takes over these responsibilities for certain period of time. Such delegation of responsibilities should be notified by a NOTAM and a letter to the ICAO Regional Office.

2.2.5 Since the MWO is normally not a separate administrative unit, but part of the functions of an aerodrome meteorological office or other meteorological office, the meteorological authority concerned should ensure that the MWO obligations and responsibilities are clearly defined and assigned to the unit designated to serve as MWO. Corresponding operational procedures should be established and the meteorological staff should be trained accordingly.

2.2.6 In preparing SIGMET information MWOs should follow strictly the format determined in Annex 3 (detailed format description is provided in Appendix 6, Table A6-1 of Annex 3). SIGMET should be issued only for those weather phenomena listed in Annex 3 and only when specified criteria for their intensity and spatial extent are met.

Note: MWOs should not issue SIGMET for weather phenomena of lower intensity or such of transient nature or smaller scale, which do not affect significantly the flight safety and their transmission to users may lead to unnecessary precautionary measures.

2.2.7 The MWOs should be adequately equipped in order to be able to identify, analyze and forecast (to the extent required) those phenomena for which SIGMET is required. The MWO should make use of all available sources of information, such as special air-reports, information from meteorological satellites and weather radars.

2.2.8 On receipt of a special air-report from the associated ACC or FIC, the MWO should:

a) issue SIGMET information based on the special-air report; or

b) send the special air-report for on-ward transmission in case that the issuance of SIGMET information is not warranted (e.g., the phenomenon concerned is of transient nature).

2.2.9 Appropriate telecommunication means should be available at the MWO in order to ensure timely dissemination of SIGMET according to a dissemination scheme, which should include transmission to:

- Local ATS users;

- Aeronautical MET offices within its AOR, where SIGMET is required for briefing and/or flight documentation;

- Other MWOs concerned (it should be ensured that SIGMET is sent to all MWOs whose AORs are, at least partly, within the 1800 km (1000 NM) range from the observed phenomenon);

- Centres designated for transmission of VOLMET or D-VOLMET where SIGMET is required for those transmissions;

- Responsible ROBEX centre and Regional OPMET Data Bank (it should be arranged that through the ROBEX scheme SIGMETs are sent to the designated OPMET data banks in the other ICAO regions, to the WAFCs and to the SADIS and ISCS providers);

- Responsible TCAC or VAAC according to FASID Tables MET 3A and MET 3B.

2.2.10 In issuing SIGMET for tropical cyclones or volcanic ash, the MWOs should include as appropriate the advisory information received from the responsible TCAC or VAAC. In addition to the information received from the TCAC and VAAC the MWOs may use the available complementary information from other reliable sources. In such a case the responsibility for this additional information would lie completely on the MWO concerned.

2.3 Responsibilities of ATS units

2.3.1 Close coordination should be established between the MWO and the corresponding ATS unit (ACC or FIC) and arrangements should be in place to ensure:

- receipt without delay and display at the relevant ATS units of SIGMET issued by the associated MWO;

- receipt and display at the ATS unit of SIGMETs issued by MWOs responsible for the adjacent FIRs/ACCs if these SIGMETs are required according to p. 2.3.4 below, (within 1800 km (1000 NM) range from the observed phenomenon); and

- transmission without delay by the ATS unit of special air-reports received through voice communication to the associated MWO.

2.3.2 SIGMET information should be transmitted to aircraft with the least possible delay on the initiative of the responsible ATS unit, by the preferred method of direct transmission followed by acknowledgement or by a general call when the number of aircraft would render the preferred method impracticable.

2.3.3 SIGMET information transmitted to aircraft-in-flight should cover a portion of the route up to two hours flying time ahead of the aircraft. SIGMET should be transmitted only during the time corresponding to their period of validity (p. 3.4.2.3 refers).

2.3.4 Air traffic controllers should ascertain whether any of the currently valid SIGMETs may affect any of the aircraft they are controlling, either within or outside the FIR/CTA boundary, up to a distance of 1000 NM (1800 KM), which corresponds to two hours flying time ahead of the current position of the aircraft. If this is the case, the controllers should at their own initiative transmit the SIGMET promptly to the aircraft-in-flight likely to be affected. If necessary, the controller should pass to the aircraft available SIGMETs issued for the adjacent FIR/CTA, which the aircraft will be entering, if relevant to the expected flight route.

2.3.5 The ATS units concerned should also transmit to aircraft-in-flight the special air reports received, for which SIGMET has not been issued. Once a SIGMET for the weather phenomenon reported in the special air report is made available this obligation of the ATS unit expires.

2.4 Responsibilities of pilots

2.4.1 Timely issuance of SIGMET information is largely dependant on the prompt receipt by MWOs of special air-reports. That is why, it is essential that pilots prepare and transmit such reports to the ATS units whenever any of the specified en-route conditions are encountered or observed.

2.4.2 It should be emphasized that, even when automatic dependent surveillance (ADS) is being used for routine air-reports, pilots should continue to make special air-reports.

2.5 Coordination between MWOs and the TCACs and VAACs

2.5.1 Amongst the phenomena for which SIGMET information is required, the volcanic ash clouds and tropical cyclones are of particular importance for the planning of long-haul flights.

2.5.2 Since the identification, analysis and forecasting of volcanic ash and tropical cyclones requires considerable technical and human resource, normally not available at each MWO, the Volcanic Ash Advisory Centres (VAAC) and Tropical Cyclone Advisory Centres (TCAC) have been designated to provided VA and TC advisories to the users and assist the MWOs in the preparation of the forecast part of the SIGMETs for those phenomena. Close coordination should be established between the MWO and its responsible TCAC and/or VAAC.

2.5.3 Information regarding the VAACs and TCACs serving ASIA/PAC Region with their corresponding areas of responsibility and lists of MWOs and ACCs to which advisories are to be sent is provided in FASID Tables MET 3A and MET 3B of the ASIA/PAC FASID. These tables are reproduced in Appendix B and Appendix C to this Guide.

2.5.4 TC and VA advisories are required for global exchange through the satellite distribution systems, SADIS and ISCS. They are used by the operators during the preflight planning. Nevertheless, it should be emphasized that SIGMET information is still of higher operational status and is required especially for in-flight re-planning. SIGMETs should be transmitted to aircraft-in-flight through voice communication or VOLMET or D-VOLMET thus providing vital information for making in-flight decisions regarding large-scale route deviations due to volcanic ash clouds or tropical cyclones.

PART 3. PROCEDURES FOR PREPARATION OF SIGMET INFORMATION

3.1 General

3.1.1 SIGMET information is prepared in abbreviated plain language using approved ICAO abbreviations, a limited number of non-abbreviated words, geographical names and numerical values of self-explanatory nature. All abbreviations and words to be used in SIGMET are given in Appendix D.

3.1.2 The increasing use of automated systems for handling the MET information by the aviation users makes it essential that all types of OPMET information, including SIGMET, are prepared and transmitted in the prescribed standardized formats. Therefore, the structure and format of the SIGMET message, as specified in Annex 3, Part II, Appendix 6, which provides detailed information regarding the content and order of elements in the SIGMET message, should be followed strictly by the MWOs.

3.1.3 SIGMET is intended for transmission to aircraft in flight either by ATC or by VOLMET or D-VOLMET. Therefore, SIGMET messages should be kept consise and clear without additional descriptive text other than the prescribed in Annex 3.

3.1.4 After the issuance of a SIGMET the MWO should maintain watch over the evolution of the phenomenon for which the SIGMET has been issued and issue updated SIGMET when necessary. The TC and VA SIGMET should be updated at least every 6 hours.

3.1.5 SIGMET should be promptly cancelled when the phenomenon is no longer occurring or no longer expected to occur in the MWO's area of responsibility. The SIGMET is understood to cancel itself automatically at the end of its validity period. If the phenomenon persists a new SIGMET message for a further period of validity should be issued.

3.2 Types of SIGMET

3.2.1 Although Annex 3 provides one general SIGMET format, which encompasses all weather phenomena, it is convenient when describing the structure and format of the messages to distinguish between three types of SIGMET, as follows:

- SIGMET for en-route weather phenomena other than VA and TC (this includes: TS, CB, TURB, ICE, MTW, DS and SS); this SIGMET will be referred as WS SIGMET;
- SIGMET for volcanic ash, which will hereafter be denoted as VA SIGMET or WV SIGMET; and
- SIGMET for tropical cyclones, which will hereafter be denoted as TC SIGMET or WC SIGMET.

3.2.2 The three types of SIGMET can be identified by the data type designator included in the WMO abbreviated heading of the SIGMET message, as explained below.

3.3 Structure of the SIGMET message

3.3.1 A SIGMET message consists of:

- ***WMO heading*** – all SIGMETs are preceded by an appropriate WMO heading;

- ***First line***, containing location indicators of the respective ATS unit and MWO, sequential number and period of validity;
- ***SIGMET main body***, containing information concerning the observed or forecast weather phenomenon for which the SIGMET is issued together with its expected evolution within the period of validity;

3.3.2 The first two parts of the SIGMET message are common for all types of SIGMET. The format and content of the third part is different; that is why, in the following paragraphs the meteorological part of the SIGMET message is described separately for the three types of SIGMET.

3.4 Format of SIGMET

Note: In the following text, square brackets - [ ] - are used to indicate an optional or conditional element, and angled brackets - < > - for symbolic representation of a variable element, which in a real SIGMET accepts concrete numerical value.

3.4.1 <u>WMO Header</u>

$T_1T_2A_1A_2$ii CCCC YYGGgg [CCx]

3.4.1.1 The group **$T_1T_2A_1A_2$ii** is the bulletin identification for the SIGMET message. It is constructed in the following way:

T_1T_2	Data type designator	**WS** – for SIGMET for meteorological phenomena other than volcanic ash cloud or tropical cyclone **WC** – for SIGMET for tropical cyclone **WV** – for SIGMET for volcanic ash
A_1A_2	Country or territory designators	Assigned according to Table C1, Part II of Manual on the Global Telecommunication System, Vol I – Global Aspects (WMO - No. 386)
Ii	Bulletin number	Assigned on national level according to p 2.3.2.2, Part II of Manual on the Global Telecommunication System, Vol I – Global Aspects (WMO - No. 386)

3.4.1.2 **CCCC** is the ICAO location indicator of the communication centre disseminating the message (could be the same as the MWO location indicator).

3.4.1.3 **YYGGgg** is the date/time group, where YY is the date and GGgg is the time of transmission of the SIGMET in hours and minutes UTC (normally this time is assigned by the disseminating (AFTN) centre).

3.4.1.4 The group **CCx** should be used only when issuing a correction to a SIGMET which had already been transmitted. The third letter "x" takes the value A for the first correction, B for the second correction, etc.

Examples:

WSTH31 VTBS 121200
WVJP01 RJTD 010230
WCNG21 AYPY 100600 CCA

3.4.2 <u>First line of SIGMET</u>

CCCC SIGMET [nn]n VALID YYGGgg/YYGGgg CCCC-

3.4.2.1 The meaning of the groups in the first line of the SIGMET is as follows:

CCCC	ICAO location indicator of the ATS unit serving the FIR or CTA to which the SIGMET refers
SIGMET	Message identifier
[nn]n	Daily sequence number (see p.3.4.2.2)
VALID	Period of validity indicator
YYGGgg/YYGGgg	Validity period of the SIGMET given by date/time group of the beginning and date/time group of the end of the period (see p.3.4.2.3)
CCCC	ICAO location indicator of the issuing MWO
-	**hyphen** to separate the preamble from the text

3.4.2.2 The numbering of SIGMETs starts every day at 0001 UTC. The sequence number should consist of up to three symbols and may be a combination of letters and numbers, such as:

- 1, 2, …
- 01, 02, …
- A01, A02, …

Examples:

RPMM SIGMET 3 VALID 121100/121700 RPLL-
WSJC SIGMET A04 VALID 202230/210430 WSSS-

Note 1: No other combinations should be used, like "CHARLIE 05" or "NR7".

Note 2: Some States in the Region, like Australia, use more than 3 symbols, e.g., two letters and two figures. In the case of Australia this difference is due to the fact that more than one MWO serves one FIR and 4 characters are used to identify the part of the FIR for which the SIGMET is issued.

Note 3: Correct numbering of SIGMET is very important since the number is used for reference in communication between ATC and pilots and in VOLMET and D-VOLMET.

3.4.2.3 The following considerations should be taken into account when determining the validity period:

- The period of validity of a WS SIGMET should be not more than 4 hours;
- The period of validity of a WC or WV SIGMET should be up to 6 hours;
- In case of a SIGMET for an observed phenomenon, the filing time (date/time group in the WMO header) should be the same or very close to the time in the date/time group indicating the start of the SIGMET validity period;
- When the SIGMET is issued for a forecast phenomenon:
  - o the beginning of validity period should be the time of the expected commencement (occurrence) of the phenomenon in the MWO area of responsibility;
  - o the time of issuance of the SIGMET should be not more than 4 hours before the start of validity period (i.e., expected time of occurrence of the

phenomenon); for TC and VA SIGMET the lead time should be up to 12 hours.

3.4.2.4 The period of validity is that period during which the SIGMET information is valid for transmission to aircraft in flight.

Examples:

1. SIGMET for an observed phenomenon:

WSTH31 VTBS 241120
VTBB SIGMET 3 VALID 241120/241500 VTBS–

2. SIGMET for a forecast phenomenon (expected time of occurrence 1530)

WSSG31 WSSS 311130
WSJC SIGMET 1 VALID 1530/1930 WSSS-

3.4.3 ***Format of the meteorological part of SIGMET messages for weather phenomena other than TC and VA***

3.4.3.1 The meteorological part of a SIGMET for weather phenomena consists of seven elements as shown in the table below.

Start of the second line of the message

1	**2**	**3**	**4**	**5**
Name of the FIR/UIR or CTA	Description of the phenomenon	Observed or forecast	Location	Level
<CCCC> <name> FIR [CTA]	<Phenomenon>	OBS [AT <GGgg>Z] FCST	Geographical location of the phenomenon given by coordinates, or geographical objects, or location indicators	FL<nnn> or FL<nnn/nnn> or [TOP [ABV or BLW]] FL<nnn>

6	7
Movement or expected movement	Changes in intensity
MOV <direction, speed>KMH[KT] or STNR	INTSF or WKN or NC

3.4.3.1.1 Name of the FIR/UIR or CTA

CCCC <name> FIR[/UIR]
or
CCCC <name> CTA

The ICAO location indicator and the name of the FIR/CTA is given followed by the appropriate abbreviation: FIR, FIR/UIR or CTA.

Examples:

VTBB BANGKOK FIR

3.4.3.1.2 Phenomenon

The phenomenon description consists of a qualifier and a phenomenon abbreviation. SIGMET should be issued only for the following phenomena observes or forecast at cruising levels (irrespective of altitude):

- thunderstorms – if they are OBSC, EMBD, FRQ or SQL with or without hail;
- turbulence – only SEV
- icing – only SEV with or without FZRA
- mountain waves – only SEV
- dust storm – only HVY
- sand storm – only HVY
- radioactive cloud – RDACT CLD

The appropriate abbreviations and combinations, and their meaning are given in Appendix E.

3.4.3.1.3 Indication whether the phenomenon is observed or forecast

OBS [AT <GGgg>Z]
or FCST

The indication whether the phenomenon is observed or forecast is given by using the abbreviations OBS or FCST. OBS is followed by an optional time group in the form AT GGggZ, where GGgg is the time of the observation in hours and minutes UTC. If the exact time of the observation is not known the time is not included. When FCST is used, it is assumed that the time of occurrence or commencement of the phenomenon coincides with the beginning of the period of validity included in the first line of the SIGMET.

Examples:

OBS AT 0140Z
FCST

3.4.3.1.4 Location of the phenomenon

The location of the phenomenon is given with reference to geographical coordinates (latitude and longitude) or with reference to geographical features well known internationally. The MWOs should try to be as specific as possible in reporting the location of the phenomenon and, at the same time, to avoid overwhelming geographical information, which may be difficult to process or perceive.

The following are the most common ways to describe the location of the phenomenon:

- Indication of a part of the FIR with reference to latitude:
  N OF or S OF <Nnn[nn]> or <Snn[nn]>
- Indication of a part of the FIR with reference to longitude:
  E OF or W OF <Ennn[nn]> or <Wnnn[nn]>
- Indication of a part of the FIR with reference to latitude and longitude:
  any combination of the above two cases;
- Location with reference to a **LINE** described with lat/lon of two points;
- With reference to a location with ICAO location abbreviation CCCC (normally, this should be the case of SIGMET based on special air-report in which the reported phenomenon is given with reference to an airport or another object with ICAO location indicator CCCC);
- With reference to geographical features well known internationally.

More details on reporting the location of the phenomenon are given in Appendix 6 to Annex 3 and in Appendix F to this Guide.

3.4.3.1.5 Flight level and extent

FL<nnn>
or FL<nnn/nnn>
or TOP FL<nnn>
or [TOP] ABV FL<nnn>
or [TOP] BLW FL<nnn>

The location or extent of the phenomenon in the vertical is given by one or more of the above abbreviations, as follows:

- reporting single level – **FL<nnn>**
- reporting a layer – **FL<nnn/nnn>**, where the lower level is reported first; this is used particularly in reporting turbulence and icing;
- reporting a level or layer with reference to one FL using ABV or BLW
- reporting the level of the tops of the TS clouds using the abbreviation TOP.

Examples:

EMBD TS … TOP ABV FL340
SEV TURB … FL180/210
SEV ICE … BLW FL150
SEV MTW … FL090

3.4.3.1.6 Movement

MOV <direction> <speed>KMH[KT]
or
STNR

Direction of movement is given with reference to one of the eight points of compass. Speed is given in KMH or KT. The abbreviation STNR is used if no significant movement is expected.

Examples:

MOV NW 30KMH
MOV E 25KT

3.4.3.1.7 Expected changes in intensity

The expected evolution of the phenomenon’s intensity is indicated by one of the following abbreviations:

INTSF – intensifying
WKN – weakening
NC – no change

3.4.4 Structure of the meteorological part of VA SIGMET

3.4.4.1 The general structure of the meteorological part of the SIGMET message is given in the table below:

Start of the second line of the message

1	2			3
FIR/UIR or CTA	Phe nome non	Volcano		Volcanic ash cloud observed or forecast
		Name	Location	
<CCCC> <name> FIR [/UIR][CTA]	VA	[ERUPTION] [MT <name>]	[LOC <lat,lon>]	VA CLD OBS AT <GGgg>Z VA CLD FCST

4			5
Extent of the cloud			Expected movement
Vertical	Horizontal	Position	
FL <nnn/nnn>	[APRX <nnn> KM[NM] BY <nnn> KM[NM]]	[<lat,lon> - <lat,lon> - …]	MOV <direction> <speed>

6	
Volcanic ash cloud forecast at the end of the period of validity	
FCST time	Position
FCST <GGgg>Z	VA CLD APRX <lat,lon> - <lat,lon> - …

3.4.4.2 Name and location of the volcano and/or indicator for VA cloud

VA [ERUPTION] [MT <name>] [LOC <lat,lon>] VA CLD
or
VA CLD

3.4.4.2.1 The description of the volcano injecting volcanic ash consists of the following elements:

- starts with the abbreviation **VA** – volcanic ash;

- the word **ERUPTION** is used when the SIGMET is issued for a known volcanic eruption;
- geographical/location information:
    i. if the name of the volcano is known, it is given by the abbreviation **MT** – mountain, followed by the name;
    e.g., **MT RABAUL**
    ii. location of the volcano is given by the abbreviation **LOC** – location, followed by the latitude and longitude in degrees and minutes;
    e.g., **LOC N3520 E09040**
- this section of the message ends with the abbreviation **VA CLD** – volcanic ash cloud.

3.4.4.2.2 If the FIR is affected by a VA cloud with no information about the volcanic eruption which generated the cloud, only the abbreviation **VA CLD** should be included in the SIGMET.

3.4.4.3 Time of observation or indication of forecast

VA CLD OBS AT <GGgg>Z
or
VA CLD FCST

The time of observation is taken from the source of the observation – satellite image, special air-report, report from a volcanological station, etc. If the VA cloud is not yet observed over the FIR but the volcanic ash advisory received from the responsible VAAC indicates that the cloud is going to affect the FIR within the next 12 hrs, SIGMET should be issued according to paragraph 2.4 above and the abbreviation VA CLD FCST should be used.

Examples:

VA CLD OBS AT 0100Z
VA CLD FCST

3.4.4.4 Level and extent of the volcanic ash cloud

FL<nnn/nnn> [APRX <nnn>KM BY <nnn>KM] [<P1(lat,lon) - P2(lat,lon) - … >]
or
FL<nnn/nnn> [APRX <nnn>NM BY <nnn>NM] [<P1(lat,lon) - P2(lat,lon) - … >]

FL<nnn/nnn>	The layer of the atmosphere where the VA cloud is situated, given by two flight levels from the lower to the upper boundary of the cloud
[APRX <nnn>KM BY <nnn>KM] or [APRX <nnn>NM BY <nnn>NM] or [nnKM WID LINE BTN (nnNM WID LINE BTN]	Approximate horizontal extent of the VA cloud in KM or NM; or along line with defined width (WID)
[<P1(lat,lon) – P2(lat,lon) - … >]	Approximate description of the VA cloud by a number of points given with their geographical coordinates[1]; the points should be separated by hyphen

[1] The format of geographical coordinates reporting in SIGMET is given in Appendix F.

If the VA cloud spreads over more than one FIR, separate SIGMETs should be issued by all MWOs whose FIRs are affected. In such a case, the description of the volcanic ash cloud by each MWO should encompass the part of the cloud, which lies over the MWO's area of responsibility. The MWOs should try and keep the description of the volcanic ash clouds consistent by checking the SIGMET messages received from the neighboring MWOs.

Examples:

FL100/180 APRX 10KM BY 50KM N0100 E09530 – N1215 E11045
FL 150/210 S0530 E09300 – N0100 E09530 – N1215 E11045

3.4.4.5 Movement or expected movement of the VA cloud

MOV <direction> <speed>KMH[KT]
or
STNR

The direction of movement is given by the abbreviation **MOV** – moving, followed by one of the eight points of compass: N, NE, E, SE, S, SW, W, NW. The speed of movement is given in KMH or KT.

Examples:

MOV E 35KMH
MOV SW 20KT
STNR

3.4.4.6 Forecast position of the VA cloud at the end of the validity period of the SIGMET message

FCST <GGgg>Z VA CLD APRX <P1(lat,lon) - P2(lat,lon) - … >

The **GGggZ** group should indicate the end of validity period given in the first line of the SIGMET message. The description of the expected position of the volcanic ash cloud is given by a number of points forming a simplified geometrical approximation of the cloud.

3.4.4.7.2 When the wind direction distribution with height determines that the cloud is spread horizontally into different directions at different height layers the VA cloud may need to be described by more than one layer; the different layers should be indicated by flight levels in the form FL<nnn/nnn>.

3.4.5 Structure of the meteorological part of TC SIGMET

3.4.5.1 The general structure of the meteorological part of the TC SIGMET is given in the table below:

Start of the second line of the message

1	2	3		4
FIR/UIR or CTA	TC name	Observed or forecast		Extent
		Time	Location of TC centre	
<CCCC> <name> FIR [/UIR][CTA]	TC <name>	OBS AT <GGgg>Z [FCST]	<lat,lon>	CB TOP [ABV or BLW] FL<nnn> WI <nnn>KM[NM] OF CENTRE

5	6	7
Expected movement	Intensity change	Forecast of the centre position at the end of the validity period
MOV <direction> <speed>KMH[KT] or STNR	INTSF or WKN or NC	FCST <GGgg>Z TC CENTRE <lat,lon>

3.4.5.2 Name of the tropical cyclone

TC <name>

The description of the tropical cyclone consists of the abbreviation TC followed by the international name of the tropical cyclone given by the corresponding WMO RSMC.

Examples:

TC GLORIA
TC 04B

3.4.5.3 Time of observation or indication of forecast

OBS AT <GGgg>Z
or
FCST

The time in UTC is given in hours and minutes, followed by the indicator Z. Normally, time is taken from own observations or from a TC advisory received from the responsible TCAC. If the TC is not yet observed in the FIR but the tropical cyclone advisory received from the responsible TCAC, or any other TC forecast used by the MWO, indicates that the TC is going to affect the FIR within the next 12 hrs, SIGMET should be issued, according to paragraph 2.4 above, and the abbreviation FCST should be used.

Examples:

OBS AT 2330

3.4.5.4 Location of the TC centre

<location>

The location of the TC centre is given by its lat,lon coordinates in degrees and minutes.

Examples:

N1535 E14230

3.4.5.5 Vertical and horizontal extent of the CB cloud formation around TC centre

CB TOP [ABV or BLW] <FLnnn> WI <nnnKM or nnnNM> OF CENTRE

Examples:

CB TOP ABV FL450 WI 200NM OF CENTRE
CB TOP FL500 WI 250KM OF CENTRE

3.4.5.6 Movement or expected movement

MOV <direction> <speed>KMH[KT]
or
STNR

Direction of movement is given with reference to one of the eight points of compass. Speed is given in KMH or KT. The abbreviation STNR is used if no significant movement is expected.

Examples:

MOV NW 30KMH
MOV E 25KT

3.4.5.7 Intensity change

The expected change of the intensity of the tropical cyclone is indicated by one of the following abbreviations:

INTSF – intensifying
WKN – weakening
NC – no change

3.4.5.8 Forecast location of the TC centre at the end of the validity period of the SIGMET message

FCST <GGgg>Z TC CENTRE <location>

Normally, the time given by GGggZ should be the same as the end of validity period indicated in the first line of the SIGMET message. Since the period of validity is up to 6 hours (normally, 6 hours), this is a 6-hour forecast of the position of the TC centre.

The location of the TC centre is given by its lat, lon coordinates following the general rules of reporting lat, lon information provided in Appendix F to this Guide.

Examples:

FCST 1200Z TC CENTRE N1430 E12800

3.4.6 Cancellation of SIGMET

3.4.6.1 If during the validity period of a SIGMET the phenomenon for which the SIGMET had been issued is no longer occurring or no longer expected, the SIGMET should be cancelled by the issuing MWO. The cancellation is done by issuing same type of SIGMET with the following structure:

- WMO heading with the same data type designator;
- First line that contains as period of validity the remaining time of the original period of validity;
- Second line, which contains the name of the FIR or CTA, the combination CNL SIGMET, followed by the sequential number of the original SIGMET and its validity period.

Examples:

1. Cancellation of a WS or WC SIGMET:

WSXY31 YUSO 101200
YUDD SIGMET 5 VALID 101200/101600 YUSO-
YUDD SHANLON FIR …

Cancellation SIGMET:

WSXY31 YUSO 101430
YUDD SIGMET 6 VALID 101430/101600 YUSO-
YUDD SHANLON FIR CNL SIGMET 5 101200/101600=

2. Cancellation of a VA SIGMET

WVXY31 YUSO 131518
YUDD SIGMET 03 VALID 131515/132115 YUSO-
YUDD SHANLON FIR …

Cancellation SIGMET:

WVXY31 YUSO 132000
YUDD SIGMET 04 VALID 132000/132115 YUSO-
YUDD SHANLON FIR CNL SIGMET 03 13151500/132115=

or, in case that the volcanic ash cloud moves to an adjacent FIR:

WVXY31 YUSO 132000
YUDD SIGMET 04 VALID 132000/132115 YUSO-
YUDD SHANLON FIR CNL SIGMET 03 13151500/132115 VA MOV TO YUDO FIR=

3.5 Dissemination

3.5.1 SIGMET information is part of the operational meteorological (OPMET) information. According to Annex 3 the telecommunication facilities used for the exchange of the operational meteorological information should be the aeronautical fixed service (AFS).

3.5.2 The AFS consists of a terrestrial segment, AFTN or ATN (AMHS), and a satellite segment which comprises the SADIS and ISCS satellite broadcasts provided by the UK and the USA respectively.

3.5.3 Currently, AFTN links should be used by the MWOs to send the SIGMET, as follows:

- to the adjacent MWOs and ACCs[*] using direct AFTN addressing;
- When required for VOLMET or D-VOLMET, SIGMET should be sent to the relevant centre providing the VOLMET service;
- SIGMET should be sent to all regional OPMET Data Banks (RODB);
- It should be arranged that SIGMET is relayed to the SADIS and ISCS providers for satellite dissemination, as well as to the WAFCs London and Washington, either through the ROBEX scheme, or directly by the issuing MWO;
- SIGMET for volcanic ash should be disseminated to the responsible VAAC.

3.5.4 Through SADIS and ISCS, SIGMET is disseminated to all authorised users . In this way, SIGMET is available on a global basis, meeting the aeronautical requirements.

[*] *Note: For this dissemination it is required that SIGMET is available at the ACCs for transmission to aircraft in flight for the route ahead up to a distance corresponding to two hours flying time.*

APPENDIX A

FASID TABLE MET 1B

METEOROLOGICAL WATCH OFFICES

EXPLANATION OF THE TABLE

Column

1 Location of the meteorological watch office (MWO). Locations, other than aerodromes, where an MWO is to be established are shown in parentheses.

2 ICAO location indicator, assigned to the MWO.

3 Name of the FIR, UIR and/or search and rescue region (SRR) served by the MWO.

4 ICAO location indicator assigned to the ATS unit serving the FIR, UIR and/or SRR.

5 Indication of requirement for the MWO to issue SIGMET for volcanic ash.

6 Indication of requirement for the MWO to issue SIGMET for tropical cyclones.

7 Remarks.

Note. — Unless otherwise stated in column 5, the MWO listed in column 1 is the designated collecting centre for the air-reports received within the corresponding FIR/UIR listed in column 3.

MWO Location	ICAO loc. ind.	Area served		SIGMET		Remarks
		Name	ICAO loc. ind.	VA	TC	
1	2	3	4	5	6	7
AUSTRALIA						
ADELAIDE/Adelaide	YPRM	Melbourne FIR [1]	YMMM			MWOs have areas of responsibility (AOR) defined by specific forecast area boundaries. These boundaries are not aligned with FIR boundaries MWO Darwin is designated to issue VA SIGMET for the whole Brisbane and Melbourne FIRs.
BRISBANE/Brisbane	YBRF	Brisbane FIR [2] Melbourne FIR [3]	YBBB YMMM		X	
DARWIN/Darwin	YDRM	Brisbane FIR [4] Melbourne FIR [5]	YBBB YMMM	X	X	
HOBART/Hobart	YMHF	Melbourne FIR [6]	YMMM			
MELBOURNE/Melbourne	YMRF	Brisbane FIR [7] Melbourne FIR [8]	YBBB YMMM			
PERTH/Perth	YPRF	Brisbane FIR [9] Melbourne FIR [10]	YBBB YMMM		X	
SYDNEY/Sydney	YSRF	Brisbane FIR [11] Melbourne FIR [12]	YBBB YMMM			
TOWNSVILLE	YBTL	Brisbane FIR [13]	YBBB			
BANGLADESH						
DHAKA/Zia Intl	VGZR	Dhaka FIR and SRR	VGFR	X	X	
CAMBODIA						
PHNOM-PENH/Pochentong	VDPP	Phnom-Penh FIR and SRR	VDPP	X	X	Not Implemented
CHINA						
BEIJING/Capital	ZBAA	Beijing FIR and SRR	ZBPE	X		
GUANGZHOU/Baiyun	ZGGG	Guangzhou FIR and SRR	ZGZU	X	X	
KUNMING/Wujiaba	ZPPP	Kunming FIR and SRR	ZPKM	X		
LANZHOU/Zhongchuan	ZLLL	Lanzhou FIR and SRR	ZLHW	X		
HAIKOU/Meilan	ZJSY	Sanya FIR and SRR	ZJSA	X	X	
SHANGHAI/Hongqiao	ZSSS	Shanghai FIR and SRR	ZSHA	X	X	
SHENYANG/Taoxian	ZYTX	Shenyang FIR and SRR	ZYSH	X		
TAIBEI/Taibei Intl	RCTP	Taibei FIR and SRR	RCAA	X	X	
URUMQI/Diwopu	ZWWW	Urumqi FIR and SRR	ZWUQ	X		
WUHAN/Tianhe	ZHHH	Wuhan FIR and SRR	ZHWH	X		
HONG KONG/Hong Kong Intl	VHHH	Hong Kong FIR and SRR	VHHK	X	X	
DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA						
PYONGYANG/Sunan	ZKPY	Pyongyang FIR and SRR	ZKKK	X	X	Not Implemented
FIJI						
NADI/Nadi Intl	NFFN	Nadi FIR and SRR	NFFF	X	X	
FRENCH POLYNESIA						
TAHITI/Faaa	NTAA	Tahiti FIR and SRR	NTTT	X	X	
INDIA						
CHENNAI/Chennai	VOMM	Chennai FIR and SRR	VOMF	X	X	

MWO Location	ICAO loc. ind.	Area served		SIGMET		Remarks
		Name	ICAO loc. ind.	VA	TC	
1	2	3	4	5	6	7
DELHI/Indira Ghandi Intl	VIDP	Delhi FIR and SRR	VIDF	X	X	
KOLKATA/Kolkata	VECC	Kolkata FIR and SRR	VECF	X	X	
MUMBAI/Jawaharlal Nehru Intl	VABB	Mumbai FIR and SRR	VABF	X	X	
INDONESIA						
JAKARTA/Soekarno-Hatta Intl	WIII	Jakarta FIR/UIR and SRR	WIIF	X	X	
UJUNG PANDANG/Hasanuddin	WAAA	Ujung Pandang FIR/UIR and SRR	WAAF	X	X	
JAPAN						
(TOKYO/Tokyo)	RJTD	Fukuoka FIR and Tokyo SRR	RJJJ	X	X	
LAO PEOPLE'S DEMOCRATIC REPUBLIC						
VIENTIANE/Wattay	VLVT	Vientiane FIR and SRR	VLVT	X		Not Implemented
MALAYSIA						
KOTA KINABALU/Kota Kinabalu Intl	WBKK	Kota Kinabalu FIR and SRR	WBFC	X	X	
KUALA LUMPUR/Kuala Lumpur Intl	WMKK	Kuala Lumpur FIR and SRR	WMFC	X	X	
MALDIVES						
MALE/Hulule	VRMM	Male FIR and SRR	VRMM	X	X	
MONGOLIA						
ULAN BATOR/Ulan Bator	ZMUB	Ulan Bator FIR and SRR	ZMUB	X		
MYANMAR						
YANGON/Yangon Intl	VYYY	Yangon FIR and SRR	VYYY	X	X	
NAURU						
NAURU I./Nauru	ANAU	Nauru FIR and SRR	ANAU	X	X	Not Implemented
NEPAL						
KATHMANDU/Tribhuvan Intl	VNKT	Kathmandu FIR and SRR	VNSM	X		
NEW ZEALAND						
(Wellington/Kelburn)	NZKL	Auckland Oceanic FIR and SRR New Zealand FIR AND SRR	NZZO NZZC	X		Operational monitoring coverage south of 60˚S is limited due to the lack of information
PAKISTAN						
KARACHI/Quaid-E-Azam Intl	OPKC	Karachi FIR and SRR	OPKR	X	X	
LAHORE/Lahore	OPLA	Lahore FIR and SRR	OPLR	X		
PAPUA NEW GUINEA						
PORT MORESBY/Jacksons	AYPY	Port Moresby FIR and SRR	AYPY	X	X	
PHILIPPINES						
MANILA/Ninoy Aquino Intl	RPLL	Manila FIR and SRR	RPHI	X	X	
REPUBLIC OF KOREA						
INCHEON/Incheon Intl	RKSI	Incheon FIR and SRR	RKRR	X	X	
SINGAPORE						
SINGAPORE/Singapore Changi	WSSS	Singapore FIR and SRR	WSJC	X	X	
SOLOMON ISLANDS						

MWO Location	ICAO loc. ind.	Area served		SIGMET		Remarks
		Name	ICAO loc. ind.	VA	TC	
1	2	3	4	5	6	7
HONIARA/Henderson	AGGH	Honiara FIR and SRR	AGGG	X	X	Not Implemented
SRI LANKA						
COLOMBO/Katunayake	VCBI	Colombo FIR and SRR	VCBI	X	X	
THAILAND						
BANGKOK/Bangkok Suvarnabhumi Intl	VTBS	Bangkok FIR and SRR	VTBB	X	X	
UNITED STATES						
(ANCHORAGE)	PAWU	Anchorage FIR	PAZA	X		
HONOLULU/Honolulu Intl	PHFO	Oakland Oceanic FIR South of 30N, East of 130E and West of 140W; Honolulu SRR.	KZOA	X	X	
(KANSAS CITY/Missouri)	KMKC	Oakland Oceanic FIR North of 30N.	KZOA	X		
VIET NAM						
(Gia Lam)	VVGL	Hanoi FIR and SRR	VVNB	X	X	
		Ho-Chi-Minh FIR and SRR	VVTS	X	X	

1) limited by the coordinates: 27S/128E;27S/135E;26S/138E; 2806S/14012E;29S/142E; 3414S/14205E;3345S/14045E; 40S/14045E;45S/14045E; 45S/129E;33S/129E;30S/129E; 2715S/12830E.

2) outside the AOR of YBTL MWO and limited by the coordinates: 0937S/14102E;0916S/14203E; 0913S/14206E;0911S/14214E; 0914S/14217E;0922S/14230E; 0922S/14230E;0923S/14236E; 0919S/14248E;0908S/14352E; 0924S/14414E;0957S/14405E; 1130S/14402E;1144S/14404E; 12S/144E;12S/155E;14S/155E; 14S/16115E;1740S/163E; 2830S/163E;2830S/155E; 2850S/15316E;29S/150E; 29S/14330E;26S/138E; 14S/138E;0937S/14102E.

3) limited by the coordinates: 26S/138E;29S/143E;29S/142E; 2806S/14012E;26S/138E.

4) limited by the coordinates: 1055S/12447E;0920S/12650E; 07S/135E;0950S/13940E; 0950S/141E;14S/138E; 18S/138E;2215S/138E; 26S/138E;2218S/13638E; 2128S/13609E;2111S/13134E; 2151S/13058E;2313S/12828E; 2322S/12629E;2327S/12415E; 2250S/12330E;2030S/12330E; 20S/129E;16S/12915E; 1528S/12806E;1450S/12825E; 14S/12730E;1345S/12609E; 14S/124E;1055S/12447E.

5) limited by the coordinates: 2250S/12330E;2327S/12415E; 2322S/12629E;2313S/12828E; 2151S/13058E;2111S/13134E; 2128S/13609E;2218S/13638E; 26S/138E;27S/135E; 2715S/12830E;25S/12815E; 25S/12330E;2250S/12330E.

6) limited by the coordinates: 40S/14045E;40S/143E; 3953S/14353E;4006S/14759E; 40S/150E;45S/150E; 45S/14045E;40S/14045E.

7) limited by the coordinates: 3730S/15033E;3730S/163E; 45S/163E;45S/150E; 4434S/150E;4351S/15040E; 43S/151E;3811S/15019E; 3730S/15033E.

8) limited by the coordinates: 3345S/14045E;3414S/14205E; 3510S/14728E;3730S/150E; 3730S/15033E;3811S/15019E; 43S/151E;4351S/15040E; 4434S/150E;40S/150E; 4006S/14759E;3953S/14353E; 40S/143E;40S/14045E; 3811S/14045E;3345S/14045E.

9) limited by the coordinates: 12S/110E;12S/12320E; 1055S/12447E;14S/124E; 1345S/12609E;14S/12730E; 1450S/12825E;1528S/12806E; 16S/12915E;20S/129E; 2030S/12330E;2250S/12330E; 2153S/12226E; then along the major arc of a circle of 15 NM radius centred on 2143S 12213E; 2133S/12201E;2026S/12045E; then along the minor arc of a circle of 120NM radius centred on 2023S 11837E; 1823S/11825E;1753S/11822E; then along the minor arc of a circle of 150NM radius centred on 2023S 11837E; 1934S/11606E;1931S/11331E; 12S/110E.

10) limited by the coordinates: 06S/75E;02S/78E;02S/92E;12S/107E;12S/110E;1931S/11331E;1934S/11606E; then along the minor arc of a circle of 120NM radius centred on 2023S 11837E; 1753S/11822E;1823S/11825E; then along the minor arc of a circle of 120NM radius centred on 2023S 11837E; 2026S/12045E;2133S/12201E; then along major arc of a circle of 15.0NM radius centred on 2143S 12213E; 2153S/12225E;2250S/12330E; 25S/12330E;25S/12815E; 2715S/12830E;30S/129E; 30S/129E;33S/129E;45S/129E; 45S/75E;06S/75E.

11) limited by the coordinates: 29S/14632E;29S/150E; 2850S/15328E;2830S/155E; 2830S/163E;3730S/163E; 3730S/15033E 3657S/15045E; then east of the minor arc of a circle of 120NM radius centred on 3457S/15032E; 3519S/15256E;3421S/15140E; 3359S/15201E;3351S/15154E; 3328S/15148E;3315S/15126E; 3312S/15114E;3320S/15042E; 3327S/15033E;3206S/14850E; 29S/14632E.

12) limited by the coordinates: 29S/142E;29S/14330E; 29S/14632E;3206S/14850E; 3327S/15033E;3320S/15042E; 3312S/15114E;3315S/15126E; 3328S/15148E;3351S/15154E; 3359S/15201E;3421S/15140E; 3519S/15256E; then east of the minor arc of a circle of 120NM radius centred on 3457S 15032E; 3657S/15045E;3730S/15033E; 3730S/150;3510S/14728E; 3414S/14205E;29S/142E.

13) limited by the coordinates: 14S/138E;10S/141E;09S/142E; 09S/144E;13S/145E;15S/147E; 1817S/148E;2309S/15252E; 2334S/14811E;1818S/14332E; 18S/138E;14S/138E.

APPENDIX B

FASID TABLE MET 3A

TROPICAL CYCLONE ADVISORY CENTRES

EXPLANATION OF THE TABLE

Column

1. Location of the tropical cyclon advisory centre (TCAC).
2. ICAO location indicator of TCAC (for use in the WMO heading of advisory bulletin).
3. Area of responsibility for the preparation of advisory information on tropical cyclones by the TCAC in Column 1.
4. Period of operation of the TCAC.
5. MWOs to which the advisory information on tropical cyclones should be sent.
6. ICAO location indicator of the MWOs in Column 4.

Note: MWOs in italics are situated outside the Asia/Pacific Region.

TROPICAL CYCLONE ADVISORY CENTRE	ICAO LOC. IND.	AREA OF RESPONSIBILITY	PERIOD OF OPERATION[2]	MWOs TO WHICH ADVISORY INFORMATION IS TO BE SENT	
				Name	ICAO LOC. IND.
1	2	3	4	5	6
Darwin (Australia)	YDRM (ADRM)	South-East Indian Ocean[1] N: 0°S S: 36°S W: 90°E E: 141°E South-West Pacific Ocean[2]: N: 0°S S: 40°S W: 141°E E: 160°E	November – April	Adelaide[3]	YPRM
				Brisbane	YBRF
				Colombo	VOMM
				Darwin	YDRM
				Hobart[3]	YMHF
				Honiara[4]	AGGH
				Jakarta	WIII
				Melbourne[3]	YMRF
				Perth	YPRF
				Port Moresby	AYPY
				Sydney[3]	YSRF
				Townsville[3]	YBTL
				Ujung Pandang	WAAA
Honolulu (United States)	PHFO	Central Pacific: N: 60°N S: 0°N W: 180°W E: 140°W	May – November	Anchorage	PAWU
				Honolulu	PHFO
				Kansas City	KKCI
				Tahiti	NTAA
Miami (United States)	KNHC	Eastern Pacific: N: 60°N S: 0°N W: 140°E E: Coastline	May – November	Honolulu	PHFO
				Kansas City	KKCI
				~~*Miami*~~	~~*KNHC*~~
				Tahiti	NTAA
Nadi (Fiji)	NFFN	Southern Pacific: N: 0°S S: 40°S W: 160°E E: 120°W	November – April	Brisbane	YBRF
				Hobart[3]	YMHF
				Honiara[4]	AGGH
				Honolulu	PHFO
				Melbourne[3]	YMRF
				Nadi	NFFN
				Sydney[3]	YSRF
				Tahiti	NTAA
				Townsville[3]	YBTL
				Wellington	NZKL
New Delhi (India)	VIDP	1) Bay of Bengal 2) Arabian Sea N: Coastline S: 5°N W: 60°E E: 100°E	April – June October – December	Chennai	VOMM
				Colombo	VCBI
				Dhaka	VGZR
				~~Delhi~~	~~VIDP~~
				Jakarta	WIII

TROPICAL CYCLONE ADVISORY CENTRE	ICAO LOC. IND.	AREA OF RESPONSIBILITY	PERIOD OF OPERATION[2)]	MWOs TO WHICH ADVISORY INFORMATION IS TO BE SENT	
				Name	**ICAO LOC. IND.**
1	2	3	4	5	6
				Karachi	OPKC
				Kuala Lumpur	WMKK
				Male	VRMM
				Mumbai	VABB
				Tehran	*OIII*
				Yangon	VYYY
Tokyo (Japan)	RJTD	Western Pacific (incl. South China Sea)		Bangkok	VTBS
				Guangzhou	ZGGG
				Gia Lam	VVGL
				Hong Kong	VHHH
				Honolulu	PHFO
				Jakarta	WIII
				Kansas City	KMKC
				Kota Kinabalu	WBKK
				Kuala Lumpur	WMKK
				Manila	RPLL
				Nadi	NFFN
				Phnom-Penh[4)]	VDPP
				Pyongyang[4)]	ZKPY
				Shanghai	ZSSS
				Singapore	WSSS
				Incheon	RKSI
				Taibei	RCTP
				Tokyo	RJTD
				Ujung Pandang	WAAA

NOTES:

1) Co-ordinates of the areas of responsibility of the Darwin and Nadi Tropical Cyclone Advisory Centres to be confirmed.
2) Indicates approximately the main seasons for tropical cyclones.
3) Tropical cyclone SIGMET for the Australian FIRs is issued by MWOs: Brisbane, Darwin and Perth.
4) MWO not implemented

APPENDIX C

FASID TABLE MET 3B

VOLCANIC ASH ADVISORY CENTRES

EXPLANATION OF THE TABLE

Column

3. Location of the volcanic ash advisory centre (VAAC).

4. ICAO location indicator of VAAC (for use in the WMO heading of advisory bulletin).

5. Area of responsibility for the preparation of advisory information on volcanic ash by the VAAC in column 1.

6. ICAO Region of the State in column 5.

7. State of the MWO in column 6.

8. MWOs to which the advisory information on volcanic ash should be sent.

9. ICAO location indicator of the MWOs in column 6.

10. ACCs to which the advisory information on volcanic ash should be sent.

11. ICAO location indicator of the ACCs in column 8.

VOLCANIC ASH ADVISORY CENTRE	ICAO LOC. IND.	AREA OF RESPONSIBILITY	ICAO REGION	STATE	MWOs TO WHICH ADVISORY INFORMATION IS TO BE SENT		ACC TO WHICH ADVISORY INFORMATION IS TO BE SENT	
					Name	ICAO LOC. IND.	Name	ICAO LOC. IND.
1	2	3	4	5	6	7	8	9
Anchorage (United States)	PAWU	Anchorage Oceanic Anchorage Continental Anchorage Arctic and west to E150, north of N60	NAM	USA	Anchorage	PAWU	Anchorage	PAZA
			APAC	Japan	Tokyo	RJTD	Saporo Tokyo Fukuoka Naha	RJCG RJTG RJDG RORG
Darwin (Australia)	YDRM (ADRM)	Southward from N10 and from E100 to E160 and the Perth FIR between E100 and E75, Colombo FIR and those parts of the Kuala Lumpur, Bangkok, Chennai, Yangon and Kolkata FIRs lying within N10 E100 to N20 E100 to N20 E82 to N10 E82 to N6 E78 to S2 E78 to E6 E75	APAC	Australia	Adelaide[3)]	YPRM	Adelaide	YPAD
			APAC	Thailand	Bangkok	VTBS	Bangkok	VTBB
			APAC	Australia	Brisbane[3)]	YBRF	Brisbane Cairns	YBBN YBCS
			APAC	India	Chennai	VOMM	Chennai	VOMF
			APAC	Australia	Darwin	YDRM	Darwin	YPDN
			APAC	Viet Nam	Gia Lam	VVGL	Hanoi Ho-Chi-Minh	VVNB VVTS
			APAC	Australia	Hobart[3)]	YMHF	Hobart	YMHB
			APAC	Solomon I.	Honiara[2)]	AGGH	Honiara	AGGH
			APAC	Indonesia	Jakarta	WIII	Jakarta	WIIF
			APAC	Malaysia	Kota Kinabalu	WBKK	Kota Kinabalu	WBFC
			APAC	Malaysia	Kuala Lumpur	WMKK	Kuala Lumpur	WMFC
			APAC	Philippines	Manila	RPLL	Manila	RPHI
			APAC	Australia	Melbourne[3)]	YMRF	Melbourne	YMMM
			APAC	Australia	Perth[3)]	YPRF	Perth	YPPH
			APAC	Papua New Guinea	Port Moresby	AYPY	Port Moresby	AYPM
			APAC	Singapore	Singapore	WSSS	Singapore	WSJC
			APAC	Australia	Sydney[3)]	YSRF	Sydney	YSSY
			APAC	Australia	Townsville[3)]	YBTL	Townsville	YBTL
			APAC	Indonesia	Ujung Pandang	WAAA	Ujung Pandang	WAAF
			APAC	Myanmar	Yangon	VYYY	Yangon	VYYY
Tokyo (Japan)	RJTD	N60 to N10 – and from E90 to Oakland Oceanic and Anchorage Oceanic and Continental FIR	APAC	Thailand	Bangkok	VTBS	Bangkok	VTBB
			EUR	Russian Federation	Blagove-schensk	UHBB	Blagoveschensk	UHBB
			APAC	China	Beijing	ZBAA	Beijing Huhhot Taiyuan	ZBPE ZBHH ZBYN

VOLCANIC ASH ADVISORY CENTRE	ICAO LOC. IND.	AREA OF RESPONSIBILITY	ICAO REGION	STATE	MWOs TO WHICH ADVISORY INFORMATION IS TO BE SENT		ACC TO WHICH ADVISORY INFORMATION IS TO BE SENT	
					Name	ICAO LOC. IND.	Name	ICAO LOC. IND.
1	2	3	4	5	6	7	8	9
		boundaries	EUR	Russian Federation	Bratsk	UIBB	Bratsk	UIBB
			EUR	Russian Federation	Chita	UIAA	Chita	UIAA
			APAC	Viet Nam	Gia Lam	VVGL	Hanoi Ho-Chi-Minh	VVNB VVTS
			APAC	China	Guangzhou	ZGGG	Guangzhou Changsha Guilin Nanning	ZGZU ZGCS ZGKL ZGNN
			APAC	China	HAIKOU/ Meilan	ZJSY	Sanya	ZJSA
			APAC	China	Hong Kong	VHHH	Hong Kong	VHHH
					Incheon	RKSI	Incheon	RKRR
			EUR	Russian Federation	Irkutsk	UIII	Irkutsk	UIII
			EUR	Russian Federation	Khabarovsk	UHHH	Khabarovsk	UHHH
			EUR	Russian Federation	Kirensk	UIKK	Kirensk	UIKK
			APAC	China	Kunming	ZPPP	Kunming Chengdu Chongqing	ZPKM ZUDS ZUCK
			APAC	China	Lanzhou	ZLLL	Lanzhou Xi'an	ZLAN ZLSN
			EUR	Russian Federation	Magadan	UHMM	Magadan	UHMM
			EUR	Russian Federation	Magdagachi	UHBI	Magdagachi	UHBI
			APAC	Philippines	Manila	RPLL	Manila	RPHI
			EUR	Russian Federation	Nik.-na-Amure	UHNN	Nik.-na-Amure	UHNN
			EUR	Russian Federation	Okha	UHSH	Okha	UHSH
			EUR	Russian Federation	Okhotsk	UHOO	Okhotsk	UHOO
			EUR	Russian Federation	Pet.-Kamchatsky	UHPP	Pet.-Kamchatsky	UHPP
			APAC	Cambodia	Phnom-Penh[2)]	VDPP	Phnom-Penh	VDPP
			APAC	DPR Korea	Pyongyang[2)]	ZKPY	Pyongyang	ZKKK
			APAC	China	Shanghai	ZSSS	Shanghai Hefei Jinan Nanchang Nanjing Xiamen Qingdao	ZSHA ZSOF ZSTN ZSCN ZSNJ ZSAM ZSQD

VOLCANIC ASH ADVISORY CENTRE	ICAO LOC. IND.	AREA OF RESPONSIBILITY	ICAO REGION	STATE	MWOs TO WHICH ADVISORY INFORMATION IS TO BE SENT		ACC TO WHICH ADVISORY INFORMATION IS TO BE SENT	
					Name	ICAO LOC. IND.	Name	ICAO LOC. IND.
1	2	3	4	5	6	7	8	9
			APAC	China	Shenyang	ZYTX	Shenyang Dalian Hailar Harbin	ZYSH ZYTL ZBLA ZYHB
			APAC	China	Taibei	RCTP	Taibei	RCAA
			APAC	Japan	Tokyo	RJTD	Saporo Tokyo Fukuoka Naha	RJCG RJTG RJDG RORG
			APAC	Mongolia	Ulan-Bator	ZMUB	Ulan-Bator	ZMUB
			APAC	China	Urumqi	ZWWW	Urumqi	ZWWW ZWUQ
			APAC	Lao PDR	Vientiane	VLVT	Vientiane	VLVT
			EUR	Russian Federation	Vladivostok	UHWW	Vladivostok	UHWW
			APAC	China	Wuhan	ZHHH	Wuhan	ZHWH
			EUR	Russian Federation	Yuzhnosakhalinsk	UHSS	Yuzhnosakhalinsk	UHSS
Washington (United States)	KNES	Oakland Oceanic FIR	NAM	USA	Honolulu	PHFO	Oakland	KZOA
			NAM	USA	Kansas City	KKCI	Guam	PGZU
			APAC	Japan	Tokyo	RJTD	Saporo Tokyo Fukuoka Naha	RJCG RJTG RJDG RORG
			APAC	Australia	Darwin	YDRM	Darwin	YPDN
Wellington (New Zealand)	NZKL	Southward from the Equator and from E160 to W140[1]	APAC	Australia	Brisbane[3]	YBRF	Brisbane	YBBN
			APAC	Australia	Darwin	YDRM	Darwin	YPDN
			APAC	USA	Honolulu	PHFO	Oakland	KZOA
			APAC	Solomon I.	Honiara[2]	AGGH	Honiara	AGGH
			APAC	Australia	Melbourne[3]	YMRF	Melbourne	YMMM
			APAC	Fiji	Nadi	NFFN	Nadi	NFFF
			APAC	Nauru	Nauru[2]	ANAU	Nauru	ANAU
			APAC	Australia	Sydney[3]	YSRF	Sydney	YSSY
			APAC	French Polynesia	Tahiti	NTAA	Tahiti	NTTT
			APAC	New Zealand	Wellington	NZKL	Auckland Christchurch	NZZO NZZC

Notes: – 1) Coverage south of 60°S latitude is currently not feasible.
2) MWO not implemented.
3) MWO Darwin is designated to issue VA SIGMET for Brisbane and Melbourne FIRs.

APPENDIX D

LIST OF THE ABBREVIATIONS AND CODE WORDS USED IN SIGMET

ABV	Above
AND*	And
APRX	Approximate or approximately
AT	At *(followed by time)*
BLW	Below
BY*	By
CB	Cumulonimbus
CENTRE*	Centre *(used to indicate tropical cyclone centre)*
CLD	Cloud
CNL	Cancel *or* cancelled
CTA	Control area
DS	Duststorm
E	East *or* eastern longitude
ERUPTION*	Eruption *(used to indicate volcanic eruption)*
EMBD	Embedded in layer *(to indicate CB embedded in layer of other clouds)*
FCST	Forecast
FIR	Flight information region
FL	Flight level
FRQ	Frequent
FZRA	Freezing rain
GR	Hail
HVY	Heavy *(used to indicate intensity of weather phenomena)*
ICE	Icing
INTSF	Intensify *or* intensifying
ISOL	Isolated
KM	Kilometers
KMH	Kilometers per hour
KT	Knots
LINE*	Line
MOD	Moderate *(used to indicate intensity of weather phenomena)*
MOV	Move *or* moving *or* movement
MT	Mountain
MTW	Mountain waves
N	North *or* northern latitude
NC	No change
NE	North-east
NM	Nautical miles
NW	North-west
OBS	Observed
OBSC	Obscured
OCNL	Occasional
OF*	Of … *(place)*
RA	Rain
RDOACT*	Radioactive
S	South *or* southern latitude
SE	South-east
SEV	Severe *(used e.g. to qualify icing and turbulence reports)*

SFC	Surface
SIGMET	SIGMET *(used to indicate SIGMET information)*
SQL	Squall line
SS	Sandstorm
STNR	Stationary
SW	South-west
TC	Tropical cyclone
TO	To … *(place)*
TOP	Cloud top
TS	Thunderstorm
TURB	Turbulence
UIR	Upper flight information region
VA	Volcanic ash
VALID*	Valid
W	West *or* western longitude
WI	Within
WID	Width
Z	Coordinated Universal Time *(used in meteorological messages)*

** not in the ICAO Doc 8400, ICAO Abbreviations and Codes*

APPENDIX E

METEOROLOGICAL PHENOMENA TO BE REPORTED BY SIGMET

Phenomenon	Description	Meaning
TS	OBSC[2] TS EMBD[3] TS FRQ[4] TS SQL[5] TS OBSC TSGR EMBD TSGR FRQ TSGR SQL TSGR	Obscured thunderstorm(s) Embedded thunderstorm(s) Frequent thunderstorm(s) Squall line thunderstorm(s) Obscured thunderstorm(s) with hail Embedded thunderstorm(s) with hail Frequent thunderstorm(s) with hail Squall line thunderstorm(s) with hail
TC	TC (+ TC name)	Tropical cyclone (+ TC name)
TURB	SEV TURB[6]	Severe turbulence
ICE	SEV ICE SEV ICE FZRA	Severe icing Severe icing due to freezing rain
MTW	SEV MTW[7]	Severe mountain wave
DS	HVY DS	Heavy duststorm
SS	HVY SS	Heavy sandstorm
VA	VA (+ volcano name, if known)	Volcanic ash (+ volcano name)

Notes:

1 *Only one of the weather phenomena listed should be selected and included in each SIGMET*

2. *Obscured (**OBSC**) indicates that the thunderstorm (including, if necessary, CB-cloud which is not accompanied by a thunderstorm) is obscured by haze or smoke or cannot be readily seen due to darkness*

3. *Embedded (**EMBD**) – indicates that the thunderstorm (including, if necessary, CB-cloud which is not accompanied by a thunderstorm) is embedded within cloud layers and cannot be readily recognized*

4. *Frequent (**FRQ**) indicates an area of thunderstorms within which there is little or no separation between adjacent thunderstorms with a maximum spatial coverage greater than 75% of the area affected, or forecasts to be affected, by the phenomenon (at a fixed time or during the period of validity)*

5. *Squall line (**SQL**) indicates thunderstorms along a line with little or no space between individual clouds*

6. *Severe (**SEV**) turbulence (**TURB**) refers only to:*

- *low-level turbulence associated with strong surface winds;*
- *rotor streaming;*
- *turbulence whether in cloud or not in cloud (CAT) near to jet streams.*

Turbulence is considered severe whenever the peak value of the cube root of EDR exceeds 0.7.

7. *A mountain wave (**MTW**) is considered severe – whenever an accompanying downdraft of 3.0 m/s (600 ft/min) or more and/or severe turbulence is observed or forecast.*

APPENDIX F

STANDARD FOR REPORTING GEOGRAPHICAL COORDINATES IN SIGMETS

When reporting geographical coordinates of points in SIGMET the following should apply:

1. Each point is represented by a latitude/longitude coordinates in whole degrees or degrees and minutes in the form:

N(S)nn[nn] W(E)nnn[nn]

Note: There is a space between the latitude and longitude value.

Examples: **N3623 W04515**
S1530 E12500
N42 E023

2. In describing lines or polygons, the lat,lon values of the respective points are separated by the combination space-hyphen-space, as in the following examples:

S0530 E09300 – N0100 E09530 – N1215 E11045 – S0820 E10330

S05 E093 – N01 E095 – N12 E110 – S08 E103

Note: It is not necessary to repeat the first point when describing a polygon.

3. When describing a volcanic ash cloud approximate form and position, a limited number of points, which form a simplified geometric figure (a line, or a triangle, or quadrangle, etc.) should be used in order to allow for a straightforward interpretation by the user.

3. Reporting a phenomenon occupying two different geographical areas within the FIR. This is frequently the case with two (or more) separate TS formations occurring in different parts of the FIR at the same time. The question is whether a separate SIGMET should be issued for each formation, or, one SIGMET could include location description for two (or more) geographical areas. The current SIGMET format does not allow for reporting of more than one phenomenon or two different TS areas. Therefore, in cases like this, two separate SIGMETs should be issued. The main concern with issuing separate SIGMETs is that, in general, a new SIGMET for the same FIR would replace the previous one; this may lead to rejecting valid information in case as described above. It should be noted in this regard, that the current SIGMET format allows for using different sequence numbers and thus, for keeping more than one SIGMET at a time valid for the FIR concerned; for instance, a series A1, A2,… could be used for "phenomenon A" and B1, B2, … , for "phenomenon B".

4. Location with reference to **LINE. LINE** is defined as a straight line between two points drawn on a map in Mercator projection or a straight line between two points which crosses lines of longitude at a constant level.

Example: **NE OF LINE S2520 W11510 – S2730 W12010**

5.

APPENDIX G

EXAMPLES

Note: ***Most examples are based on real SIGMETs mainly from Asia/Pacific region with some exceptions. The real SIGMETs have been corrected in order to make them compliant with the Annex 3 format.***

1. <u>SIGMET</u>

1.1 <u>SIGMET for thunderstorms</u>

```
WSSR20 WSSS 091131
WSJC SIGMET 3 VALID 091140/091540 WSSS-
WSJC SINGAPORE FIR EMBD TS OBS AT 1130Z N OF N01 E OF E106 W OF E114 STNR NC=
```

```
WSNT03 KKCI 032340
KZNY SIGMET C17 VALID 032345/040345 KKCI-
KZNY NEW YORK OCEANIC FIR FRQ TS OBS WI AREA N2400 W05500 - N2300 W04930 -
N1845 W05645 - N2100 W05800 - N2400 W05500 TOP FL450 MOV E 15KT INTSF=
```

```
WSVS31 VVGL 122305
VVTS SIGMET 9 VALID 122330/130230 VVGL-
VVTS HOCHIMINH FIR EMBD TS OBS S OF LINE N1420 E10930 - N1000 E10400 TOP
FL280 MOV W 10KMH WKN=
```

```
WSUK31 EGGY 121120
EGTT SIGMET 01 VALID 121125/121525 EGRR-
EGTT LONDON FIR EMBD TSGR OBS AT 1115Z SE OF LINE N5130 E00200 - N5000 W00400
TOPS FL220 MOV NE 30KT NC=
```

1.2 <u>SIGMET for severe turbulence</u>

```
WSAU21 AMMC 280546
YBBB SIGMET BS02 VALID 280600/281200 YMMC-
YBBB BRISBANE FIR SEV TURB FCST WI S3900 E15100 - S4300 E15100 - S4300 E16000
- S4100 E16300 - S3700 E16300 - S3900 E16000 FL260/370 MOV E 20 KT NC=
```

```
WSNZ21 NZKL 280003
NZZC SIGMET 01 VALID 280002/280402 NZKL-
NZZC NEW ZEALAND FIR SEV TURB OBS NE OF THE SOUTH ISLAND BLW FL100 STNR NC=
```

1.3 <u>SIGMET for severe icing</u>

```
WSFR31 LFPW 280400
LFMM SIGMET 2 VALID 280500/280900 LFMM-
LFMM FIR MARSEILLE SEV ICE OBS AT 0400Z LION GULF FL040/100 STNR NC=
```

```
WSIY31 LIIB 032152
LIMM SIGMET 07 VALID 032200/040200 LIMM-
LIMM MILANO FIR SEV ICE FCST OVER ALPS AND N PART APPENNINIAN AREA FL030/120
MOV E NC=
```

1.4 SIGMET for heavy duststorm

```
WSAW31 LOWM 160530
OEJD SIGMET 4 VALID 160600/161000 OEJN-
OEJD JEDDAH FIR HVY DS OBS N OF N2200 S OF N3100 E OF E04440 W OF E04800 MOV
E 10KMH NC=
```

1.5 SIGMET for severe mountain wave

```
WSUK31 EGGY 150550
EGTT SIGMET 03 VALID 150600/151000 EGRR-
EGTT LONDON FIR SEV MTW FCST N OF N5100 FL090/140 STNR WKN=
```

2. VA SIGMET

2.1 VA SIGMET - full

```
WVPH01 RPLL 211110
RPHI SIGMET 2 VALID 211100/211700 RPLL-
RPHI MANILA FIR VA ERUPTION MT PINATUBO LOC S1500 E07348
VA CLD OBS AT 1100Z FL310/450 APRX 220KM BY 35KM S1500 E07348 – S1530 E07642
MOV SE 65KMH FCST 1700Z VA CLD APRX S1506 E07500 – S1518 E08112 – S1712
E08330 – S1824 E07836=
```

Note:

1. *The coordinates used in describing the VA cloud are fictitious.*

2.2 "Short" first SIGMET (no FCST)

```
YUDD SIGMET 2 VALID 211100/211700 YUSO-
YUDD SHANLON FIR/UIR VA ERUPTION MT ASHVAL LOC S1500 E07348
VA CLD OBS AT 1100Z FL310/450 APRX 220KM BY 35KM S1500 E07348 – S1530 E07642
MOV SE 65KMH FCST 1700Z VA CLD APRX S1506 E07500 – S1518 E08112 – S1712
E08330 – S1824 E07836=
```

or

```
YUDD SIGMET 2 VALID 211100/211700 YUSO-
YUDD SHANLON FIR/UIR VA ERUPTION MT ASHVAL LOC S1500 E07348
VA CLD OBS AT 1100Z FL100/180 APRX 220KM BY 35KM S1500 E07348 – S1530 E07642=
```

```
WVFJ01 NFFN 090900
NFFF SIGMET 03 VALID 090915/091515 NFFN-
NFFF NADI FIR VA ERUPTION MT LOPEVI LOC S1630 E16820 VA CLD OBS AT 0330Z
FL090 APRX 10NM BY 10NM MOV SE 25KT FCST 1515Z VA CLD APPRX S1630 E16820 -
S1900 E17600 - S1930 E17030=
```

2.3 SIGMET for VA CLD in the FIR but the volcano information is unknown

```
YUDD SIGMET 2 VALID 211100/211700 YUSO-
YUDD SHANLON FIR/UIR VA CLD OBS AT 1100Z FL310/450 APRX 220KM BY 35KM S1500
E07348 – S1530 E07642 MOV SE 65KMH FCST 1700Z VA CLD APRX S1506 E07500 –
S1518 E08112 – S1712 E08330 – S1824 E07836=
```

2.4 SIGMET for VA CLD forecast to affect the FIR

We assume that the responsible VAAC has issued an advisory at 0200Z with forecast positions of the VA CLD for 0800Z, 1400Z and 2000Z. From this forecast it is seen that the VA CLD will enter the YUDD FIR around 0800Z. The responsible MWO, YUSO receiving this advisory prepares a SIGMET for the expected penetration of the VA cloud in its FIR and this SIGMET is send at 0230Z.

```
WVXY01 YUSO 210230
YUDD SIGMET 2 VALID 210800/211400 YUSO-
YUDD SHANLON FIR/UIR VA CLD FCST FL310/450 APRX 220KM BY 35KM S1500 E07348 –
S1530 E07642 MOV SE 65KMH FCST 1400Z VA CLD APRX S1506 E07500 – S1518 E08112
– S1712 E08330 – S1824 E07836=
```

Notes:

1. *The forecast positions at 0800Z and 1400Z are taken from the VA advisory.*

3. TC SIGMET

3.1. TC Graham – SIGMET issued by MWO Perth - Australia

```
WCOC31 APRF 280453
YBBB SIGMET PH01 VALID 280500/281100 YPRF-
YBBB BRISBANE FIR TC GRAHAM OBS AT 0400Z S1806 E12145 CB TOP FL450 WI 120NM
OF CENTRE MOV SE 7KT INTSF FCST 1100Z TC CENTRE S1808 E12150
OTLK 281700 TC CENTRE S1835 E12218 010400 TC CENTRE S1910 E12240=
```

3.2. SIGMET messages issued in July 2003 during the passage of TC Koni

```
WCSS20 VHHH 200240
VHHK SIGMET 2 VALID 200900/201500 VHHH-
VHHK HONG KONG CTA TC KONI OBS AT 0000Z N1618 E11506 CB TOP FL500 WI 90NM OF
CENTRE MOV NW 8KT NC FCST 1500Z TC CENTRE N1749 E11347
OTLK 202100 TC CENTRE N1829 E11304 210300 TC CENTRE N1902 E11208=
```

Note: This SIGMET is issued before the TC Koni started affecting the Hong Kong CTA, as seen from the issuing time and the start of validity time

```
WCSS20 VHHH 201150
VHHK SIGMET 7 VALID 201200/201800 VHHH-
VHHK HONG KONG CTA TC KONI OBS AT 0900Z N1712 E11400 CB TOP FL500 WI 90NM OF
CENTRE MOV NW 10KT NC FCST 1800Z TC CENTRE N1810 E11300=

WCSS20 VHHH 201450
VHHK SIGMET 10 VALID 201500/202100 VHHH-
```

VHHK HONG KONG CTA TC KONI OBS AT 1200Z N1730 E11330 CB TOP FL500 WI 60NM OF CENTRE MOV NW 10KT NC FCST 2100Z TC CENTRE N1818 E11240=

Note: The two SIGMETs above are issued with an interval of 3 hours, which corresponds to the requirement for updating the TC SIGMETs at least every 6 hours. In the case of Hong Kong, China, the update interval has been selected to be 3 hours.

APPENDIX H

WMO HEADINGS FOR SIGMET BULLETINS USED BY ASIA/PAC METEOROLOGICAL WATCH OFFICES

MWO location	ICAO location indicator	WMO SIGMET Headings			FIR/ACC served	Remarks
		WS	WC	WV	ICAO location indicator	
1	2	3	4	5	6	7
AUSTRALIA						*Note: Non-ICAO location indicators are used in the WMO headings*
ADELAIDE/Adelaide	YPRM	WSAU31			YMMM	APRM
BRISBANE/Brisbane	YBRF	WSAU31	WCAU01		YBBB YMMM	ABRF
DARWIN/Darwin	YDRM	WSAU31	WCAU01	WVAU01	YBBB YMMM	ADRM
HOBART/Hobart	YMHF	WSAU31			YMMM	AMHF
MELBOURNE/Melbourne	YMRF	WSAU31			YBBB YMMM	AMRF
PERTH/Perth	YPRF	WSAU31	WCAU01		YBBB YMMM	APRF
SYDNEY/Sydney	YSRF	WSAU31			YBBB YMMM	ASRF
TOWNSVILLE	YBTL	WSAU31			YBBB	ABTL
BANGLADESH						
DHAKA/Zia Intl	VGZR	WSBW20	WCBW20		VGFR	
CAMBODIA						
PHNOM-PENH/Pochentong	VDPP				VDPP	MWO not established
CHINA						
BEIJING/Capital	ZBAA	WSCI33		WVCI33	ZBPE	
GUANGZHOU/Baiyun	ZGGG	WSCI35	WCCI35	WVCI35	ZGZU	
HAIKOU/Meilan	ZJHK	WSCI35		WVCI35		
KUNMING/Wujiaba	ZPPP	WSCI36		WVCI36	ZPKM	
LANZHOU/Chongchuan	ZLLL	WSCI37		WVCI37	ZLHW	
SHANGHAI/Hongqiao	ZSSS	WSCI34	WCCI34	WVCI34	ZSHA	
SHENYANG/Taoxian	ZYTX	WSCI38		WVCI38	ZYSH	
TAIBEI/Taibei Intl	RCTP	WSCI31	WCCI31	WVCI31	RCTP	
URUMQI/Diwopu	ZWWW	WSCI39		WVCI39	ZWUQ	
WUHAN/Tianhe	ZHHH	WSCI35		WVCI35	ZHWH	
HONG KONG/Hong Kong Intl	VHHH	WSSS20	WCSS20	WVSS20	VHHK	

MWO location	ICAO location indicator	WMO SIGMET Headings			FIR/ACC served	Remarks
		WS	WC	WV	ICAO location indicator	
1	2	3	4	5	6	7
DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA						
PYONGYANG/Sunan	ZKPY				ZKKK	No SIGMET issued
FIJI						
NADI/Nadi Intl	NFFN	WSFJ01,02,…	WCFJ01,02,…	WVFJ01,02,…	NFFF	
FRENCH POLYNESIA						
TAHITI/Faaa	NTAA	WSPF21,22	WCPF21	WVPF21	NTTT	
INDIA						
CALCUTTA/Calcutta	VECC	WSIN31	WCIN31		VECF	
CHENNAI/Chennai	VOMM	WSIN31	WCIN31		VOMF	
DELHI/Indira Ghandi Intl	VIDP	WSIN31	WCIN31		VIDF	
MUMBAI/Jawaharlal Nehru Intl	VABB	WSIN31	WCIN31		VABF	
INDONESIA						
JAKARTA/Soekarno-Hatta Intl	WIII	WSID20	WCID20	WVID20	WIIZ	
UJUNG PANDANG/Hasanuddin	WAAA	WSID21	WCID21	WVID21	WAAZ	
JAPAN						
TOKYO/Narita Intl	RJAA	WSJP31	WCJP31	WVJP31	RORG RJTG	
LAO PEOPLE'S DEMOCRATIC REPUBLIC						
VIENTIANE/Wattay	VLVT	WSLA31		WVLA31	VLVT	Not confirmed
MALAYSIA						
KOTA KINABALU/Kota Kinabalu Intl	WBKK	-	-	-	WBFC	
KUALA LUMPUR/Kuala Lumpur Intl	WMKK	WSMS31	WCMS31	WVMS31	WMFC	
MALDIVES						
MALE/Hulule	VRMM	WSMV31			VRMM	
MONGOLIA						
ULAN BATOR/Ulan Bator	ZMUB	WSMO31			ZMUB	Not confirmed

MWO location	ICAO location indicator	WMO SIGMET Headings			FIR/ACC served	Remarks
		WS	WC	WV	ICAO location indicator	
1	2	3	4	5	6	7
MYANMAR YANGON/Yangon Intl	VYYY	WSBM31	WCBM31		VYYY	Not confirmed
NAURU NAURU I./Nauru	ANAU				ANAU	No Information
NEPAL KATHMANDU/Tribhuvan Intl	VNKT	WSNP31			VNSM	Not confirmed
NEW ZEALAND WELLINGTON/Kelburn Intl	NZKL	WSNZ21 WSPS21	WCNZ21 WCPS21	WVNZ21 WVPS21	NZZC NZZO	Operational monitoring coverage south of 60˚S is limited due to the lack of information
NORTHERN MARIANA ISLANDS (United States) SAIPAN I. (OBYAN)/Saipan I.(Obyan) Intl	PGSN					No Information
PAKISTAN KARACHI/Quaid-E-Azam Intl LAHORE/Lahore	OPKC OPLA	WSPK31 WSPK31	WCPK31		OPKR OPLR	
PAPUA NEW GUINEA PORT MORESBY/Jacksons	AYPY	WSNG20	WCNG20	WVNG20 WVNG01	AYPY	
PHILIPPINES MANILA/Ninoy Aquino Intl	RPLL	WSPH31	WCPH31	WVPH31	RPHI	
REPUBLIC OF KOREA INCHEON/Incheon Intl	RKSI	WSKO31	WCKO31	WVKO31	RKRR	
SINGAPORE SINGAPORE/Singapore Changi	WSSS	WSSR20	WCSR20	WVSR20	WSJC	
SOLOMON ISLANDS HONIARA/Henderson	AGGH				AGGG	No Information
SRI LANKA COLOMBO/Katunayake	VCBI	WSSB31	WCSB31		VCBI	

MWO location	ICAO location indicator	WMO SIGMET Headings			FIR/ACC served	Remarks
		WS	WC	WV	ICAO location indicator	
1	2	3	4	5	6	7
THAILAND						
BANGKOK/Bangkok Intl	VTBD	WSTH31	WCTH31	WVTH31	VTBB	
UNITED STATES						
ANCHORAGE/Anchorage Intl	PAWU	WSAK01-09 PAWU	WCAK01-09 PAWU	WVAK01-09 PAWU	PAZA	
HONOLULU/Honolulu Intl	PHFO	WSPA01-13 PHFO	WCPA01-13 PHFO	WVPA 01-13 PHFO	KZOA	
(KANSAS CITY/Missouri)	KKCI	WSNT01-13 KKCI	WCNT01-13 KKCI	WVNT01-13 KKCI	KZNY KZMA KZHU TJZU	
(KANSAS CITY/Missouri)	KKCI	WSPN01-13 KKCI	WCPN01-13 KKCI	WVPN01-13 KKCI	KZOA	
VIET NAM						
Gia Lam MWO	VVGL	WSVS31	WCVS31	WVVS31	VVNB VVTS	

APPENDIX I

WMO HEADINGS FOR TROPICAL CYCLONE AND VOLCANIC ASH ADVISORY BULLETINS (FK and FV)

USED BY ASIA/PAC TCACs and VAACs

Explanation of Table

Col. 1:	Name of the TCAC or VAAC
Col 2:	ICAO location indicator used by the TCAC or VAAC
Col 3:	WMO heading (TTAAii CCCC) of the FK or FV bulletin
Col 4:	Remarks (e.g., Area of coverage of the advisory, or any other bulletin-specific information)

TCAC/VAAC (State)	ICAO location indicator	WMO Heading TTAAii CCCC	Remarks
1	2	3	4
TC Advisories (FK)			
Miami (United States)	KNHC	FKNT21-24 KNHC FKPZ21-25 KNHC	Atlantic For Northeast Pacific to 140W; ii = 21 – 25; up to 5 different bulletins possible at a time according to the number of TCs in the TCAC's area of resp.
Honolulu (United States)	PHFO	FKPA21-25 KHFO	For North Central Pacific: 140W – 180W; ii = 21 – 25; up to 5 different bulletins possible at a time according to the number of TCs in the TCAC's area of resp.
New Delhi (India)	VIDP	FKIN20 VIDP FKIN21 VIDP	Bay of Bengal Arabian Sea
Darwin (Australia)	ADRM	FKAU01 ADRM FKAU02 ADRM	Area bounded by Equator 125E, 15S 125E, 15S 129E, 32S 129E, 32S 138E, 14S 138E,10S 141E, Equator 141E, Equator 125E. (Advisories prepared by Darwin)
		FKAU03 ADRM FKAU04 ADRM	Area bounded by 10S 141E, 14S 138E, 32S 138E, 32S 160E, 5S 160E, 8S 155E, 12S 155E, 12S 147E, 9S 144E, 10S 141E and Port Moresby TCWC area. (Advisories prepared by Brisbane)

TCAC/VAAC (State)	**ICAO location indicator**	**WMO Heading TTAAii CCCC**	**Remarks**
1	2	3	4
		FKAU05 ADRM FKAU06 ADRM	Area bounded by 10S 90E, 36S 90E, 36S 129E, 15S 129E, 15S 125E, 10S 125E, 10S 90E, and the interim Indonesia area. (Advisories prepared by Perth)
Nadi (Fiji)	NFFN	FKPS01 NFFN	
Tokyo (Japan)	RJTD	FKPQ30-35 RJTD	
VA Advisories (FV)			
Anchorage (United States)	PAWU	FVAK21-25 PAWU	ii = 21 – 25; up to 5 different bulletins possible at a time according to the number of VA clouds in the VAAC's area of resp.
Darwin (Australia)	ADRM	FVAU01-06 ADRM	
Tokyo (Japan)	RJTD	FVFE01 RJTD	
Washington (United States)	KNES	FVXX20-27 KNES	ii = 20 – 27; up to 8 different bulletins possible at a time according to the number of VA clouds in the VAAC's area of responsibility
Wellington (New Zealand)	NZKL	FVPS01 NZKL	

APPENDIX J

ASIA/PAC SIGMET TEST PROCEDURES
(revision 8 Jan 2007)

1. Introduction

1.1 The MET Divisional Meeting (2002) formulated Recommendation 1/12 b), *Implementation of SIGMET requirements,* which called, *inter alia,* for the relevant planning and implementation regional groups (PIRGs) to conduct periodic tests of the issuance and reception of SIGMET messages, especially those for volcanic ash.

1.2 The Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG) recognized that, since SIGMET was irregular non-scheduled information, periodic were necessary to monitor the SIGMET availability and identify deficiencies in the dissemination procedures. Based on the results of the tests, States would be provided with specific advice aimed at improving their SIGMET-related practices and procedures. Therefore, the fifteenth meeting of APANPIRG held in Bangkok, 23 to 27 August 2004, adopted Conclusion 15/42, as follows:

> ***Conclusion 15/42 – Conducting SIGMET tests in the Asia/Pacific region***
>
> *That, ICAO Regional Office invite all TCAC and VAAC Provider States in the Asia/Pacific region, and all Asia/Pacific States with MWOs responsible for issuance of SIGMET for volcanic ash and/or tropical cyclones, to take part in the SIGMET tests to be carried out according to procedures developed by the VA/TC Implementation Task Force.*
>
> *Note: ICAO Regional Office will coordinate the tests and notify the participating States about their schedule and procedures.*

1.3 The VA/TC Implementation Task Force (VA/TC/I TF), in coordination with the OPMET Management Task Force (OPMET/M TF) and the Regional Office, Bangkok, developed the procedures for conducting regional SIGMET tests as described in this document. The test procedures encompass all the three types of SIGMET, as follows:

- SIGMET for volcanic ash (WV SIGMET);
- SIGMET for tropical cyclones (WC SIGMET); and
- SIGMET for other weather phenomena (WS SIGMET).

1.4 The requirements for dissemination of SIGMET are specified in Annex 3, Appendix 6, 1.2. Regional guidance on the preparation and dissemination of SIGMET is provided in this *Regional SIGMET Guide*.

2. Purpose and Scope of SIGMET tests

2.1 The purpose of the SIGMET tests is to check the awareness of participating MWOs of the ICAO requirements for the issuance of SIGMET and the compliance of the States’ procedures for preparation and dissemination of SIGMET bulletins with the relevant ICAO Standards and Recommended Practices (SARPs) and regional procedures.

2.2 In the case of SIGMET for tropical cyclones and volcanic ash clouds (referred hereafter as WC SIGMET and WV SIGMET respectively) the scope of the tests is to check also the interaction between the Tropical Cyclone Advisory Centres (TCAC) and Volcanic Ash Advisory Centres (VAAC), and the MWOs in their areas of responsibility. Therefore, during the WC and WV SIGMET tests the issuance of TEST SIGMET by the MWO should be triggered by a test advisory issued by the respective TCAC or VAAC.

2.3 The Regional OPMET Data Banks (RODB) will monitor the dissemination by filing all TEST SIGMETs and advisories and the corresponding reception times. The monitoring results will be provided in the form of summaries to the Rapporteurs of the VA/TC/I Task Force and the OPMET/M TF with a copy to the Regional Office, Bangkok.

2.4 Participating States, for which discrepancies of the procedures or other findings are identified by the tests, will by advised the Regional Office and requested to take necessary corrective action.

3. SIGMET test procedures

3.1 Procedures for WC and WV SIGMET tests

3.1.1 Participating units:

3.1.1.1 Tropical Cyclone Advisory Centre (TCAC):
Darwin
Honolulu
Miami
Nadi
New Delhi
Tokyo

3.1.1.2 Volcanic Ash Advisory Centres (VAAC):
Anchorage
Darwin
Tokyo
Washington
Wellington

3.1.1.3 Regional OPMET Data Banks (RODB):
Bangkok
Brisbane
Nadi
Singapore
Tokyo

3.1.1.4 Meteorological Watch Offices (MWO):
All MWOs listed in FASID Tables MET 3A and MET 3B of the ASIA/PAC Basic ANP and FASID (Doc 9673), under the responsibility of the corresponding VAACs and TCACs.

Note: Participation of MWOs of States outside ASIA/PAC region, but listed in FASID Tables MET 3A and MET 3B should be coordinated through the ICAO Regional Office concerned.

3.1.2 Test messages

3.1.2.1 On the specified date for the test **at 0200 UTC** (if not otherwise advised by the Regional Office) the participating VAAC and TCAC should issue a TEST VA or TC advisory. The structure of the TEST advisories should follow the standard format given in Annex 3 with indication that it is a test message as shown in Appendix A to the Procedures.

3.1.2.2 MWOs, upon receipt of the TEST VA or TC advisory, should issue a TEST SIGMET for volcanic ash or tropical cyclone, respectively, and send it to all RODBs. The WMO heading and the first line of the SIGMET should be valid ones, while the body of the message should contain only explanatory note regarding the test in plain language, as shown in Appendix A. The period of validity of the TEST SIGMET should be very short, e.g., 10 minutes.

3.1.2.3 To avoid over-writing of a valid SIGMET, TEST SIGMET for VA or TC should not be issued by the MWO in case that there is a valid SIGMET of the same type for its area of responsibility. Such MWOs are strongly encouraged to notify the Regional Office via e-mail of their non-participation in the test due to the said reasons.

3.2 Procedures for WS SIGMET tests

3.2.1 Participating units:

3.2.1.1 Regional OPMET Data Banks (RODB):
Bangkok
Brisbane
Nadi
Singapore
Tokyo

3.2.1.2 Meteorological Watch Offices (MWO):
All MWOs listed in FASID Table MET 1B of ASIA/PAC Basic ANP and FASID (Doc 9673).

3.2.2 Test SIGMET

3.2.2.1 The MWOs should issue a TEST SIGMET during the 10-minutes period between **0200 and 0210 UTC** (if not otherwise advised by the Regional Office) on the date agreed for the test.

3.2.2.2 The WMO heading and the first line of the SIGMET bulletin should be valid ones, while the body of the message should contain an explanatory text on the tests as shown in Appendix A. The period of validity of the TEST SIGMET should be very short, e.g., 10 minutes.

3.2.3 Special procedure to avoid overwriting of a valid SIGMET

3.2.3.1 It is vital to ensure that TEST SIGMET is not confused with operational SIGMET and avoid overwriting a valid operational SIGMET in an automated system. In order to prevent this it is suggested that:

a) If at the time of the SIGMET test NO SIGMET is current for the FIR, the number of the Test SIGMET should follow the normal numbering sequence; e.g. if the last "normal" SIGMET before the test was number "03", the TEST SIGMET should be number "04", and the first "normal" SIGMET after the test should be number "05".

b) If a SIGMET is VALID at the time of the test then the TEST SIGMET should be issued and the valid SIGMET should be repeated immediately after the TEST SIGMET. E.g., if the following SIGMET is issued at 0100 on the date of the test:

WSAU01 YBRF 250100
YBBB SIGMET 1 VALID 250100/250500 YBRF-
BRISBANE FIR SEV TURB FCST WI ….=

A SIGMET test is scheduled for 0200 UTC on the 25th. The TEST SIGMET is issued with the next consecutive sequence number as follows:

WSAU01 YBRF 250200
YBBB SIGMET 2 VALID 250200/250210 YBRF-
THIS IS A TEST SIGMET PLEASE DISREGARD=

The original SIGMET is then retransmitted immediately after this with the next consecutive sequence number and the validity period is amended accordingly:

WSAU01 YBRF 250200
YBBB SIGMET 3 VALID 250200/250500
BRISBANE FIR SEV TURB FCST WI … =

3.3 Common procedures

3.3.1 Test date and time

3.3.1.1 ICAO Regional Office will set a date and time for each SIGMET test after consultation with the participating VAACs, TCACs and RODBs. The information about the agreed date and time will be sent to all States concerned by a State letter and copied to the States' SIGMET Tests Focal Points.

3.3.1.2 Tests for different types of SIGMET should preferably be conducted on separate dates.

3.3.1.3 At least two SIGMET tests per year should be conducted.

3.3.2 Dissemination of test SIGMETs and advisories

3.3.2.1 All TEST SIGMETs and advisories should be sent to the five ASIA/PAC RODBs. The AFTN addresses to be used by the MWOs, TCACs and VAACs are as follows:

Bangkok	VTBBYPYX
Brisbane	YBBBYPYX
Nadi	NFZZRFXX
Singapore	WSZZYPYM
Tokyo	RJAAYPYX

3.3.2.2 RODB/IROG Singapore will relay the test bulletins to the corresponding IROG in the European Region where additional monitoring of those bulletins may be performed.

3.3.3 Coordination with the ATS units

3.3.3.1 MWOs should inform the associated ATS units of the forthcoming SIGMET tests by a suitable advanced notice.

3.4 Processing of the test messages and results

3.4.1 The RODBs should file all incoming TEST advisories and SIGMETs and perform an analysis of the availability, timeliness of arrival and the correctness of the WMO bulletin headings. The results should be presented by each RODB in SIGMET TEST Summary Tables, as shown in Appendix B. WV/WC SIGMET Summary Tables should be sent to the Rapporteur of the VA/TC/I TF, and WS SIGMET Summary Tables to the Rapporteur of the OPMET/M TF, with copies of all tables to the Regional Office.

3.4.2 A consolidated summary report will be prepared by both Rapporteurs and submitted to the Regional Office. The report should include recommendations for improvement of the SIGMET exchange and availability. The results of the tests should be reported to OPMET/M TF and CNS/MET Sub-group meetings.

3.4.3 The current contact information for sending Summary Tables is as follows:

WS SIGMET summary tables sent to:

Mr. Rick Houghton
National Manager Defence Weather Services
Bureau of Meteorology
6th Floor Bureau of Meteorology Building
700 Collins St. Docklands
Victoria
AUSTRALIA
Tel: +61 (3) 9669-4253
Fax: +61 (3) 9669-4695
e-mail: R.Houghton@bom.gov.au

WV/WC SIGMET summary tables sent to:

Mr. Masashi Kunitsugu
Senior Scientific Officer, Administration Division
Japan Meteorological Agency
Forecast Department
1-3-4, Otemachi
Chiyodaku
Tokyo 100-8122
JAPAN
Tel: +81 (3) 3212-8341 ext.3351
Fax: +81 (3) 3284-0180
e-mail: kunitsugu@met.kishou.go.jp

All Summary Tables and any enquiries about the SIGMET tests sent to:

ICAO Regional Office, Bangkok
e-mail: icao_apac@bangkok.icao.int
cc: divanov@bangkok.icao.int

ASIA/PAC SIGMET TEST PROCEDURES - Format of TEST advisories and SIGMETs

1. Format of TEST Volcanic Ash Advisory

```
VOLCANIC ASH ADVISORY
ISSUED:                 YYYYMMDD/0200Z
VAAC:                   (name of VAAC)
VOLCANO:                TEST
LOCATION:               UNKNOWN
AREA:                   (name of VAAC) VAAC AREA
SUMMIT ELEVATION:       UNKNOWN
ADVISORY NUMBER:        YYYY/nn (actual number)
INFORMATION SOURCE:     NIL
AVIATION COLOUR CODE:   NIL
ERUPTION DETAILS: NIL
OBS ASH DATE/TIME:      DD/0150Z
OBS ASH CLD:            ASH NOT IDENTIFIABLE FROM SATELLITE DATA
FCST ASH CLD +6 HR:     01/0800Z SFC/FL600 NO ASH EXP
FCST ASH CLD +12 HR:    01/1400Z SFC/FL600 NO ASH EXP
FCST ASH CLD +18 HR:    01/2000Z SFC/FL600 NO ASH EXP
NEXT ADVISORY:          NO FURTHER ADVISORIES
REMARKS: THIS IS A TEST VA ADVISORY. MWO SHOULD NOW ISSUE A TEST SIGMET FOR
VA, UNLESS THERE IS A VAILD SIGMET FOR VA.
PLEASE REFER TO THE LETTER FROM ICAO APAC OFFICE DATED xxxxxx=
```

2. Format of TEST Tropical Cyclone Advisory

```
TC ADVISORY
DTG:                    YYYYMMDD/0200Z
TCAC:                   (name of TCAC)
TC:                     TEST
NR:                     nn (actual number)
PSN:                    NIL
MOV:                    NIL
C:                      NIL
MAX WIND:               NIL
FCST PSN +12HR:         NIL
FCST MAX WIND +12HR:    NIL
FCST PSN +18HR:         NIL
FCST MAX WIND +18HR:    NIL
FCST PSN +24HR:         NIL
FCST MAX WIND +24HR:    NIL
NXT MSG:                NIL
REMARKS: THIS IS A TEST TC ADVISORY. MWO SHOULD NOW ISSUE A TEST SIGMET FOR
TC, UNLESS THERE IS A VAILD SIGMET FOR TC.
PLEASE REFER TO THE LETTER FROM ICAO APAC OFFICE DATED xxxxxx=
```

3. Format of TEST SIGMET for Volcanic Ash

```
WVXXii CCCC YYGGgg
CCCC SIGMET n(nn) VALID YYGGgg/YYGGgg CCCC–
THIS IS A TEST SIGMET PLEASE DISREGARD. TEST VA ADVISORY NUMBER XX RECEIVED
AT YYGGggZ=
```

Example:

```
WVHK31 VHHH 180205
VHHK SIGMET 01 VALID 180205/180215 VHHH-
THIS IS A TEST SIGMET, PLEASE DISREGARD. TEST VA ADVISORY NUMBER 01
RECEIVED AT 180200Z=
```

4. Format of TEST SIGMET for Tropical Cyclone

```
WCXXii CCCC YYGGgg
CCCC SIGMET n(nn) VALID YYGGgg/YYGGgg CCCC–
THIS IS A TEST SIGMET PLEASE DISREGARD. TEST TC ADVISORY NUMBER XX RECEIVED AT
YYGGggZ=
```

Example:

```
WCHK31 VHHH 180205
VHHK SIGMET 01 VALID 180205/180215 VHHH-
THIS IS A TEST SIGMET PLEASE DISREGARD. TEST TC ADVISORY NUMBER 01
RECEIVED AT 180200Z=
```

5. Format of TEST SIGMET for other weather phenomena

```
WSXXii CCCC YYGGgg
CCCC SIGMET n(nn) VALID YYGGgg/YYGGgg CCCC–
THIS IS A TEST SIGMET PLEASE DISREGARD=
```

Example:

```
WSHK31 VHHH 180200
VHHK SIGMET 04 VALID 180200/180210 VHHH-
THIS IS A TEST SIGMET PLEASE DISREGARD=
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Notes: *1) "XX" in the WMO heading to be replaced by the respective WMO geographical designator*
2) Actual SIGMET number to be used in all TEST SIGMETs

— END —

Part VI

METEOROLOGY (MET)

INTRODUCTION

1. This part of the Asia and Pacific (ASIA/PAC) Basic Air Navigation Plan contains elements of the existing planning system and introduces the basic planning principles, operational requirements and planning criteria related to aeronautical meteorology (MET) as developed for the ASIA/PAC regions.

2. As a complement to the Statement of Basic Operational Requirements and Planning Criteria (BORPC) set out in Part I, Part VI constitutes the stable guidance material and considered to be the minimum necessary for effective planning of MET facilities and services in the ASIA/PAC regions. A detailed description/list of the facilities and/or services to be provided by States in order to fulfill the requirements of the plan is contained in the ASIA/PAC Facilities and Services Implementation Document (FASID). During the transition and pending full implementation of the future communications, navigation and surveillance/air traffic management (CNS/ATM) system, it is expected that the existing requirements will gradually be replaced by new CNS/ATM-related requirements. Further, it is expected that some elements of the CNS/ATM system will be subject to amendment, as necessary, on the basis of experience gained in their implementation.

3. The Standards, Recommended Practices and Procedures to be applied are contained in:

a) Annex 3 — *Meteorological Service for International Air Navigation*; and

b) *Regional Supplementary Procedures* (Doc 7030).

4. Background information of importance in the understanding and effective application of this part of the plan is contained in the *Report of the Third Asia/Pacific Regional Air Navigation Meeting* (Doc 9614, ASIA/PAC/3 (1993)), supplemented by information appropriate to the ASIA/PAC regions which is contained in the reports of the other regional air navigation (RAN) meetings.

5. A RAN meeting recommendation or conclusion, ASIA/PAC Air Navigation Planning and Implementation Regional Group (APANPIRG) conclusion or ICAO operations group conclusion shown in brackets below a heading indicates the origin of all paragraphs following that heading. A RAN meeting recommendation or conclusion, APANPIRG conclusion or ICAO operations group conclusion shown in brackets below a paragraph indicates the origin of that particular paragraph.

METEOROLOGICAL SERVICE REQUIRED AT AERODROMES AND REQUIREMENTS FOR METEOROLOGICAL WATCH OFFICES

(FASID Tables MET 1A and MET 1B)

6. The service to be provided at international aerodromes listed in the Appendix to Part III of the Basic ANP is set out in Table MET 1A.
[ASIA/PAC/3, Recs. 8/1 and 8/16]

7. The service to be provided for flight information regions (FIRs), upper flight information regions (UIRs), control areas (CTAs) and search and rescue regions (SRRs) is set out in Table MET 1B.
[ASIA/PAC/3, Recs. 8/2 and 8/16]

8. Hourly routine observations should be made at all aeronautical meteorological stations, to be issued as local

routine reports and METAR, together with special observations to be issued as local special reports and SPECI.

9. Aerodrome forecasts should be issued as TAF, normally at intervals of six hours, with the period of validity beginning at one of the main synoptic hours (00, 06, 12, 18 UTC). The period of validity should be of eighteen or twenty-four hours' duration to meet the requirements indicated in Table MET 1A. The filing time of the forecasts should be approximately two hours before the start of the period of validity.
[ASIA/PAC/3, Rec. 8/16]

10. The forecast maximum and minimum temperature together with their respective times of occurrence should be included in TAF for certain aerodromes as agreed between the meteorological authorities and the operators concerned.
[ASIA/PAC/3, Rec. 8/16]

11. Trend forecasts should be provided at the aerodromes as indicated in Table MET 1A.
[ASIA/PAC/3, Recs. 8/1 and 8/16]

12. Meteorological service should be provided on a twenty-four-hour basis, except as otherwise agreed between the meteorological authority, the air traffic services (ATS) authority and the operators concerned.
[ASIA/PAC/3, Rec. 8/16]

13. At aerodromes with limited hours of operation, METAR should be issued prior to the aerodrome resuming operations to meet pre-flight and in-flight planning requirements for flights due to arrive at the aerodrome concerned as soon as it is opened for use. Furthermore, TAF should be issued with adequate periods of validity so that they cover the entire period during which the aerodrome is open for use.
[ASIA/PAC/3, Rec. 8/16]

14. When a meteorological watch office (MWO) is temporarily not functioning or is not able to meet all its obligations, its responsibilities should be transferred to another MWO and a NOTAM should be issued to indicate such a transfer and the period during which the office is unable to fulfil all its obligations.
[ASIA/PAC/3, Rec. 8/16]

15. Details of the service provided should be indicated in the Aeronautical Information Publication (AIP) in accordance with the provisions of Annex 15.
[ASIA/PAC/3, Rec. 8/16]

16. As far as possible, English should be among the

[ASIA/PAC/3, Rec. 8/16]

languages used in meteorological briefing and consultation.
[ASIA/PAC/3, Rec. 8/16]

17. Tables MET 1A and MET 1B should be implemented as soon as possible. ~~, on the understanding that only those parts of the briefing and documentation called for in Column 7 of Table MET 1A that are required for current operations need to be available, and that t~~The implementation of a new MWO~~s~~ or changes to the area served by existing MWO indicated in Table MET 1B, ~~Columns 1 and 3 respectively,~~ should take place coincidently with the implementation of, or changes to, the FIR/UIR/CTA/SRR concerned.
[ASIA/PAC/3, Rec. 8/16]

AIRCRAFT OBSERVATIONS AND REPORTS
(FASID Table MET 1B)

18. The meteorological authority should adopt the approved list of ATS/MET reporting points, as it relates to points located within and on the boundaries of the FIR for which the State is responsible. Those ATS/MET reporting points should be published in the AIP, under GEN 3.5.6 — Aircraft reports, of the State concerned.
[ASIA/PAC/3, Rec. 8/16]

Note.— The approved list of ATS/MET reporting points is published and kept up to date by the ICAO Regional Office concerned, on the basis of consultations with ATS and MET authorities in each State and the provisions of Annex 3 in this respect.

19. The MWOs designated as collecting centres for air-reports received by voice communication with the corresponding FIR/UIR are shown in Table MET 1B.

SIGMET AND AIRMET INFORMATION
(FASID Tables MET 3A and MET 3B)

~~20. The period of validity of SIGMET messages should not exceed four hours. In the special case of SIGMET messages for volcanic ash cloud and tropical cyclones, the validity period should be extended up to six hours and an outlook should be added giving information for an additional period of up to twelve hours concerning the trajectory of the volcanic ash cloud and positions of the~~

~~centre of the tropical cyclone respectively.~~
~~[ASIA/PAC/3, Rec. 8/16]~~

21. T~~In order to assist MWOs in the preparation of the outlook included in SIGMET messages for tropical cyclones, tr~~opical cyclone advisory centres (TCACs) Darwin, Honolulu, Miami, Nadi, New Delhi and Tokyo have been designated to prepare the required advisory information and disseminate it to the MWOs concerned in the ASIA/PAC regions. Table MET 3A sets out the area of responsibility, the period(s) of operation of the TCAC(s) and the MWOs to which the advisory information should be sent.~~ Advisory information should be issued for tropical cyclones in which the surface wind speed averaged over ten minutes is expected to equal or exceed 63 km/h (34 kt)~~.
[ASIA/PAC/3, Recs. 8/4 and 8/16]
[APANPIRG/12 Conc. 12/33]

22. ~~In order to assist MWOs in the preparation of the outlook included in SIGMET messages for v~~Volcanic ash, volcanic ash advisory centres (VAACs) Anchorage, Darwin, Tokyo, Washington and Wellington have been designated to prepare the required advisory information and disseminate it to the MWOs and area control centres (ACCs) concerned in the ASIA/PAC regions following notification/detection of the ash cloud. Table MET 3B sets out the areas of responsibility of the VAACs and the MWOs and ACCs to which the advisory information should be sent.
[IAVWOPSG~~/1,~~ Conc~~.~~lusion 1/1, Conclusion 3/2]]

23. In order for the VAACs to initiate the monitoring of volcanic ash from satellite data and the forecast of volcanic ash trajectories, MWOs should notify the relevant VAAC immediately on receipt of information that a volcanic eruption has occurred or volcanic ash has been observed in the FIR for which they are responsible. In particular, any special air-reports of pre-eruption volcanic activity, a volcanic eruption or volcanic ash cloud received by MWOs should be transmitted without delay to he VAAC concerned. Selected State volcano observatories have been designated for direct notification of significant pre-eruption volcanic activity, a volcanic eruption and/or volcanic ash in the atmosphere to their corresponding ACC, MWO and VAAC.
[IAVWOPSG~~/1,~~ Conc~~.~~lusion 1/1, Conclusion 2/2]

24. AIRMET messages are not required to be issued by MWOs.
[APANPIRG/7, Conc. 7/22]

EXCHANGE OF OPERATIONAL METEOROLOGICAL (OPMET) INFORMATION
(FASID Tables MET 2A, MET 2B,
MET 4A, MET 4B and MET 4C)

Exchange of METAR, SPECI and TAF

25. Tables MET 4A and MET 4B set out the Regional OPMET Bulletin Exchange (ROBEX) Scheme for the collection and dissemination of METAR, SPECI and TAF. These tables contain information regarding the designated ROBEX centres and their respective areas of responsibility.
[ASIA/PAC/3, Recs. 9/6 and 9/8]
[APANPIRG/7, Conc. 7/20]

Note.— Details of the ROBEX procedures regarding the exchange of OPMET information required under the scheme are given in the ROBEX Handbook prepared by the ICAO Asia and Pacific Regional Office (Bangkok) in coordination with the ICAO Middle East Regional Office (Cairo).

26. Tables MET 4A and MET 4B should be updated, as necessary, by the ICAO Regional Office on the basis of changes in the pattern of aircraft operations, the Statement of Basic Operational Requirements and Planning Criteria and in consultation with those States and international organizations directly concerned.
[ASIA/PAC/3, Rec. 9/8]

27. Requirements for METAR, SPECI and TAF not carried on the ROBEX Scheme which should be available at meteorological offices are contained in Table MET 2A. This table should be updated, as necessary, by the ICAO Regional Office on the basis of changes in the pattern of aircraft operations, the Statement of Basic Operational Requirements and Planning Criteria, and in consultation with those States and international organizations directly concerned.
[ASIA/PAC/3, Recs. 9/1 and 9/8]

28. The exchanges indicated in Table MET 2A should be implemented as soon as possible, but only for those related to current aircraft operations. New exchanges should be started coincidently with the introduction of new aircraft operations. Any changes in this respect (i.e. additional OPMET information needed or OPMET information no longer required) should be notified to the corresponding meteorological authority which, in turn, should inform the ICAO Regional Offices concerned.
[ASIA/PAC/3, Rec. 9/8]

OPMET data banks to support the ROBEX Scheme

29. The OPMET data banks in Bangkok, Brisbane, Nadi, Singapore and Tokyo have been designated to support the ROBEX scheme and serve States in the ASIA/PAC regions to access OPMET information which is required but not received. Table MET 4C sets out the responsibilities of the ASIA/PAC OPMET data banks for collection and dissemination of OPMET bulletins to support the ROBEX Scheme.
[APANPIRG/7, Rec. 7/20]

Note.— A list of the OPMET information available at the OPMET data banks to serve the ASIA/PAC regions, together with the procedures to be used in communicating with the data banks, is contained in the Asia/Pacific OPMET data banks interface control document prepared by the ICAO Regional Office, Bangkok.

Exchange of SIGMET information and air-reports

30. ~~The exchange requirements for SIGMET and special air-reports are contained in Table MET 2B. This table should be updated, as necessary, by the ICAO Regional Office on the basis of changes in the pattern of aircraft operations, the Statement of Basic Operational Requirements and Planning Criteria, and in consultation with those States and international organizations directly concerned.~~
~~[ASIA/PAC/3, Recs. 9/2 and 9/8]~~

31. Each MWO should arrange for the transmission to all aerodrome meteorological offices within its associated FIR of its own SIGMET messages and relevant SIGMET messages for other FIR, as required for briefing and, where appropriate, for flight documentation.
[ASIA/PAC/3, Rec. 8/16]

32. Each MWO should arrange for the transmission to its associated ACC/FIC of SIGMET information and special air-reports received from other MWOs.

33. Each MWO should arrange for the transmission of routine air-reports received by voice communication to all meteorological offices within its associated FIR. Special air-reports which do not warrant the issuance of a SIGMET should be disseminated by MWOs in the same way as SIGMET messages~~, in accordance with Table MET 2B~~.

Note.— Details of the procedures regarding the exchange of SIGMET information required by FASID Table MET 1B are provided in the ASIA/PAC SIGMET Guide prepared by the ICAO Asia and Pacific Regional Office, Bangkok.

WORLD AREA FORECAST SYSTEM (WAFS)
(FASID Tables MET 5, MET 6 and MET 7
and Charts MET 4, MET 5 and MET 6)

34. FASID Table MET 5 sets out the ASIA/PAC ~~regions'~~ Regions requirements for WAFS forecasts to be provided by WAFC London and WAFC Washington.
[WAFSOPSG~~/1,~~ Conc~~.~~lusion 1/2]

~~35. The levels for which forecasts of upper-air wind and temperature and SIGWX forecasts in chart form are to be provided by WAFC London and WAFC Washington, and the areas to be covered by these charts, are indicated in Table MET 5.~~
~~[WAFSOPSG/1, Conc. 1/2]~~

~~*Note.— WAFCs will continue to issue forecasts of upper- air wind and temperature and of SIGWX in chart form until 1 July 2005.*~~

36. FASID Table MET 6 sets out the responsibilities of WAFC London and WAFC Washington for the production of WAFS forecasts. For back-up purposes, each WAFC should have the capability to produce WAFS forecasts for all the required areas of coverage.
[WAFSOPSG~~/1,~~ Conclusion~~.~~ 1/2]

~~37. The projection of the WAFS forecasts in chart form and their areas of coverage should be as indicated in Charts MET 4, MET 5 and MET 6 associated with Table MET 6; their scale should be 1:20 × 10^6, true at 22.5° in the case of charts in the Mercator projection, and true at 60° latitude in the case of charts in the polar stereographic projection.~~
~~[WAFSOPSG/1, Conc. 1/2]~~

~~*Note.— WAFCs will continue to issue forecasts of upper- air wind and temperature and of SIGWX in chart form until 1 July 2005.*~~

38. WAFS products should be disseminated by WAFC London using the satellite distribution system for information relating to air navigation (SADIS) and by WAFC Washington using the international satellite communications system (ISCS/2) ~~To fulfill the requirements of long-distance flights, transmission of WAFS products should be completed not later than eleven~~

~~hours before validity time.~~covering the reception area shown in FASID Table CNS4.
[WAFSOPSG~~/1,~~ Conclusion~~.~~ 1/2]

~~39. The amendment service to the SIGWX forecasts issued by WAFC London and WAFC Washington should be by means of amended binary universal form for the representing of meteorological data (BUFR) files disseminated through SADIS and ISCS2.~~
~~[WAFSOPSG/1, Conc. 1/2]~~

40. Each State should make the necessary arrangements to receive and make full operational use of WAFS products disseminated by WAFC London and WAFC Washington. FASID Table MET 7 lists the authorized users of the SADIS and ISCS2 satellite broadcasts in the ASIA/PAC regions and location of the operational VSATs.
[WAFSOPSG~~/1,~~ Conclusion~~.~~ 1/2]

Table MET 1B

METEOROLOGICAL WATCH OFFICES

EXPLANATION OF THE TABLE

Column

1 Location of the meteorological watch office (MWO). Locations, other than aerodromes, where an MWO is to be established are shown in parentheses.

2 ICAO location indicator, assigned to the MWO.

3 Name of the FIR, UIR and/or search and rescue region (SRR) served by the MWO.

4 ICAO location indicator assigned to the ATS unit serving the FIR, UIR and/or SRR.

5 Indication of requirement for the MWO to issue SIGMET for volcanic ash.

6 Indication of requirement for the MWO to issue SIGMET for tropical cyclones.

~~5~~7 Remarks.

Note. — Unless otherwise stated in column 5, the MWO listed in column 1 is the designated collecting centre for the air-reports received within the corresponding FIR/UIR listed in column 3.

MWO Location	ICAO loc. ind.	Area served		SIGMET		Remarks
		Name	ICAO loc. ind.	VA	TC	
1	2	3	4	5	6	7
AUSTRALIA						
ADELAIDE/Adelaide	YPRM	Melbourne FIR [1)]	YMMM			MWOs have areas of responsibility (AOR) defined by specific forecast area boundaries. These boundaries are not aligned with FIR boundaries MWO Darwin is designated to issue VA SIGMET for the whole Brisbane and Melbourne FIR
BRISBANE/Brisbane	YBRF	Brisbane FIR [2)] Melbourne FIR [3)]	YBBB YMMM		X	
DARWIN/Darwin	YDRM	Brisbane FIR [4)] Melbourne FIR [5)]	YBBB YMMM	X	X	
HOBART/Hobart	YMHF	Melbourne FIR [6)]	YMMM			
MELBOURNE/Melbourne	YMRF	Brisbane FIR [7)] Melbourne FIR [8)]	YBBB YMMM			
PERTH/Perth	YPRF	Brisbane FIR [9)] Melbourne FIR [10)]	YBBB YMMM		X	
SYDNEY/Sydney	YSRF	Brisbane FIR [11)] Melbourne FIR [12)]	YBBB YMMM			
TOWNSVILLE	YBTL	Brisbane FIR [13)]	YBBB			
BANGLADESH						
DHAKA/Zia Intl	VGZR	Dhaka FIR and SRR	VGFR	X	X	
CAMBODIA						
PHNOM-PENH/Pochentong	VDPP	Phnom-Penh FIR and SRR	VDPP	X	X	MWO not implemented
CHINA						
BEIJING/Capital	ZBAA	Beijing FIR and SRR	ZBPE	X		
GUANGZHOU/Baiyun	ZGGG	Guangzhou FIR and SRR	ZGZU	X	X	
KUNMING/Wujiaba	ZPPP	Kunming FIR and SRR	ZPKM	X		
LANZHOU/Zhongchuan	ZLLL	Lanzhou FIR and SRR	ZLHW	X		
~~Sanya~~HAIKOU/Meilan	ZJSY	Sanya FIR and SRR	ZJSA	X	X	
SHANGHAI/Hongqiao	ZSSS	Shanghai FIR and SRR	ZSHA	X	X	
SHENYANG/Taoxian	ZYTX	Shenyang FIR and SRR	ZYSH	X		
TAIBEI/Taibei Intl	RCTP	Taibei FIR and SRR	RCAA	X	X	
URUMQI/Diwopu	ZWWW	Urumqi FIR and SRR	ZWUQ	X		
WUHAN/Tianhe	ZHHH	Wuhan FIR and SRR	ZHWH	X		
HONG KONG/Hong Kong Intl	VHHH	Hong Kong FIR and SRR	VHHK	X	X	
DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA						
PYONGYANG/Sunan	ZKPY	Pyongyang FIR and SRR	ZKKK	X	X	MWO not implemented
FIJI						
NADI/Nadi Intl	NFFN	Nadi FIR and SRR	NFFF	X	X	
FRENCH POLYNESIA						
TAHITI/Faaa	NTAA	Tahiti FIR and SRR	NTTT	X	X	
INDIA						
CHENNAI/Chennai	VOMM	Chennai FIR and SRR	VOMF	X	X	
DELHI/Indira Ghandi Intl	VIDP	Delhi FIR and SRR	VIDF	X		

MWO Location	ICAO loc. ind.	Area served		SIGMET		Remarks
		Name	ICAO loc. ind.	VA	TC	
1	2	3	4	5	6	7
KOLKATA/Kolkata	VECC	Kolkata FIR and SRR	VECF	X	X	
MUMBAI/Jawaharlal Nehru Intl	VABB	Mumbai FIR and SRR	VABF	X	X	
INDONESIA						
JAKARTA/Soekarno-Hatta Intl	WIII	Jakarta FIR/UIR and SRR	WIIF	X	X	
UJUNG PANDANG/Hasanuddin	WAAA	Ujung Pandang FIR/UIR and SRR	WAAF	X	X	
JAPAN						
(TOKYO/Tokyo)	RJTD	Fukuoka FIR and Tokyo SRR	RJJJ	X	X	
LAO PEOPLE'S DEMOCRATIC REPUBLIC						
VIENTIANE/Wattay	VLVT	Vientiane FIR and SRR	VLVT	X		MWO not implemented
MALAYSIA						
KOTA KINABALU/Kota Kinabalu Intl	WBKK	Kota Kinabalu FIR and SRR	WBFC	X	X	
KUALA LUMPUR/Kuala Lumpur Intl	WMKK	Kuala Lumpur FIR and SRR	WMFC	X	X	
MALDIVES						
MALE/Hulule	VRMM	Male FIR and SRR	VRMM	X	X	
MONGOLIA						
ULAN BATOR/Ulan Bator	ZMUB	Ulan Bator FIR and SRR	ZMUB	X		
MYANMAR						
YANGON/Yangon Intl	VYYY	Yangon FIR and SRR	VYYY	X	X	
NAURU						
NAURU I./Nauru	ANAU	Nauru FIR and SRR	ANAU	X	X	MWO not implemented
NEPAL						
KATHMANDU/Tribhuvan Intl	VNKT	Kathmandu FIR and SRR	VNSM			
NEW ZEALAND						
(Wellington/Kelburn)	NZKL	Auckland Oceanic FIR and SRR New Zealand FIR AND SRR	NZZO NZZC	X		Operational monitoring coverage south of 60˚S is limited due to the lack of information
PAKISTAN						
KARACHI/Quaid-E-Azam Intl	OPKC	Karachi FIR and SRR	OPKR	X	X	
LAHORE/Lahore	OPLA	Lahore FIR and SRR	OPLR	X		
PAPUA NEW GUINEA						
PORT MORESBY/Jacksons	AYPY	Port Moresby FIR and SRR	AYPY	X	X	
PHILIPPINES						
MANILA/Ninoy Aquino Intl	RPLL	Manila FIR and SRR	RPHI	X	X	
REPUBLIC OF KOREA						
INCHEON/Incheon Intl	RKSI	Incheon FIR and SRR	RKRR	X	X	
SINGAPORE						
SINGAPORE/Singapore Changi	WSSS	Singapore FIR and SRR	WSJC	X	X	
SOLOMON ISLANDS						
HONIARA/Henderson	AGGH	Honiara FIR and SRR	AGGG	X	X	MWO not implemented

MWO Location	ICAO loc. ind.	Area served		SIGMET		Remarks
		Name	ICAO loc. ind.	VA	TC	
1	2	3	4	5	6	7
SRI LANKA						
COLOMBO/Katunayake	VCBI	Colombo FIR and SRR	VCBI	X	X	
THAILAND						
BANGKOK/Bangkok Suvarnabhumi Intl	VTBS	Bangkok FIR and SRR	VTBB	X	X	
UNITED STATES						
(ANCHORAGE)	PAWU	Anchorage FIR	PAZA	X		
HONOLULU/Honolulu Intl	PHFO	Oakland Oceanic FIR South of 30N, East of 130E and West of 140W; Honolulu SRR.	KZOA	X	X	
(KANSAS CITY/Missouri)	KMKC	Oakland Oceanic FIR North of 30N.	KZOA	X		
VIET NAM						
(Gia Lam)	VVGL	Hanoi FIR and SRR Ho-Chi-Minh FIR and SRR	VVNB VVTS	X	X	

1) limited by the coordinates: 27S/128E;27S/135E;26S/138E; 2806S/14012E;29S/142E; 3414S/14205E;3345S/14045E; 40S/14045E;45S/14045E; 45S/129E;33S/129E;30S/129E; 2715S/12830E.

2) outside the AOR of YBTL MWO and limited by the coordinates: 0937S/14102E;0916S/14203E; 0913S/14206E;0911S/14214E; 0914S/14217E;0922S/14230E; 0922S/14230E;0923S/14236E; 0919S/14248E;0908S/14352E; 0924S/14414E;0957S/14405E; 1130S/14402E;1144S/14404E; 12S/144E;12S/155E;14S/155E; 14S/16115E;1740S/163E; 2830S/163E;2830S/155E; 2850S/15316E;29S/150E; 29S/14330E;26S/138E; 14S/138E;0937S/14102E.

3) limited by the coordinates: 26S/138E;29S/143E;29S/142E; 2806S/14012E;26S/138E.

4) limited by the coordinates: 1055S/12447E;0920S/12650E; 07S/135E;0950S/13940E; 0950S/141E;14S/138E; 18S/138E;2215S/138E; 26S/138E;2218S/13638E; 2128S/13609E;2111S/13134E; 2151S/13058E;2313S/12828E; 2322S/12629E;2327S/12415E; 2250S/12330E;2030S/12330E; 20S/129E;16S/12915E; 1528S/12806E;1450S/12825E; 14S/12730E;1345S/12609E; 14S/124E;1055S/12447E.

5) limited by the coordinates: 2250S/12330E;2327S/12415E; 2322S/12629E;2313S/12828E; 2151S/13058E;2111S/13134E; 2128S/13609E;2218S/13638E; 26S/138E;27S/135E; 2715S/12830E;25S/12815E; 25S/12330E;2250S/12330E.

6) limited by the coordinates: 40S/14045E;40S/143E; 3953S/14353E;4006S/14759E; 40S/150E;45S/150E; 45S/14045E;40S/14045E.

7) limited by the coordinates: 3730S/15033E;3730S/163E; 45S/163E;45S/150E; 4434S/150E;4351S/15040E; 43S/151E;3811S/15019E; 3730S/15033E.

8) limited by the coordinates: 3345S/14045E;3414S/14205E; 3510S/14728E;3730S/150E; 3730S/15033E;3811S/15019E; 43S/151E;4351S/15040E; 4434S/150E;40S/150E; 4006S/14759E;3953S/14353E; 40S/143E;40S/14045E; 3811S/14045E;3345S/14045E.

9) limited by the coordinates: 12S/110E;12S/12320E; 1055S/12447E;14S/124E; 1345S/12609E;14S/12730E; 1450S/12825E;1528S/12806E; 16S/12915E;20S/129E; 2030S/12330E;2250S/12330E; 2153S/12226E; then along the major arc of a circle of 15 NM radius centred on 2143S 12213E; 2133S/12201E;2026S/12045E; then along the minor arc of a circle of 120NM radius centred on 2023S 11837E; 1823S/11825E;1753S/11822E; then along the minor arc of a circle of 150NM radius centred on 2023S 11837E; 1934S/11606E;1931S/11331E; 12S/110E.

10) limited by the coordinates: 06S/75E;02S/78E;02S/92E;12S/107E;12S/110E;1931S/11331E;1934S/11606E; then along the minor arc of a circle of 120NM radius centred on 2023S 11837E; 1753S/11822E;1823S/11825E; then along the minor arc of a circle of 120NM radius centred on 2023S 11837E; 2026S/12045E;2133S/12201E; then along major arc of a circle of 15.0NM radius centred on 2143S 12213E; 2153S/12225E;2250S/12330E; 25S/12330E;25S/12815E; 2715S/12830E;30S/129E; 30S/129E;33S/129E;45S/129E; 45S/75E;06S/75E.

11) limited by the coordinates: 29S/14632E;29S/150E; 2850S/15328E;2830S/155E; 2830S/163E;3730S/163E; 3730S/15033E 3657S/15045E; then east of the minor arc of a circle of 120NM radius centred on 3457S/15032E; 3519S/15256E;3421S/15140E; 3359S/15201E;3351S/15154E; 3328S/15148E;3315S/15126E; 3312S/15114E;3320S/15042E; 3327S/15033E;3206S/14850E; 29S/14632E.

12) limited by the coordinates: 29S/142E;29S/14330E; 29S/14632E;3206S/14850E; 3327S/15033E;3320S/15042E; 3312S/15114E;3315S/15126E; 3328S/15148E;3351S/15154E; 3359S/15201E;3421S/15140E; 3519S/15256E; then east of the minor arc of a circle of 120NM radius centred on 3457S 15032E; 3657S/15045E;3730S/15033E; 3730S/150;3510S/14728E; 3414S/14205E;29S/142E.

13) limited by the coordinates: 14S/138E;10S/141E;09S/142E; 09S/144E;13S/145E;15S/147E; 1817S/148E;2309S/15252E; 2334S/14811E;1818S/14332E; 18S/138E;14S/138E.

TABLE MET 3A

TROPICAL CYCLONE ADVISORY CENTRES

EXPLANATION OF THE TABLE

Column

1. Location of the tropical cyclon advisory centre (TCAC).
2. ICAO location indicator of TCAC (for use in the WMO heading of advisory bulletin).
3. Area of responsibility for the preparation of advisory information on tropical cyclones by the TCAC in Column 1.
4. Period of operation of the TCAC.
5. MWOs to which the advisory information on tropical cyclones should be sent.
6. ICAO location indicator of the MWOs in Column 5.

Note: MWOs in italics are situated outside the Asia/Pacific Region.

TROPICAL CYCLONE ADVISORY CENTRE	ICAO LOC. IND.	AREA OF RESPONSIBILITY	PERIOD OF OPERATION2)	MWOs TO WHICH ADVISORY INFORMATION IS TO BE SENT	
				Name	ICAO LOC. IND.
1	2	3	4	5	6
Darwin (Australia)	YDRM (ADRM)	South-East Indian Ocean1) N: 0°S S: 36°S W: 90°E E: 141°E South-West Pacific Ocean2: N: 0°S S: 40°S W: 141°E E: 160°E	November – April	Adelaide3) Brisbane Colombo Darwin Hobart3) Honiara4) Jakarta Melbourne3) Perth Port Moresby Sydney3) Townsville3) Ujung Pandang	YPRM YBRF VOMM YDRM YMHF AGGH WIII YMRF YPRF AYPY YSRF YBTL WAAA
Honolulu (United States)	PHFO	Central Pacific: N: 60°N S: 0°N W: 180°W E: 140°W	May – November	Anchorage Honolulu Kansas City Tahiti	PAWU PHFO KKCI NTAA
Miami (United States)	KNHC	Eastern Pacific: N: 60°N S: 0°N W: 140°E E: Coastline	May – November	Honolulu Kansas City ~~*Miami*~~ Tahiti	PHFO KKCI ~~*KNHC*~~ NTAA
Nadi (Fiji)	NFFN	Southern Pacific: N: 0°S S: 40°S W: 160°E E: 120°W	November – April	Brisbane Hobart3) Honiara4) Honolulu Melbourne3) Nadi Sydney3) Tahiti Townsville3) Wellington	YBRF YMHF AGGH PHFO YMRF NFFN YSRF NTAA YBTL NZKL
New Delhi (India)	VIDP	1) Bay of Bengal 2) Arabian Sea N: Coastline S: 5°N	April – June October – December	Chennai Colombo Dhaka	VOMM VCBI VGZR

TABLE 3A-13 ASIA/PAC FASID

TROPICAL CYCLONE ADVISORY CENTRE	ICAO LOC. IND.	AREA OF RESPONSIBILITY	PERIOD OF OPERATION[2)]	MWOs TO WHICH ADVISORY INFORMATION IS TO BE SENT	
				Name	ICAO LOC. IND.
1	2	3	4	5	6
		W: 60°E E: 100°E		~~Delhi~~	~~VIDP~~
				Jakarta	WIII
				Karachi	OPKC
				Kuala Lumpur	WMKK
				Male	VRMM
				Mumbai	VABB
				Tehran	*OIII*
				Yangon	VYYY
Tokyo (Japan)	RJTD	Western Pacific (incl. South China Sea)		Bangkok	VTBS
				Guangzhou	ZGGG
				Gia Lam	VVGL
				Hong Kong	VHHH
				Honolulu	PHFO
				Jakarta	WIII
				Kansas City	KMKC
				Kota Kinabalu	WBKK
				Kuala Lumpur	WMKK
				Manila	RPLL
				Nadi	NFFN
				Phnom-Penh[4)]	VDPP
				Pyongyang[4)]	ZKPY
				Shanghai	ZSSS
				Singapore	WSSS
				Incheon	RKSI
				Taibei	RCTP
				Tokyo	RJTD
				Ujung Pandang	WAAA

NOTES:

1) Co-ordinates of the areas of responsibility of the Darwin and Nadi Tropical Cyclone Advisory Centres to be confirmed.
2) Indicates approximately the main seasons for tropical cyclones.
3) Tropical cyclone SIGMET for the Australian FIRs is issued by MWOs: Brisbane, Darwin and Perth.
4) MWO not implemented

FASID TABLE MET 3B — VOLCANIC ASH ADVISORY CENTRES

EXPLANATION OF THE TABLE

Column

1. Location of the volcanic ash advisory centre (VAAC).

2. ICAO location indicator of VAAC (for use in the WMO heading of advisory bulletin).

3. Area of responsibility for the preparation of advisory information on volcanic ash by the VAAC in ~~Column~~ column 1.

4. ICAO Region of the State in column 5.

5. State of the MWO in column 6.

~~4.~~6. MWOs to which the advisory information on volcanic ash should be sent.

~~5.~~7. ICAO location indicator of the MWOs in ~~Column~~ column ~~4~~6.

~~6.~~8. ACCs to which the advisory information on volcanic ash should be sent.

~~7.~~9. ICAO location indicator of the ACCs in ~~Column~~ column ~~6~~8.

~~*Note: MWOs and ACCs in italics are situated outside the Asia/Pacific Region*~~

VOLCANIC ASH ADVISORY CENTRE	ICAO LOC. IND.	AREA OF RESPONSIBILITY	ICAO REGION	STATE	MWOs TO WHICH ADVISORY INFORMATION IS TO BE SENT		ACC TO WHICH ADVISORY INFORMATION IS TO BE SENT	
					Name	ICAO LOC. IND.	Name	ICAO LOC. IND.
1	2	3	4	5	~~4~~6	~~5~~7	~~6~~8	~~7~~9
Anchorage (United States)	PAWU	Anchorage Oceanic Anchorage Continental Anchorage Arctic and west to E150, north of N60	NAM	USA	Anchorage	PAWU	Anchorage	PAZA
			APAC	Japan	Tokyo	RJTD	Saporo Tokyo Fukuoka Naha	RJCG RJTG RJDG RORG
Darwin (Australia)	YDRM (ADRM)	Southward from N10 and from E100 to E160 and the Perth FIR between E100 and E75, Colombo FIR and those parts of the Kuala Lumpur, Bangkok, Chennai, Yangon and Kolkata FIRs lying within N10 E100 to N20 E100 to N20 E82 to N10 E82 to N6 E78 to S2 E78 to E6 E75	APAC	Australia	Adelaide[3)]	YPRM	Adelaide	YPAD
			APAC	Thailand	Bangkok	VTBS	Bangkok	VTBB
			APAC	Australia	Brisbane[3)]	YBRF	Brisbane Cairns	YBBN YBCS
			APAC	India	Chennai	VOMM	Chennai	VOMF
			APAC	Australia	Darwin	YDRM	Darwin	YPDN
			APAC	Viet Nam	Gia Lam	VVGL	Hanoi Ho-Chi-Minh	VVNB VVTS
			APAC	Australia	Hobart[3)]	YMHF	Hobart	YMHB
			APAC	Solomon I.	Honiara[2)]	AGGH	Honiara	AGGH
			APAC	Indonesia	Jakarta	WIII	Jakarta	WIIF
			APAC	Malaysia	Kota Kinabalu	WBKK	Kota Kinabalu	WBFC
			APAC	Malaysia	Kuala Lumpur	WMKK	Kuala Lumpur	WMFC
			APAC	Philippines	Manila	RPLL	Manila	RPHI
			APAC	Australia	Melbourne[3)]	YMRF	Melbourne	YMMM
			APAC	Australia	Perth[3)]	YPRF	Perth	YPPH
			APAC	Papua New Guinea	Port Moresby	AYPY	Port Moresby	AYPM
			APAC	Singapore	Singapore	WSSS	Singapore	WSJC
			APAC	Australia	Sydney[3)]	YSRF	Sydney	YSSY
			APAC	Australia	Townsville[3)]	YBTL	Townsville	YBTL
			APAC	Indonesia	Ujung Pandang	WAAA	Ujung Pandang	WAAF
			APAC	Myanmar	Yangon	VYYY	Yangon	VYYY
Tokyo (Japan)	RJTD	N60 to N10 – and from E90 to Oakland Oceanic and	APAC	Thailand	Bangkok	VTBS	Bangkok	VTBB
			EUR	Russian Federation	Blagovesche nsk	UHBB	Blagoveschens k	UHBB

VOLCANIC ASH ADVISORY CENTRE	ICAO LOC. IND.	AREA OF RESPONSIBILITY	ICAO REGION	STATE	MWOs TO WHICH ADVISORY INFORMATION IS TO BE SENT		ACC TO WHICH ADVISORY INFORMATION IS TO BE SENT	
					Name	ICAO LOC. IND.	Name	ICAO LOC. IND.
1	2	3	4	5	~~4~~6	~~5~~7	~~6~~8	~~7~~9
		Anchorage Oceanic and Continental FIR boundaries	APAC	China	Beijing	ZBAA	Beijing Huhhot Taiyuan	ZBPE ZBHH ZBYN
			EUR	Russian Federation	Bratsk	UIBB	Bratsk	UIBB
			EUR	Russian Federation	Chita	UIAA	Chita	UIAA
			APAC	Viet Nam	Gia Lam	VVGL	Hanoi Ho-Chi-Minh	VVNB VVTS
			APAC	China	Guangzhou	ZGGG	Guangzhou Changsha Guilin Nanning	ZGZU ZGCS ZGKL ZGNN
			APAC	China	HAIKOU/Meilan	ZJSY	Sanya	ZJSA
			APAC	China	Hong Kong	VHHH	Hong Kong	VHHH
					Incheon	RKSI	Incheon	RKRR
			EUR	Russian Federation	Irkutsk	UIII	Irkutsk	UIII
			EUR	Russian Federation	Khabarovsk	UHHH	Khabarovsk	UHHH
			EUR	Russian Federation	Kirensk	UIKK	Kirensk	UIKK
			APAC	China	Kunming	ZPPP	Kunming Chengdu Chongqing	ZPKM ZUDS ZUCK
			APAC	China	Lanzhou	ZLLL	Lanzhou Xi'an	ZLAN ZLSN
			EUR	Russian Federation	Magadan	UHMM	Magadan	UHMM
			EUR	Russian Federation	Magdagachi	UHBI	Magdagachi	UHBI
			APAC	Philippines	Manila	RPLL	Manila	RPHI
			EUR	Russian Federation	Nik.-na-Amure	UHNN	Nik.-na-Amure	UHNN
			EUR	Russian Federation	Okha	UHSH	Okha	UHSH
			EUR	Russian Federation	Okhotsk	UHOO	Okhotsk	UHOO
			EUR	Russian Federation	Pet.-Kamchatsky	UHPP	Pet.-Kamchatsky	UHPP
			APAC	Cambodia	Phnom-Penh[2)]	VDPP	Phnom-Penh	VDPP
			APAC	DPR Korea	Pyongyang[2)]	ZKPY	Pyongyang	ZKKK

VOLCANIC ASH ADVISORY CENTRE	ICAO LOC. IND.	AREA OF RESPONSIBILITY	ICAO REGION	STATE	MWOs TO WHICH ADVISORY INFORMATION IS TO BE SENT		ACC TO WHICH ADVISORY INFORMATION IS TO BE SENT	
					Name	ICAO LOC. IND.	Name	ICAO LOC. IND.
1	2	3	4	5	~~4~~6	~~5~~7	~~6~~8	~~7~~9
			APAC	China	Shanghai	ZSSS	Shanghai Hefei Jinan Nanchang Nanjing Xiamen Qingdao	ZSHA ZSOF ZSTN ZSCN ZSNJ ZSAM ZSQD
			APAC	China	Shenyang	ZYTX	Shenyang Dalian Hailar Harbin	ZYSH ZYTL ZBLA ZYHB
			APAC	China	Taibei	RCTP	Taibei	RCAA
			APAC	Japan	Tokyo	RJTD	Saporo Tokyo Fukuoka Naha	RJCG RJTG RJDG RORG
			APAC	Mongolia	Ulan-Bator	ZMUB	Ulan-Bator	ZMUB
			APAC	China	Urumqi	ZWWW	Urumqi	ZWWW ZWUQ
			APAC	Lao PDR	Vientiane	VLVT	Vientiane	VLVT
			EUR	Russian Federation	Vladivostok	UHWW	Vladivostok	UHWW
			APAC	China	Wuhan	ZHHH	Wuhan	ZHWH
			EUR	Russian Federation	Yuzhnosakh alinsk	UHSS	Yuzhnosakhalin sk	UHSS
Washington (United States)	KNES	Oakland Oceanic FIR	NAM	USA	Honolulu	PHFO	Oakland ~~Honolulu~~	KZOA ~~PHZH~~
			NAM	USA	Kansas City	KKCI	Guam	PGZU
			APAC	Japan	Tokyo	RJTD	Saporo Tokyo Fukuoka Naha	RJCG RJTG RJDG RORG
			APAC	Australia	Darwin	YDRM	Darwin	YPDN
Wellington (New Zealand)	NZKL	Southward from the Equator and from E160 to W140~~*~~[1]	APAC	Australia	Brisbane[3]	YBRF	Brisbane	YBBN
			APAC	Australia	Darwin	YDRM	Darwin	YPDN
			APAC	USA	Honolulu	PHFO	~~Honolulu~~ Oakland	~~PHZH~~ KZOA
			APAC	Solomon I.	Honiara[2]	AGGH	Honiara	AGGH
			APAC	Australia	Melbourne[3]	YMRF	Melbourne	YMMM
			APAC	Fiji	Nadi	NFFN	Nadi	NFFF

VOLCANIC ASH ADVISORY CENTRE	ICAO LOC. IND.	AREA OF RESPONSIBILITY	ICAO REGION	STATE	MWOs TO WHICH ADVISORY INFORMATION IS TO BE SENT		ACC TO WHICH ADVISORY INFORMATION IS TO BE SENT	
					Name	ICAO LOC. IND.	Name	ICAO LOC. IND.
1	2	3	4	5	~~4~~6	~~5~~7	~~6~~8	~~7~~9
			APAC	Nauru	Nauru[2)]	ANAU	Nauru	ANAU
			APAC	Australia	Sydney[3)]	YSRF	Sydney	YSSY
			APAC	French Polynesia	Tahiti	NTAA	Tahiti	NTTT
			APAC	New Zealand	Wellington	NZKL	Auckland Christchurch	NZZO NZZC

~~*~~Notes~~.~~: – 1) Coverage south of 60°S latitude is currently not feasible.
2) MWO not implemented.
3) MWO Darwin is designated to issue VA SIGMET for Brisbane and Melbourne FIRs.

Meteorological information and services in support of air traffic management.

1. Focus

The focus of this survey is on forecast meteorological elements and advice on expected conditions in support of air traffic management. While completing this survey please consider the current and future requirements for meteorological information for all aspects of ATM.

2. Use of Met

A list of meteorological elements commonly required in support of ATM is provided in the table below. A sample response is provided at Attachment A. Please fill in the appropriate sections of the form to provide:

A. A brief description of how each element is used in your planning and operations (e.g. runway planning, capacity planning, sequencing etc)
B. Information source for this element (e.g. TAF, Trend, SIGWX chart, verbal advice etc.)
C. Deficiencies and suggestions. If your needs are not currently met provide comments on or explanation of why. (e.g. accuracy, information not available, inadequate lead time, inadequate spatial/temporal/vertical resolution, unsuitable format/presentation, use of inappropriate thresholds, etc). Please indicate any suggestions on the provision of the element to better satisfy your requirements (e.g. probability/forecast uncertainty/confidence/alternate scenario etc.)

Additional Met: If there are any elements/services affecting ATM that are not listed please add any elements to the table.
You may wish to consider the following elements which have been identified by the WMO CAeM Expert Team on New Terminal Forecast and European ICAO METG:

- Low level wind (in addition to “surface wind”)
- Temperature
- Runway condition forecast (temperature, icing, frost)
- Density altitude
- Precipitation rate
- Hail size
- CB activity
- Noise abatement parameters
- Low level temperature inversion
- Extended forecast (beyond 24 h) for specific hazard (TC).

State:
Organisation:

	A	B	C
Element	**Description of Use(s)**	**Current Source(s) of Information**	**Deficiencies and suggested improvements**
Surface Wind			
Surface Wind Gusts			
Visibility			
RVR			
Vertical Visibility			
Significant weather 1 (e.g. TS)			
Significant weather 2 (e.g SN)			

Significant weather 3			
Significant weather 4			
Cloud base/amount			
Turbulence (Terminal)			
Wake Turbulence/Vortex information			
Turbulence (Enroute)			
Upper Winds			

Icing			
Wind shear			
TC			
VA			
Other 1			
Other 2			
Other 3			
Other 4			

3. Prioritisation

Please indicate the 5 elements which have the biggest impact or cause you the greatest concerns to ATM.

	Element	**Impact/Concerns**
1		
2		
3		
4		
5		

4. MET Support in addition to Annex 3 products

Does your ATM Authority currently have access to:

a. Advice on terminal weather (in addition to Annex 3 type products)?: Yes/No

If so please provide a brief description of the additional service and information and how it is delivered (e.g. Routine web based product focussed on ATM specific cloud/visibility and wind thresholds, or daily elaborative telephone briefings).

……
……
……
……

b. Advice on en-route weather (in addition to Annex 3 type products)?: Yes/No

If so please provide a brief description of the additional service and information and how it is delivered.

……
……

5. Decision Support Tools

a. Has your ATM or/or MET authority developed any MET related decision support tools for use by ATM? Yes/No
If so please provide a brief description of the tool(s) and the benefits realised.

……
……
……
………………………………………………………………………………………………

b. Is your ATM or/or MET authority developing any MET related decision support tools for use by ATM? Yes/No
If so please provide a brief description of the tool(s) and expected benefits.

……
……
……
………………………………………………………………………………………………

6. Other Comments

Please feel free to provide any further comments on current and future ATM requirements for MET.

……
……
……
………………………………………………………………………………………………

7. Contact Details

If you are happy to contacted for further follow-up or clarification please include your contact details here.

Name:
Organisation:
E-mail:
Phone:
Facsimile:

Attachment A – Example

STATE: Weatherland (fictitious country)

	A	**B**	**C**
Element	**Description of Use(s)**	**Current Source(s) of Information**	**Deficiencies and suggested improvements**
Surface Wind	Runway planning, capacity planning.	TAF, Trend, METAR, local report, Doppler Radar, real-time sensors	Information is of sufficient quality but could be packaged better. Forecast confidence indication would be beneficial. Graphical Display, longer lead times, confidence/alternate scenarios provided
Surface Wind Gusts	Runway planning, capacity planning.	TAF, Trend, METAR, local report, real-time sensors	Forecast gust information not available. No forecast information is available for low speed gusts threshold should be zero. Provided for whole of aerodrome but required for individual runway thresholds.
Visibility	Runway planning, flow management/capacity planning, sequencing	TAF, Trend, METAR, local report, real-time sensors	ATM thresholds reflected by forecasts or hourly values provided.
RVR	Not used	Nil	Not applicable
Vertical Visibility	Used to assess landing conditions	METAR, local report, real-time sensors	Nil
Thunderstorm	Runway planning, capacity planning. Assists with enroute diversion decisions.	TAF, Radar, Satellite Imagery, SIGWX charts (WAFS/Local),SIGMET/ AIRMET	Lack of spatial/temporal resolution. Require hourly en-route TS location forecast out the 3 hours, and to 60 minutes for terminal TS locations
Snow	Used to estimate surface movement delays, clearing requirements	TAF/Trend	Quantitative estimate would be useful.
Significant weather 3			
Significant weather 4			
Cloud base/amount	Runway planning, flow management/capacity planning, sequencing	TAF, Trend, METAR	Refer visibility

Turbulence (Terminal)	Short term capacity planning, sequencing	Aircraft reports, TAF, Trend, SIGMET/AIRMET	A intensity metric would be useful, more study the relationship between intensity and ATM impacts required
Wake Turbulence/Vortex information	Short term capacity planning, sequencing	Aircraft reports	Observed only - no forecast information available. Reliable forecasts could increase capacity through reductions in separation standards applied
Turbulence (Enroute)	Provides advice of possible enroute delays and congestion	Aircraft reports, SIGWX/SIGMET/AIRMET	Nil
Upper Winds	Flow management, sequencing	WAFS, Aircraft reports, Lidar	Temporal and spatial resolution inadequate for tailored arrival concept. Resolution required at least 3 hourly at 10km, and several more vertical levels.
Icing	Provides advice of possible en-route delays and congestion	Aircraft reports, SIGWX/SIGMET/AIRMET	Nil
Wind shear	Short term capacity planning, sequencing	Aircraft reports/Wind Shear Warnings	Information not available at long enough lead time for capacity planning Development of longer term forecasts required.
TC	Runway planning, capacity planning. Route planning	TC advisories, TAF/Trend/ briefings	Nil
VA	Route planning	VA advisories, briefings	Lack of VA information for poorly monitored volcanoes. Introduction of VA graphic has saved significant work and been very well received
Extended period forecasts (out to 72 hours)	Capacity planning, staff planning	Written briefing, verbal advice	Accuracy and temporal resolution of cloud base/visibility for airport capacity planning needs improvement at longer lead times.
Other 2			
Other 3			
Other 4			

IFALPA Position on the Proposed Use of metres per second for wind speed

Whilst IFALPA acknowledges that some countries use metres/second in their wind speed in METAR/SPECI and TAF the majority of the States apply knots.

As the operators of aircraft that have performance limitations specified by the major airline manufacturers (Boeing and Airbus) and certified by the worlds major Regulatory Authorities (FAA JAA) that require the use of knots for cross-wind, head and tail wind limits, it is important in adverse flying conditions associated with Low Visibility, Wind Shear etc, that pilots not be further burdened with time critical calculations involving mental arithmetic in the latter stages of what can be difficult conditions. This has the potential to significantly detract from the primary operation of safe flight

The general use of meters/second in International aviation for operational wind speed determinations would add a further unnecessary complication to the world pilot body that applies wind speed determinations based on Knots in a mental vector pictorial to determine whether or not they comply with the structural limitations imposed by the manufacturers. To implement metres/second in general, would have pilots doing a 2 step conversion. The mental pictorial of the resultant vectors, the inherent errors when in difficult conditions, high work load, time critical decision making and general stress impose the real possibility of "incorrect applications" and the resultant real possibility of an incident or accident.

This is particularly evident in long and ultra long haul operations where aircrew are near fatigue limits and then presented with difficult arrival procedures and associated weather conditions.

As such, IFALPA does not support a general move towards the implementation of metres/second as a generally accepted measure of wind speed for arrival or departure.

_ _ _ _ _ _ _ _ _ _ _ _

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
AUSTRALIA	ATN tests were conducted. BIS Router and Backbone BIS Router and AMHS ~~will be~~ implemented ~~by 2006.~~	AFTN based AIDC Implemented between Brisbane and Melbourne, Auckland, Nadi and Auckland. AIDC is also in use between Melbourne and Mauritius.	Implemented and integrated with ATM systems to support FANS1/A equipped aircraft.	Implemented.	Implemented.	5 ADS-B sites are operational. A total of 28 ground stations are expected to become operational throughout 2007. Additional 20 stations will be delivered in June 2007 for installation at enroute radar site and other sites. 5NM Separation service being introduced. NFRM on the carriage and use of ADS-B avionics to be issued in Apr.07	FANS 1/A ADS-C implemented.	
BANGLADESH	BIS Router and AMHS planned for 2007.							
BHUTAN	ATN BIS Router and UA service 2008.			Procedures developed for NPA.				

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
BRUNEI DARUSSALAM	ATN BIS Router planned for Sept 2008 and AMHS~~H~~ planned for 2008-2011							
CAMBODIA	BIS Router and AMHS planned for 2007			Procedure developed for NPA				

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
CHINA	ATN BIS Router AMHS will be implemented from 2006. - Tripartite BBIS trial completed with Bangkok and Hong Kong, China in Jan. 2003. - ATN trial with Hong Kong, China conducted 2003/2004. - AMHS with Hong Kong, China planned to conduct in 2006. - AMHS/ATN trial with Macau is under planning. - AMHS/ATN trial with Kuwait is under planning.	AIDC between some of ACCs within China has been implemented. AIDC between several other ACCs are being implemented. Operational trial on the AFTN based AIDC between Sanya and Hong Kong commenced on Aug. 2006 and put into operational use in Feb 2007.	Implemented to support certain AIS Rout. - L888 route, polar routes and Chengdu-Lhasa route. - Trial on HF data link conducted for use in western China.	RNAV (GNSS) implemented in certain airports. - Beijing, Guangzhou, Tianjin and Lhasa airports.	Implemented in certain airspace. - L888, Y1 and Y2 routes.	ADS-B trial has been conducted in 2006. 5 UAT ADS-B sites are operational and used for flight training of CAFUC. Another ADS-B of 1090ES trial will be commenced in 2007.	FANS 1/A ADS-C implemented to support certain routes. - L888 route polar routes and Chengdu-Lhasa route.	

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
HONG KONG, CHINA	-ATN and AMHS technical trial with Japan conducted in 2003 -64 Kbps ATN Link with Bangkok put into operational use in June 2004. -ATN/AMHS technical trials with China (Beijing) using VPN over Internet connection conducted in September, 2006 -Further ATN/AMHS technical trials with Thailand and China planned for 2007 -ATN/AMHS trials with Philippines planned for 2007 -ATN/AMHS technical trials with China (Macao) pplanned ((((((Macao (((M(Macaq	Trial on the AFTN based AIDC with Guangzhou and Sanya, China commenced. Operational trial with Sanya commenced in Aug. 2006 and put into operational use in Feb. 2007.	FANS 1/A based CPDLC conducted. D-ATIS D-VOLMET and PDC implemented. VDL Mode-2 technical trial completed in Dec. 2002 and planning on further trials is in progress.	RNAV (GNSS) departure procedures implemented in July 2005.	Implemented in certain airspace.	”ASMGCS” trial using ADS-B/ Multilateration system commenced in 2004/2005. A dedicated ADS-B trial evaluation system was installed in early April 2007	FANS 1/A trials for ADS-C conducted.	

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
	China (Macao) planned for 2008.							
MACAO, CHINA	ATN BIS router and AMHS planned for 2008. Trial with China and Hong Kong, China in planning stage.					"A-SMGCS" being planned with ADS-B as option for consideration.		ATZ within Hong Kong and Guangzhou FIRs. In ATZ full VHF coverage exist. Radar coverage for monitoring purposes.
COOK ISLANDS								
DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA								

CNS/ATM Implementation Planning Matrix								
State/ Organization	ATN G/G Boundary Intermediate System (BIS) Router/AMHS	AIDC	CPDLC	GNSS		ADS-B/ Multilateration	ADS-C	Remarks
				RNAV (GNSS)	En-route			
FIJI	AMHS in-house trials completed in 2006. AMHS trials completed in 2007. ATN BIS Router and AMHS plans to be implemented in 2008.	AFTN based AIDC with Brisbane and Auckland operational in 2005. AFTN based AIDC implement with Oakland	FANS-1 implemented	NPA procedures for (S) completed in Dec. 2002.	Implemented as (S).	ADS-B implementation in 2008/2009. Estimate 10 Ground Stations	ADS-C implemented in oceanic airspace using EUROCAT 2000 X.	
FRANCE (French Polynesia Tahiti)		Implementation of limited message sets with adjacent centres under discussion.	FANS-1. Implemented since 1996.				FANS 1/A ADS-C implemented since March 1999.	
INDIA	ATN BBIS router and AMHS planned for implementation at Mumbai in March 2008.	AFTN Based AIDC 1. between Mumbai and Karachi 2007 2. between Kolkata and Dhaka 2008	FANS-1 implemented at Kolkata, Chennai, Mumbai and Delhi.		SBAS - Technical developments in 2007. - Implementation planed for 2009.	Trial planned for 2006. ASMGCS Implemented at IGI Airport New Delhi.	FANS 1/A ADS-C implemented at Kolkata, Chennai, Delhi and Mumbai.	

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
INDONESIA	ATN BIS Router and AMHS planned for trial in 2008.	AFTN based AIDC planned for implementation between Brisbane and Jakarta in 2010. Brisbane and Makassar in 2008.	FANS-1/A. CPDLC in Jakarta, Ujung Pandang FIRs trial planned for 2007.	Procedure to be completed in 2006 for NPA.		2 ADS-B ground stations to be installed in 2007. Upgrading ATC automation at Makasar for ADS-B application capabilities in 2007.	FANS 1/A ADS-C trial planned at Jakarta and Ujung Pandang ACC in 2007.	
JAPAN	ATN BBIS already implemented. AMHS implemented between Japan and USA in 2005 and between Japan and Hong Kong, China planned for 2009-2010.	AIDC based. AFTN procedure implemented with Oakland and Anchorage. Planned between Incheon ACC and Fukuoka ATMC 2008.	FANS1/A system Implemented in Fukuoka FIR	NPA implemented at 4 aerodromes.	SBAS Operational In 2007	Amendment work to be radio law regulations for using ADS-B out (1090 MHz ES) is under way.	FANS 1/A. ADS-C implemented in Fukuoka FIR	
KIRIBATI								

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
LAO PDR	ATN BIS Router and AMHS planned for implementation with Bangkok in 2006.	AIDC with Bangkok planned for 2008	FANS-1/A Planned for Bay of Bengal and South China Sea areas. Equipment is under test operation.		Implemented.		FANS-1/A. ADS-C planned for Bay of Bengal and South China Sea areas. Equipment under test operation.	
MALAYSIA	ATN BIS Router completed 2007. AMHS planned in 2008.	AFTN AIDC planned with Bangkok ACC in 2010.	Planned for Bay of Bengal and South China Sea areas in 2006.	NPA at KLIA implemented.		Implementation of ADS-B proposed in 2008-2010.	FANS 1/A ADS-C planned for Bay of Bengal and South China Sea areas in 2006.	
MALDIVES	ATN BIS Router/AMHS planned for implementation in the 2008.	Planned for 2008.	FANS1/A installed Trials planned in last quarter of 2007		Trials planned for 2005-2008. Implementation in late 2008.	Trials planned for 2007-2008. Implementation in late 2008.		
MARSHALL ISLANDS				NPA implemented at Majuro Atoll.				
MICRONESIA FEDERATED STATES OF								

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
Chuuk				Implemented				
Kosrae				Implemented				
Pohnpei				Implemented				
Yap				Implemented				
MONGOLIA	ATN BIS Router and AMHS planned for 2005 and 2006. Trial with Bangkok conducted		Function available. Regular trials are conducted.	GPS procedures are being developed and implemented at 10 airports.	Implemented.	ADS-B trial in progress implementation planned for 2006.	FANS 1/A ADS-C implemented since August 1998.	
MYANMAR	Trial for ATN BIS Router with Thailand planned for 2006. Test with China planned for 2006.		Implemented since August 1998				Implemented since August 1998	
NAURU								
NEPAL	BIS Router and AMHS planned for 2007-2008.			Development of arrival procedure and NPA completed. Departure procedure is being developed.	Implemented.	ADS-B feasibility study planned for 2007		

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
NEW CALEDONIA						Tontouta ACC 2009 Tontouta APP 2009		
NEW ZEALAND	BIS Router and AMHS implementation planned for 2008.	AFTN based AIDC implemented between New Zealand, Australia, Fiji, Tahiti, Chile and USA.	FANS-1/A. Implemented	Implemented.	will be implemented as required.	Domestic trial was conducted in 2005. Use will be re-evaluated in 2008. Trial of Area MLAT conducted in 2006. ADS-B planned as an element of MLAT at specific sites for domestic use.	FANS 1/A Implemented.	
PAKISTAN	Implementation of ATN considered for Phase II (2005-2010).	Implemented between Karachi and Lahore ACCs	Implementati on planned from 2005-2010.	Arrival and departure NPA procedure are being developed.	Planned for 2005-2010.	Feasibility study for using ADS-B is in hand. One station planned for 2009 to establish confidence.	Planned for 2005-2010	Existing Radar system being upgraded.
PAPUA NEW GUINEA				Implemented at certain aerodromes.	Implemented.			

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
PHILIPPINES	ATN G/G BIS Router/AMHS implemented in 2006 AMHS trials with Singapore and Hong Kong planned in ~~April~~ 2007.	Planned for 2011.	CPDLC Planned for 2011.			Included in CNS/ATM Project and scheduled for implementation in 2011.	FANS 1/A ADS-C planned for 2011.	
REPUBLIC OF KOREA	ATN BIS Router/AMHS planned for 2005-2010.	AFTN based AIDC planned for 2008 between Incheon ACC and Fukuoka ATMC	PDC & D-ATIS implemented 2003.	NPA planned for 2008 at Incheon International Airport		ADS-B trials planned for 2008.	Trial for FANS 1/A ADS-C implemented since 2003.	
SINGAPORE	ATN BBIS Router trial with Hong Kong conducted between April and June 2003. Planned for ATN and AMHS implementation in 2006.	ATN based AIDC to be implemented in 2010	Implemented since 1997. Integrated in the ATC system in 1999.	NPA procedure developed. RNAV (SID/STAR) in 2005	Implemented.	Trial commenced in 2006. Operational in 2010. 2007 for ASMGCS	FANS 1/A ADS-C implemented since 1997. Integrated with ATC system in 1999.	

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
SRI LANKA	ATN BIS Router Planned for 2009. AMHS planned along with BIS in 2009.		PDLC in trial operation since November 2000.			ADS-B Trials planned for 2010 and implementation in 2011.	FANS 1 /A ADS-C trial since November 2000.	GPS based domestic route structure being developed.
THAILAND	BBIS/BIS Routers already implemented. Target date for AMHS in 2008.	AFTN based AIDC planned for 2010.	FANS-1/A Implemented .		Implemented.	Multilateration implemented in 2006 at Suvarnbhumi Intl. Airport. 22 ADS-B ground Stations will be implemented in 2008	FANS 1/A ADS-C Implemented.	
TONGA	AMHS planned for 2008.			NPA planned for 2007.		Trial planned for 2010		CPDLC and ADS-C is not considered for lower airspace
United States	AMHS implemented	AFTN based AIDC implemented	FANS-1/A based CPDLC implemented	Implemented	Implemented	Implemented	Implemented	
VANUATU								

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
VIET NAM	BIS Routers planned for 2009.	AFTN based AIDC planned in 2009 Trial for ATN based AIDC planned in 2010.	CPDLC operational trial conducted in early 2007.	RNAV	For en-route TBD.	TBD	FANS 1/A ADS-C operational trial conducted for oceanic area of Ho Chi Minh FIR since March 2002.	

KEY PRIORITIES FOR CNS/ATM IMPLEMENTATION IN THE ASIA/PACIFIC REGION

No.	KEY PRIORITIES	DESCRIPTION	MILESTONES	SUB-GROUP	STATUS	DISCUSSION/ACTION
1.	Performance Based Navigation (RNP/RNAV) Implementation	Implement performance based navigation, operation and procedures to improve the efficiency and flexible use of airspace.	Report to APANPIRG	ATM/AIS/SAR CNS/MET	On-going Phased implementation.	Reflect performance based navigation, not just RNP.
2.	ADS-C	The implementation of ADS-C in oceanic or remote areas in accordance with the Regional CNS/ATM Plan is required for the enhancement of safety and ATM.	Report to APANPIRG FIT-BOB reconvened September 2003. Bay of Bengal operational trial of ADS/CPDLC commenced February 2004, trial on going. FIT-SEA inaugural meeting May 2004. South China Sea operational trial of ADS/CPDLC expected 2006/2007.	ATM/AIS/SAR	Phased implementation. Implementation focus and timetable need to be developed. States are gaining experience in the use of ADS-C.	

KEY PRIORITIES FOR CNS/ATM IMPLEMENTATION IN THE ASIA/PACIFIC REGION

No.	KEY PRIORITIES	DESCRIPTION	MILESTONES	SUB-GROUP	STATUS	DISCUSSION/ACTION
3.	Co-operation in Regional CNS/ATM Planning, Implementation & Training.	The continuation and enhancement of ICAO’s co-ordinating role of technical co-operation in CNS/ATM planning and implementation, in close co-operation with all partners and taking into account the regional approach, is required.	Report to APANPIRG	All	Sub-Groups to identify requirements.	Emphasis needs to be on sharing information and training. Title ‘Technical Co-operation” is confusing with assistance programs. Need to inform States of opportunities for training well in advance of scheduled date. Training opportunities should include ICAO programs as well as associated organizations programs. ATN Seminar was conducted. Two ADS-B Seminars were conducted QMS Seminar SAIDS-2G MET/ATM Coordination Seminars were conducted PBN Seminar was conducted in Beijing by ICAO

KEY PRIORITIES FOR CNS/ATM IMPLEMENTATION IN THE ASIA/PACIFIC REGION

No.	KEY PRIORITIES	DESCRIPTION	MILESTONES	SUB-GROUP	STATUS	DISCUSSION/ACTION
~~4.~~	Preparation for WRC-2011 ~~07~~	The co-operative participation of States is required with their respective telecommunications regulatory authorities, regional groups, at the APT forums and at the WRC regional preparatory meetings for WRC-2011~~07~~ to ensure that aviation spectrum requirements are fulfilled and protected.	WRC-2007 ~~Fourth APT APG Jan 07 2nd RPG meeting planned early 2007~~	All	States are designating contact points responsible for preparation for WRC 2011~~07~~ and are providing contact details for posting on the website to facilitate coordination. ~~ICAO position was presented to APT/APG2007-3 meeting held in 13-16 Feb. 2006~~	High importance task. Spectrum must be available to enable CNS/ATM implementation. Of the 35 States 31 States have nominated the focal point of contact ~~4 States participated actively at APG 2007-3 meeting 13-16 Feb 2006~~
5.	GNSS Implementation • GBAS • SBAS	To implement GNSS in accordance with the Asia Pacific Regional Strategy. Facilitate market available GBAS ground system *(CAT I)* certified to Annex 10 SARPs.	On-going 2008	CNS/MET	SBAS receivers - (TSO C145/6) now available Lead aircraft with certified GBAS avionics now in service.	Strategy for Approach, Landing and Departure identified GBAS as a preferred CAT I option. No ground equipment is available that is certified to Annex 10 SARPs.
6.	MET support for the new CNS/ATM System.	To identify the ATM requirements for new MET products supporting CNS/ATM systems and update the plan accordingly.	2006	CNS/MET	MET/ATM TF has surveyed the new requirements and is preparing an update for the MET chapter of the ASIA/PAC Regional Plan for the New CNS/ATM Systems.	MET/ATM coordination seminar provided information for updating the Regional Plan

KEY PRIORITIES FOR CNS/ATM IMPLEMENTATION IN THE ASIA/PACIFIC REGION

No.	KEY PRIORITIES	DESCRIPTION	MILESTONES	SUB-GROUP	STATUS	DISCUSSION/ACTION
		Implementation of the transition to GRIB and BUFR coded WAFS products	2006		MET/ATM coordination seminar was conducted 8-10 February 2006. GRIB coded products have been implemented. BUFR coded SIGWX charts are being implemented with the deadline for implementation 30 Nov 2006	
7.	ADS-B	Operational Standards to support proposed separation standards. Airline aircraft certificated to participate in ADS-B operations. Avionic packages available to meet GA and low capacity operations.	2006 2006 2006	ADS-B Task Force ADS-B Task Force ADS-B Task Force	Progressed by Task Force in AIGD and completed by SASP & OPLINK. Doc4444 being amended. Lead aircraft certified for initial ADS-B OUT operation Avionics package to meet GA & low capacity operation is available.	Focus on activities to enable successful ADS-B OUT implementation. Roll-out of ADS-B considered an on-going activity.
8.	Implementation of APV and RNAV (GNSS) Approaches.	Review applicability of APV and RNAV (GNSS) Approach Design Standards, aircraft certification and augmentation system availability for Asia Pacific.	2006	CNS/MET ATM/AIS/SAR	APV and RNAV (GNSS) Design standards now in PANS OPS. Aircraft certified for RNAV (GNSS) and APV approaches.	Completed ATM/AIS/SAR/SG to consider operational issues including charting.

KEY PRIORITIES FOR CNS/ATM IMPLEMENTATION IN THE ASIA/PACIFIC REGION

No.	KEY PRIORITIES	DESCRIPTION	MILESTONES	SUB-GROUP	STATUS	DISCUSSION/ACTION
		Develop implementation strategy.	2007			
9.	Data Link Flight Information Services (DFIS) applications	To implement the following applications via request/response mode of data link in the Asia and Pacific Regions: a) Data link –automatic terminal information services (D-ATIS); b) VOLMET data link service (D-VOLMET); c) Pre-Departure Clearance (PDC) delivery via data-link; d) DCL	2008	ATM/AIS/SAR CNS/MET	Trials and demonstrations are conducted and some operational services are provided by States.	Implementation of D-ATIS is progressing Expected to be implemented at all locations except one by 2008 PDC implemented at several locations

KEY PRIORITIES FOR CNS/ATM IMPLEMENTATION IN THE ASIA/PACIFIC REGION

No.	KEY PRIORITIES	DESCRIPTION	MILESTONES	SUB-GROUP	STATUS	DISCUSSION/ACTION
10.	Safety Management Systems.	States to establish national safety management systems and effective application of safety programmes which are required for the provision of air traffic services. Required monitoring services available to support operational enhancements.		ATM/AIS/SAR RASMAG RASMAG	Annex 11 provisions effective 27 November 2003. On-going RASMAG activities. Operational enhancements suspended where effective monitoring is not available.	
11.	Air Traffic Flow Management.	States to consider and implement aspects of air traffic flow management (ATFM) including: a) centralized ATFM b) inter-regional cooperative ATFM; c) establishment of ATFM databases; d) application of strategic ATFM planning; and e) application of tactical ATFM planning	2006	ATM/ ATIS/ SAR	On going	

REPORTING FORM ON AIR NAVIGATION DEFICIENCIES IN THE CNS FIELD IN THE ASIA/PACIFIC REGION

Identification		Deficiencies			Corrective Action			
Requirement	**States/facilities**	**Description**	**Date first reported**	**Remarks**	**Description**	**Executing body**	**Target date for completion**	**Priority for action**
Provision of ATIS as specified in FASID Table CNS 2 (Doc 9673)	Bangladesh	To broadcast current, routine terminal information to arriving and departing aircraft to ease congestion on the Tower and Approach channels affecting safety of aircraft operation.	May 2007	Provide aerodrome Terminal Information broadcast system to ease congestion on VHF and to reduce controllers work load	The ATIS equipment installed has been out of service due to maintenance problem and is beyond repair. It is required to provide a new equipment.	Civil Aviation Authority of Bangladesh	December 2007	A
Adequate and reliable VHF COM	Myanmar	Quality and reliability of RCAG VHF inadequate and unavailability of required coverage. Pilot report continued to indicate occasional communication difficulties.	1998 In early 2007	Improvements in the quality of link to RCAG stations and power supply system are required.	Action should be taken to provide reliable links between the RCAG stations and Yangon ACC. High level ICAO mission was conducted. An action plan was developed to upgrade equipment at RCAG stations, provide VSAT link at all RCAG stations, to improve power supply system and to shift ACC to the new location. DCA Myanmar has replaced equipments at all 6 RCAG sites with digital VHF system and has provided VSAT links and solar power supply system at all sites. The facilities were formally implemented effective 9 June 2005 using new frequencies in place of old frequencies affected by interference. New HF transmitters were used to provide service to aircraft flying beyond VHF coverage in a small portion of Yangon FIR	DCA Myanmar	Revised target date is end of 2007. This deficiency will be removed from the list upon receipt of official report providing full details of action taken by Myanmar and confirmation by the users.	A

Identification		Deficiencies			Corrective Action			
Requirement	**States/facilities**	**Description**	**Date first reported**	**Remarks**	**Description**	**Executing body**	**Target date for completion**	**Priority for action**
Provision of ATIS as specified in FASID Table CNS 2 (Doc 9673)	Nepal	To broadcast current, routine terminal information to arriving and departing aircraft to ease congestion on the Tower and Approach channels affecting safety of aircraft operation.	April 2005	Provide aerodrome Terminal Information broadcast system to ease congestion on VHF and to reduce controllers work load	ATIS equipment provided in 2001 remained unusable due to technical problem which is still under investigation and rectification.	Civil Aviation Authority of Nepal	December 2007	A
Reliable AFTN circuit for timely exchange of operational safety messages.	Philippines	Total disruption of the AFTN circuit between Manila and Hong Kong after Philippines Long Distance Telephone Company (PLDT) failed to provide communication link between Manila and Hong Kong.	February 2007	It is urgently required to restore the Manila/Hong Kong AFTN circuit to meet the requirement for the exchange of safety messages between Manila and Hong Kong within the established transit time of 5 minutes. The problem is likely to exist until Philippines avails the service of other communication service provider.	Prolonged delay in rectification of problem experienced at Manila has resulted in diversion of message traffic for a long time via Taibei with alternate routing via Hong Kong/Fukuoka/Singapore/Manila causing traffic congestion as well as higher transit time of AFTN message.	Air Transportation Office (AOT) Philippines	By the end of September 2007	U

REPORTING FORM ON AIR NAVIGATION DEFICIENCIES IN THE MET FIELD IN THE ASIA/PAC REGION								
Identification		**Deficiencies**			**Corrective action**			
Requirements	**States/ facilities**	**Description**	**Date first reported**	**Remarks**	**Description**	**Executing body**	**Target date for completion**	**Priority for action ***
Meteorological observations and reports. (Annex 3, Chapter 4)	Solomon I.	Weather information is inadequate and not provided on a regular basis	1996 Confirmed 2006 SOA	Reported by airlines operating to Solomon I.	Equipment to be upgraded and arrangements to be made for regular observations	Ministry of Transport, Works and Aviation, Solomon I. *Note: OPMET/M TF to carry out survey*	TBD	A
Meteorological observations and reports. (Annex 3, Chapter 4)	Kiribati	METAR from Kiribati not available on regular basis.	1998 Confirmed 2005 SIP	Reported by airlines	State's MET authority to consider urgent action to be taken for providing regular observations and reports	Directorate of Civil Aviation, Kiribati. *Note: OPMET/M TF to carry out survey* ICAO SIP conducted in 2005; ICAO TC Project proposed for South Pacific; supported by WMO	TBD	A

REPORTING FORM ON AIR NAVIGATION DEFICIENCIES IN THE MET FIELD IN THE ASIA/PAC REGION								
Identification		**Deficiencies**			**Corrective action**			
Requirements	**States/ facilities**	**Description**	**Date first reported**	**Remarks**	**Description**	**Executing body**	**Target date for completion**	**Priority for action ***
Reporting of information on volcanic eruptions to civil aviation units. (Annex 3 p. 4.14 (recom.))	Indonesia	Information on volcanic activity not provided regularly to ATS units and MWOs.	1995 Confirmed by ICAO SIP mission Dec 2003	Observed by States concerned. Reported at the WMO/ICAO Workshop on Volcanic Ash Hazards (Darwin, 1995)	Three-party LOA to be signed between the MGA, DGCA and DVGHM	DGCA, MGA Indonesia	~~2004~~ TBD *(no action plan submitted to RO)*	A
Reporting of information on volcanic eruptions to civil aviation units. (Annex 3 p. 4.14 (recom.))	Papua New Guinea	Information on volcanic activity not provided regularly to ATS units and MWOs.	1995 Confirmed by ICAO SIP mission Dec 2003	Observed by States concerned. Reported at the WMO/ICAO Workshop on Volcanic Ash Hazards (Darwin, 1995)	Procedures to be set up for exchange of data between NWS, ATS and Rabaul Observatory and a LOA to be signed	NWS, ATS Papua New Guinea *Note: ICAO Regional Office to monitor*	TBD (no action plan submitted to RO)	A

REPORTING FORM ON AIR NAVIGATION DEFICIENCIES IN THE MET FIELD IN THE ASIA/PAC REGION								
Identification		**Deficiencies**			**Corrective action**			
Requirements	**States/ facilities**	**Description**	**Date first reported**	**Remarks**	**Description**	**Executing body**	**Target date for completion**	**Priority for action ***
Provision of SIGMET for volcanic ash (Annex 3, Chapter 7; ASIA/PAC FASID Table MET 1B)	Indonesia Philippines Papua New Guinea	Requirements for issuance and proper dissemination of SIGMET, including SIGMET for volcanic ash, have not been fully implemented	ICAO SIP mission Dec 2003	a) Reported by airlines b) Noted by Volcanic Ash Advisory Centres	a) ICAO to carry out a Special Implementation Project (SIP) with the primary objective to improve implementation of SIGMET procedures, especially for VA. b) State to take urgent actions to implement the SIGMET procedures.	a) State's Met authorities b) ICAO to implement the SIP. c) ICAO Regional Office to co-ordinate and monitor. *Note: ICAO SIP carried out in 2003; progress in issuance of SIGMET for VA is noted; the outstanding problems to be resolved within 1-year time* *Progress reported by VAAC Darwin*	~~2005~~ To be advised	U
a) Service for operators and flight crew members. (Annex 3, Chapter 9). b) WAFS products for flight documentation. (ASIA/PAC FASID Table MET 1A).	Cambodia Myanmar	Briefing and flight documentation not provided as required. WAFS products not available	1999	Airlines do not receive the required flight documentation including WAFS forecasts.	States to consider urgent action for installation of SADIS VSAT for receiving WAFS products and OPMET information. Action plan proposed by ICAO MET mission 2003	State's MET authorities *A TC project proposal submitted to SSCA, Cambodia*	TBD	A

REPORTING FORM ON AIR NAVIGATION DEFICIENCIES IN THE MET FIELD IN THE ASIA/PAC REGION								
Identification		**Deficiencies**			**Corrective action**			
Requirements	**States/ facilities**	**Description**	**Date first reported**	**Remarks**	**Description**	**Executing body**	**Target date for completion**	**Priority for action ***
MWO for Phnom Penh FIR and SIGMET (Annex 3, Chapter 7; ASIA/PAC FASID Table MET 1B)	Cambodia	Requirements for meteorological watch office (MWO) to be established at Phnom-Penh international airport have not been met.		MWO not established due to lack of trained personnel and technical facilities. No SIGMET service for Phnom Penh FIR	Establishment of MWO currently not feasible. Urgent need for bi-lateral agreement for SIGMET service by a neighboring State.	SSCA, Cambodia *A TC project proposal submitted to SSCA, Cambodia*	TBD	U
Provision of SIGMET information (Annex 3, Chapter 7; ASIA/PAC FASID Table MET 1B)	Lao PDR Myanmar Nepal Cambodia	Requirements for issuance and dissemination of SIGMET have not been fully implemented.	2000	SIGMET frequently not available Reported by airlines	State's MET authority to take urgent actions to implement the SIGMET procedures. ICAO issued new version of ASIA/PAC Regional SIGMET Guide in September 2003 *Note: ICAO Regional Office to enquire action plans with fixed target dates from the listed States*	State's MET authorities *In order to improve SIGMET availability, regional SIGMET tests have been conducted in 2005 and 2006*	~~2005~~ *(no action plan submitted to RO)* TBD	U

TERMS OF REFERENCE OF THE

COMMUNICATIONS, NAVIGATION, SURVEILLANCE/METEOROLOGY (CNS/MET) SUB-GROUP OF APANPIRG

TERMS OF REFERENCE

~~1.~~ Ensure the continuing and coherent development of the ASIA/PAC Regional Air Navigation Plan in the CNS/MET fields in accordance with the Global Air Navigation Plan. ~~and the ASIA/PAC Regional Plan for the New CNS/ATM Systems in.~~

2. Review and identify deficiencies that impede the implementation or provision of efficient CNS/MET services in the ASIA/PAC Region.

3. Monitor CNS/ATM systems research and development, trials and demonstrations in the fields of CNS/MET and facilitate the transfer of this information and expertise between States.

4. Make specific recommendations aimed at improving CNS/MET services by the use of existing procedures and facilities and/or through the evolutionary implementation of CNS/ATM systems.

5. Review and identify inter-regional co-ordination issues in the fields of CNS/MET and recommend actions to address those issues.

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SUBJECT/TASKS LIST IN THE CNS/MET FIELDS

The priorities assigned in the list have the following connotation:
A = Tasks of a high priority on which work should be expedited;
B = Tasks of medium priority on which work should be under taken as soon as possible but not to the detriment of Priority "A tasks; and
C = Tasks of medium priority on which work should be undertaken as time and resources permit but not to the detriment of priority "A" and "B" tasks.
TOR = Terms of Reference of the Sub-Group

TASKS NO. 1-29 HAVE BEEN COMPLETED AND REMOVED FROM THE LIST

No.	Ref.	Associated Strategic Objective & GPIs	Task	Priority	Action Proposed/In Progress	Action By	Target Date
1 (30) *	~~RAN/3 C.11/10~~ ~~(TOR 1)~~	~~D- Efficiency~~ ~~GPI-17~~ ~~GPI-22~~	~~Subject: Ensure effective transition to satellite communications.~~ ~~Task: Planning for the implementation of satellite communications.~~	~~B~~	~~In planning for the implementation of CNS/ATM take into account:~~ ~~1) Requirements for an effective transition;~~ ~~2) Time frame for implementing changes;~~ ~~3) HF requirements after implementation of satellite communications;~~ ~~4) Human factors (staffing, retraining).~~	~~CNS/MET SG~~	~~Closed~~
2 (32)	RAN/3 C.8/14 APANPIRG/14 (TOR 3)	A-Safety E-Continuity GPI-19	Subject: Inadequate implementation of procedures for advising aircraft on volcanic ash and tropical cyclones Task: Monitoring of the implementation of international airways volcano watch (IAVW) and tropical cyclone advisories and SIGMETs	A	Monitor and provide assistance in the implementation of volcanic ash and tropical cyclone advisories and SIGMETs procedures to ensure provision of timely information on volcanic ash and tropical cyclones to aircraft.	CNS/MET SG Task Force on the implementation of Volcanic Ash and Tropical Cyclone advisories and SIGMETs (VA/TC/I TF)	On going

No.	Ref.	Associated Strategic Objective & GPIs	Task	Priority	Action Proposed/In Progress	Action By	Target Date
3 (35)	(TOR 3)	D – Efficiency All GPIs	Subject: To facilitate regional implementation of CNS/ATM~~,~~ Tasks: a) coordinate training/workshops to allow States to develop and implement new CNS/ATM procedures; b) encourage States to participate in the evaluation and training of new CNS/ATM systems; c) progress the adoption of WGS-84 co-ordinate system and introduction of high integrity systems for the management of the co-ordinate data.	A	1) Identify topics for training, develop syllabi and plan training programme; 2) Encourage States in the evaluation and training of new CNS/ATM systems; 3) Co-ordinate with States and monitor progress; 4) Collect information and suggest methods of resolving problems commonly faced by States.	CNS/MET SG ATM/AIS/SAR CNS/MET SG	On-going On-going On-going On-going

No.	Ref.	Associated Strategic Objective & GPIs	Task	Priority	Action Proposed/In Progress	Action By	Target Date
4 (36)	APANPIRG D. 4/46 RAN/3 C.12/3 APANPIRG 5/3 (TOR 3)	D – Efficiency All GPIs	Subject: Provision of adequate CNS/MET services Task: Monitor CNS/ATM systems research and development, trials and demonstrations in the fields of CNS/MET and facilitate the transfer of this information and expertise between States.	A	1) Encourage States to conduct R&D, trials & demonstrations of new CNS/MET services; 2) Monitor global developments that may have beneficial consequences on regional planning activities; 3) Consolidate information on new capabilities in the CNS/ATM system, for the Sub-Groups review and action; 4) Serve as a focal point for review of ongoing work of Regional formal and informal working groups that is relevant to CNS/MET; 5) Provide for coordinated training/seminars to keep all States informed on developments of trials and demonstrations.	CNS/MET	On-going

No.	Ref.	Associated Strategic Objective & GPIs	Task	Priority	Action Proposed/In Progress	Action By	Target Date
5 (37)	C 12/24	D – Efficiency GPI-19	Subject : Transition to the GRIB and BUFR coded WAFS products Task : Implementation of the transition to the GRIB and BUFR coded WAFS products	A	1) ~~Development of guidelines for the use of BUFR and GRIB codes for the production of WAFS products;~~ ~~2) Planning and coordinating the transfer of SIGWX and WIND/TEMP charts from the current T4 facsimile format to BUFR and GRIB format;~~ ~~3) Development of a regional training programme for the operational use of BUFR and GRIB;~~ ~~4) Participate in the development and implementation of an adequate WAFS back-up system for dissemination of WAFS products in the ASIA/PAC Region~~. 5) Monitoring of implementation of BUFR coded SIGWX forecasts 6) Monitoring of the migration to SADIS 2G 7) Assist in preparation for the new gridded products for turbulence and icing	CNS/MET SG WAFS Implementation Task Force (WAFS/I TF)	Completed ~~GRIB: Completed 1 July 2005 BUFR: Nov 2006~~ Completed 2008 2010

No.	Ref.	Associated Strategic Objective & GPIs	Task	Priority	Action Proposed/In Progress	Action By	Target Date
6 (38)	C12/36 APANPIRG C14/45	D – Efficiency GPI-19	Subject: Lack of ATM requirements for MET components of the ASIA/PAC CNS/ATM Plan. Task: Developing the MET Chapter for the ASIA/PAC CNS/ATM Plan.	A	1) Development of the initial draft of the MET Chapter; 2) Development of the MET components of the CNS/ATM concept/ strategy; 3) Inclusion of ATM requirements for MET information in the CNS/ ATM Plan; 4) MET/ATM Coordination Seminar – February 2006. 5) Conduct survey on ATM requirements for MET information	CNS/MET SG with assistance of MET WG on CNS/ATM Plan CNS/MET SG METATM TF MET/ATM TF	Completed Completed ~~2006~~ Completed Completed 2007
7 (39)	APANPIRG/13 D 13/28	A - Safety D – Efficiency GPI-19	Subject: To improve the efficiency of the regional and inter-regional OPMET exchange and the availability of OPMET information from the ASIA/PAC Region Task: Review and optimize the ROBEX scheme and other OPMET exchanges; introduce monitoring and management procedures for the ROBEX centres and Regional OPMET data banks	A	1) Review and update regional ROBEX tables and relevant documents; 2) Propose optimization changes to the ROBEX scheme; 3) Improve the availability of OPMET data at the Regional OPMET Data Banks (RODB); 4) Improve the availability of OPMET information from the Pacific States; 5) Introduce monitoring and management Procedures.	CNS/MET SG OPMET Management Task Force (OPMET/M TF)	Completed Completed on-going on-going ~~on-going~~ Completed

No.	Ref.	Associated Strategic Objective & GPIs	Task	Priority	Action Proposed/In Progress	Action By	Target Date
8 ~~(41)~~			~~Subject: Regional Strategy for air-ground data communication~~ ~~Task: Develop regional strategy for the implementation of air-ground communication data link~~	~~B~~	~~Development of AMS data link~~	~~CNS/MET SG~~	~~2005 Completed~~
~~9 (42)~~		~~A – Safety GPI23~~	~~Subject: Radio Spectrum~~ ~~Tasks: Facilitate State preparation for WRC-2007~~	~~A~~	~~1) Update the list of focal point of contact person;~~ ~~2) Prepare for presentation of ICAO position at third APT meeting;~~ ~~3) Inform State aviation contact persons of APT and ITU meeting schedule to assist in representatives participating in State delegation.~~	~~CNS/MET SG~~	~~2006 Completed~~ ~~Completed~~ ~~2007Completed~~
10 (43)		D- Efficiency GPI17,18,19,22	Subject: Implementation of data link Task: Encourage implementation	A	Encourage States to implement CPDLC, D-ATIS, D-VOLMET, PDC and DPC	CNS/MET SG	2008
11 (44)		D-Efficiency GPI22	Subject: FASID Task: Updating of Table CNS-2	A	Seek State revisions of Table CNS-2 prior to May 2006. Review and update Table CNS-2 with the assistance of the Secretariat	CNS/MET SG	~~2007~~ Completed

No.	Ref.	Associated Strategic Objective & GPIs	Task	Priority	Action Proposed/In Progress	Action By	Target Date
12 (45)	APANPIRG List of deficiencies	A – Safety GPI - 19	Subject: Implementation of SIGMET Task: Improve regional procedures and availability of SIGMET from ASIA/PAC States	A	1) Assist States in implementing SIGMET requirements; 2) Conduct regular SIGMET tests; 3) Produce training and guidance material; 4) Regular monitoring on the availability and quality of SIGMET and advisories.	CNS/MET SG VA/TC/I TF	~~2007~~ Recurrent task
13 (46)	**APANPIRG/17 C 17/23**	D-Efficiency GPI-5 GPI-11	Subject: To implement Performance Based Navigation Concept in Asia/Pacific Region Task: Implement Performance Based Navigation in the Region.	A	1) To conduct Workshops/Seminars in the Region to familiarize the States about PBN Concept 2) To develop roadmap for implementation of RNP and RNAV procedures	CNS/MET SG (ATM/AIS/SAR) SG CNS/MET SG	2007 2008
14 (47)		D-Efficiency GPI22	Subject: FASID Task: Updating of FASID Table CNS-1E	A	Seek State revisions of Table CNS-1E prior to May 2008. Review and update Table CNS-1E with the assistance of the Secretariat	CNS/MET SG	2008

*** Number in bracket indicates sequential number since establishment of the Sub-group.**

The Eleventh Meeting of the Communications/Navigation/Surveillance and Meteorology Sub-Group (CNS/MET SG/11) of APANPIRG
Bangkok, Thailand, 16-20 July 2007

Attachment 1

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Attachment 2

International Civil Aviation Organization

ELEVENTH MEETING OF THE COMMUNICATIONS/NAVIGATION/SURVEILLANCE AND METEOROLOGY SUB-GROUP OF APANPIRG (CNS/MET SG/11)

Bangkok, Thailand, 16-20 July 2007

LIST OF WORKING PAPERS

WP No.	Agenda Item	Title	Presented by	Remark
1	-	Provisional Agenda	Secretariat	A
2	2	Review of Actions on the Report of the Tenth CNS/MET Sub-group and the APANPIRG/17 Meetings	”	A
3	2 (2)	Action Items of the 43rd DGCA Conference	”	A
4	2 (3)	Review of the Third Edition of the Global Air Navigation Plan (Doc 9750) and the Regional Plan for the New CNS/ATM systems	”	A
5	3 (1)	Review the Report of the Second ATNICG Meeting	”	C
6	3 (2)	Review ASIA/PAC AIDC Implementation Plan Table CNS-1D	”	C
7	4	Phasing-out of 121.5 MHz Satellite Alerting Services	”	C
8	6 (1)	Sixth Meeting of Automatic Dependent Surveillance-Broadcast (ADS-B) Study and Implementation Task Force	”	C
9	7 (1)	Regional preparatory activities for WRC-2007	”	C
10	8	SADIS Developments	United Kingdom	M
11	8	SADIS Strategic Assessment Tables 2007-2011	”	M

WP No.	Agenda Item	Title	Presented by	Remark
12	8	Summary of Recent and Forthcoming Developments to the WAFS	United Kingdom	M
13	8	Findings of ASIA/PAC Survey of the Operational Efficacy of the ISCS/2 Broadcast, and Review of the Operational Focal Points for the ASIA/PAC Region	USA	M
14	9	Use of "Metre Per Second" for Wind Speed in Aeronautical Meteorological Service	China & Hong Kong, China	M
15	5	New Edition of Catalogue of Flight Inspection Units	Secretariat	C
16	8 (3)	Performance of WAFS Gridded Products	Hong Kong, China	M
17	5 (3)	Implementation of Performance Based Navigation and Status of Performance Based Navigation (PBN) Manual (Revised Doc 9613)	Secretariat	C
18	8 (3)	Regional Progress in WAFS Implementation	Chairman, WAFS Task Force	M
19	5 (1)	Strategies for the Provision of Precision Approach, Landing & Departure Guidance Systems and the Implementation of GNSS Navigation Capability	Secretariat	C
20	12	Report on Activities of the RASMAG	"	C
21	12 (4)	Regional Survey of the Requirements for Meteorological Information in Support of ATM	Rapporteur of the METATM and CNS/MET Sub-groups	A
22	12 (2)	CNS/ATM Implementation and Planning Matrix	Secretariat	A
23	6 (2)	Regional Surveillance Strategy Asia/Pacific Region	"	C
24	13 (1)	Status of Noted Deficiencies in the CNS Field	"	C
25	2	Review Follow-up Action on the Results of Fifth Meeting of the ALLPIRRG/Advisory Group (ALLPIRG/5)	"	A

WP No.	Agenda Item	Title	Presented by	Remark
26	14	Terms of Reference and Tasks List of the CNS/MET Sub-group	Secretariat	A
27	10	Progress with SIGMET Tests - WC and WV	Rapporteur	M
28	3	The ATS Interfacility Data Communication Review Task Force Meeting (AIDC/TF)	Secretariat	C
29	12	Review Outcome of ATM/AIS/SAR SG/17	”	A
30	3	Asia and the Pacific AMHS Conformance Document	China, Hong Kong, Indonesia, Singapore, Republic of Korea and United States)	C
31	12 (4)	Report of MET/ATM Task Force	Australia	M
32	9 (1)	Report of the OPMET/M Task Force	Secretariat	M
33	10 (3)	SIGMET Seminar	Secretariat	M
34	10 (3)	FAISD Tables MET 1B, 3A and 3B	Secretariat	M
35	10 (3)	New edition of Regional SIGMET Guide	Secretariat	M
36	13 (2)	Status of MET deficiencies	Secretariat	M
37	4	Aeronautical Mobile Service (AMS) – Strategy	Secretariat	C
38	3	Upgrade of Fixed Services between the United States and Australia	Australia & USA	C
39	12 (3)	Operational Impacts of Outages Related to Data-Link Services	USA	C
40	9	The Use of 24-HR TAF in VOLMET Broadcast	Singapore	M

LIST OF INFORMATION PAPERS

IP No.	Agenda Item	Title	Presented by	Remark
1	-	Meeting Bulletin	Secretariat	A
2	10	Implementation of a Volcano Observatory Notice for Aviation	USA and New Zealand Volcanic Ash Advisory Centers	M
3	8	ISCS User Guide	USA	M
4	10	4th International Workshop on Volcanic Ash (VAWS/4)	New Zealand	M
5	11 (2)	Meteorological information and Air Traffic Management Co-ordination	New Zealand	M
6	11 (2)	An Update of the Light Detection and Ranging (LIDAR) Windshear Alerting System (LIWAS)	Hong Kong, China	M
7	15	U.S. Next Generation Air Transportation System (NextGen)	USA	A
8	10 (3)	Update on ASIA/PAC SIGMET Monitoring Tool	Hong Kong, China	M
9	10 (3)	Development of SIGMET Posters	”	M
10	11 (3)	New Forecasting Services for Airport Disruption Mitigation and Disaster Risk Reduction	”	M
11	11 (3)	Development of Lightening Detection and New Casting Service for the Hong Kong International Airport	”	M
12	12	Uplink and Downlink of Weather Information – Recent Development in Hong Kong, China	”	A

IP No.	Agenda Item	Title	Presented by	Remark
13	5 (2)	Status of the U.S. Wide Area Augmentation System (WAAS) Full LPV Performance (FLP) System	USA	C
14	5 (4)	U.S. Space-Based Positioning, Navigation and Timing (PNT) Policy	”	C
15	6 (3)	Federal Aviation Administration (FAA) Automatic Dependent Surveillance – Broadcast (ADS-B) Programme Office Roadmap	”	C
		Withdrawn		
17	10 (1)	Executive Summary of IAVWOPSG/3 Meeting	Secretariat	M
18	10 (1)	Executive Summary of WAFSOPSG/3 Meeting	”	M
19	10 (1)	Executive Summary of SADISOPSG/12 Meeting	”	M
20	5 (2)	Performance Based Navigation	”	C
21	7 (2)	Output of the Fourth Meeting of the Asia-Pacific Telecommunity (APT) Conference Preparatory Group for WRC-2007	”	C
22	11 (2)	MET Support for Operations at Aerodrome and Terminal Areas	Japan	M
23	10 (1)	VAAC Darwin Report July 2006 – June 2007	Australia	M
24	11	Establishment of a Quality Management System for Aviation Weather Services	”	M
25	11	Aviation Forecaster Competencies	”	M
26	11	Aviation Weather Service Restructure	”	M
27	11 (2)	Issuance of TAF under Amendment 74 Planned by JMA	Japan	M
28	4 (3)	Development of A Strategy for Data Link Harmonization	Secretariat	A

IP No.	Agenda Item	Title	Presented by	Remark
29	5 (3)	CAR/SAM Roadmap for Performance Base Navigation (PBN)	Secretariat	C
30	14	Work Programme of ICAO ANC Panels Related to CNS and Global ATM	”	A
31	5	Conclusions of the Study on Global Navigation Satellite System	”	C
32	3 & 4	The First Meeting of Aeronautical Communication Panel	”	C
33	5	The Eleventh Meeting of the APEC GNSS Implementation Team (GIT/11)	”	C
34	5	GNSS, GBAS Cat I and GRAS	Australia	C
35	5	Deployment of RNP-AR Terminal Area Procedures in Australia	”	C
36	5	Conformance Monitoring of RNP-AR Operations	”	C
37	5	Status of the MTSAT satellite-based augmentation system (MSAS)	Japan	C
38	12 (1)	Key Priorities and Performance Objective	Secretariat	A
39	-	List of Working and Information Papers	Secretariat	A
40	3 (3)	An Effort to Convert X.25 to IP Network Protocol in the U.S. FAA	USA	C
41	5 (2)	FAA Ground Based Augmentation System (GBAS) Programme Status	USA	C
42	12 (4)	Aviation Weather Services in the Next Generation Air Transportation System	USA	M
43	5	RVSM Separation for RVSM Compliant Aircraft Operating Information Flights	USA	C