INTERNATIONAL CIVIL AVIATION ORGANIZATION

TWENTY-SECOND MEETING OF THE ASIA/PACIFIC AIR NAVIGATION PLANNING AND IMPLEMENTATION REGIONAL GROUP (APANPIRG/22)

Bangkok, Thailand, 5-9 September 2011

Agenda Item 3: **Performance Framework for Regional air navigation planning and implementation**

3.4 CNS/MET

REPORT ON THE FIFTEENTH MEETING OF CNS/MET SUB-GROUP

(Presented by Chairpersons of CNS/MET SG)

SUMMARY

This paper presents the report of the Fifteenth Meeting of the CNS/MET Sub-group (CNS/MET SG/15) held in Bangkok from 25 to 29 July 2011. The meeting is invited to review the report and adopt the draft Decisions and Conclusions formulated by the Sub-group.

This paper relates to –

Strategic Objectives:
A: ***Safety*** *– Enhance global civil aviation safety*
C: ***Environmental Protection and Sustainable Development of Air Transport*** *– Foster harmonized and economically viable development of international civil aviation that does not unduly harm the environment*

Global Plan Initiatives: All

1. INTRODUCTION

1.1 The Fifteenth Meeting of the CNS/MET Sub-group was held from 25 to 29 July 2011. The meeting was attended by 111 participants from 24 Administrations, IATA, IFALPA, AIRINC and SITA. A summary report of the meeting prepared for the consideration by APANPIRG/22 is provided in the Appendix to this paper. Full report of the Sub Group was posted on the ICAO APAC Office website and can be access on the following webpage:
http://www.bangkok.icao.int/cns/meeting.do?method=MeetingDetail&meeting_id=78

2. DISCUSSION

2.1 The meeting considered 60 Working Papers and 50 Information Papers covering its 19 agenda items.

2.2 Based on the outcome of discussions on various agenda items, the meeting formulated 32 Draft Conclusions, 6 Draft Decisions and 6 Decisions.

2.3 The Attachment to this paper provides a Summary Report on the outcome of the CNS/MET SG/15 meeting including all draft Decisions and Conclusions for consideration by APANPIRG/22 meeting.

2.4 Appendices used from the CNS/MET SG/15 report in the Summary Report have the same Appendix numbers as those in the meeting report of CNS/MET SG/15 for easy reference.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

i) review the summary report on the outcome of the CNS/MET SG/15 meeting; and

ii) consider adoption of the draft Conclusions and the draft Decisions developed by the CNS/MET Sub-group.

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SUMMARY REPORT

OF THE

FIFTEENTH MEETING OF COMMUNICATION, NAVIGATION AND SURVEILLANCE/ METEOROLOGY SUB-GROUP (CNS/MET SG/15)

BANGKOK, 25 - 29 JULY 2011

1. Introduction

1.1 The Fifteenth Meeting of the Communications, Navigation and Surveillance /Meteorology Sub-group (CNS/MET SG/15) of Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG), was held at the ICAO Asia and Pacific Regional Office, Bangkok, Thailand from 25 to 29 July 2011. Full report of the meeting is available at the webpage: http://www.bangkok.icao.int/cns/meeting.do?method=MeetingDetail&meeting_id=78

1.2 This summary report brings out the significant outcomes of the meeting and presents draft Conclusions and Decisions formulated/recommended for the consideration by APANPIRG/22 meeting.

2. Adoption of Agenda

2.1 The meeting adopted the provisional Agenda Items, presented by the Secretariat, without any change.

3. Summary of Discussions

3.1 Outcome of the meeting in respect of the adopted Agenda Items is presented below:

3.2 Decisions adopted by CNS/MET Sub Group are not included in this summary report.

3.3 Detailed outcome of the subordinate group (ATNICG, ADS-B, PBN TF, OPMETTF etc.) meeting are available in the full reports which have been posted on the ICAO APAC website.

3.4 Actions taken on Reports of the CNS/MET SG/14 and APANPIRG/21 Meetings

3.4.1 The meeting reviewed the actions taken by APANPIRG/21 on Decisions and Conclusions formulated by CNS/MET SG/14. The meeting also noted with satisfaction, actions taken and the significant progress achieved by the States and the Secretariat. It was noted that action on 85% of the 38 Conclusions and Decisions of the APANPIRG/21 in the CNS/MET fields were completed.

Relevant Action Items of the 47th DGCA Conference

3.4.2 47th DGCA Conference developed 16 Action Items. Action Items relating to the Work Programme of the CNS/MET Sub-group were highlighted as follows:

- Action Item 47/1 - Need for ATM Contingency Plans
- Action Item 47/3 - Timely Implementation of new Flight Plan format
- Action Item 47/4 - Expedite completion of State's PBN implementation plan
- Action Item 47/5 - Maintain continuous Civil and Military coordination
- Action Item 47/10- Develop Sates' action plans on CO_2 Emissions Reduction
- Action Item 47/13 - Promote ICAO Developing Countries Training Programme

3.4.3 The meeting noted that Items 47/1, 47/3, 47/4 and 47/5 were already covered by the work programme of the CNS/MET Sub-group and APANPIRG and encouraged States to make use of the opportunities provided under ICAO Developing Countries Training Programme for the training of their national technical staff. The meeting also encouraged States to follow up the recommendations of the 47th DGCA Conference.

Review outcome of the ATM/AIS/SAR/SG/21 Meeting

3.4.4 The meeting noted the key outcomes of the ATM/AIS/SAR/SG/21 meeting related CNS/MET SG. The CNS/MET SG/15 meeting endorsed the Draft Conclusion 21/9 formulated by the ATM/AIS/SAR SG/21 that enabled States to provide priority to ADS-B Out equipped aircraft or implement exclusive ADS-B airspace.

3.4.5 While supporting a draft regional air navigation concept of operations presented by IATA (WP58) and endorsed by of ATM/AIS/SAR SG/21 (WP/53), the CNS/MET SG/15 meeting noted that use of SATCOM Voice in the draft needed to be in line with existing regional agreements adopted by APANPIRG. As a result of discussion, the meeting endorsed a revised version of the draft Asia/Pacific Air Navigation Concept of Operations as provided in the **Appendix D** to the Report which included additional editorial changes. The meeting suggested the revised Draft Conclusion as follows:

Draft Conclusion SG 21/8 − Asia/Pacific Air Navigation Concept of Operations

*That, the Asia/Pacific Air Navigation Concept of Operations provided in **Appendix D** to this report be adopted and published on the APAC website as a regional guidance material for air navigation facility, service and avionics equipage planning.*

Review outcome of the RASMAG/13 and RASMAG/14 Meetings

3.4.6 The meeting noted outcomes of the Thirteenth and Fourteenth Meetings of the Regional Airspace Safety Monitoring Advisory Group (RASMAG/13 and /14), which included termination of CRA datalink assessment services of Japan for Southeast Asian States, piecemeal report by CRAs/FITs, safety assessment of airspace and LHD block clearance carried out by Australia, significant reduction of Category E LHD consequent to AIDC implementation between Japan and ROK, RASMAG endorsement of ADS-B derived geometric height for monitoring and implementation proposal of En-route Monitoring Agency by India.

3.4.7 Noting the pre- and post-implementation system performance monitoring required by Annex 11 – *Air Traffic Service* (Para 2.26.5), the *Global Operational Data Link Document* (GOLD) and the *Guidance Material for End-to-End Safety and Performance Monitoring of Air Traffic Service Data Link Systems in the Asia/Pacific Region*, the CNS/MET SG/15 meeting endorsed RASMAG Draft Conclusion 14/1 to urge States to provide results of data link performance monitoring to CRAs/FITs in a timely manner.

3.4.8 Recognizing the significant benefits derived from implementation of AIDC in reduction of Category E errors, States were urged to work towards implementation of compatible AIDC capabilities between neighbouring ATS facilities as soon as possible in accordance with the regional air navigation plan and the available ICAO guidance material on AIDC. In this connection, the CNS/MET SG recommended that the ATM/AIS/SAR SG and/or RASMAG develop a priority list for early implementation of AIDC between ATC pairs based on statistical data.

Aeronautical Fixed Service (AFS)

Sixth Meeting of ATNICG

3.4.9 The Sixth meeting of Aeronautical Telecommunication Network Implementation Coordination Group (ATNICG/6), hosted by the Office of Civil Aviation, Ministry of Land, Transport and Maritime Affairs (MLTM) and Korea Airports Corporation (KAC) was held from 16 to 20 May 2011 in Seoul, Republic of Korea.

Terms of Reference and Subject/Tasks List

3.4.10 The meeting, after reviewing the updates proposed by ATNICG/6 to the Terms of Reference and the Subject/Tasks list, endorsed the following Draft Decision formulated by the ATNICG/6:

Draft Decision 15/1 - Revised TOR and Subject/Tasks List of ATNICG

That, the revised Terms of Reference and the updated Subject/Tasks List provided in **Appendix E** be adopted.

ATNICG Working Group Meetings

3.4.11 The meeting was informed about the outcome of the Eighth Working Group Meeting of ATNICG hosted by Airways New Zealand in Christchurch from 29 September to 1 October 2010 and the Ninth Working Group Meeting hosted jointly by Aeronautical Radio of Thailand (AEROTHAI) and ICAO Asia and Pacific Office in Bangkok from 25 to 26 January, 2011. After reviewing the progress achieved during the two meetings, CNS/MET SG/15 appreciated the assistance and support provided by Airways New Zealand and AEROTHAI by hosting the meetings.

Developments by Aeronautical Communication Panel

3.4.12 The meeting was informed about the outcome of Aeronautical Communication Panel (ACP) Working Group –I (IPS) and Working Group – M (Maintenance) meetings held in Bangkok on 27 – 28 January and 31 January – 1 February 2011 respectively. Non availability of industry body like Configuration Control Board, or forum for coordination with industry standards bodies etc. were identified as significant issue required to be addressed. It was informed that possibility of acquiring top level domain name for ICAO was being explored.

3.4.13 On behalf of ATNICG, a paper was presented to ACP WG, wherein following two key issues were raised:

a) to clarify the status of acquisition of a global IPv6 address block for ICAO.

   The meeting was informed that ICAO Secretariat had agreed that ICAO Montreal will work to acquire IPv6 address blocks for the regions; and

b) to provide guidance on the issues related to backward compatibility of AMHS specifically for interconnecting systems that support IPM84 and IPM88.

3.4.14 ACP was of the view that the issue is relevant only for one State in APAC region and hence should be addressed at the regional implementation level.

Amendment to FASID Tables CNS 1B, CNS 1C and CNS 1D

3.4.15 The meeting reviewed and updated Asia and Pacific Regions Air Navigation Plan (Doc 9673) Volume II, FASID Table 1B – Aeronautical Telecommunication Network (ATN) router plan, Table 1C – ATS Message Handling System (AMHS) routing plan and Table 1E – ATS Inter-facility Data Communication (AIDC). Consequently, the following draft Conclusion was endorsed for adoption by APANPIRG.

Draft Conclusion 15/2 - Amendment to FASID Tables – CNS 1B, 1C and 1D

That, FASID Tables CNS 1B – Aeronautical Telecommunication Network (ATN) router plan**,** Table CNS 1C – ATS Message Handling System (AMHS) routing plan and Table CNS 1E – ATS Inter-facility Data Communication (AIDC) be replaced with updated Tables provided in **Appendices F, G and H** in accordance with the established procedures.

AMHS Planning Documents and Implementation Status in other Regions

3.4.16 The Fifteenth Meeting of EUR/NAT Aeronautical Fixed Services Group (AFSG/15) was informed that the Manual on ATN using Internet Protocol Suite (IPS) Standards and Protocols (Doc 9896) and Manual on Detailed Technical Specifications for ATN using ISO/OSI Standards and Protocols (Doc 9880) were officially published in the second half of 2010 and that Manual of Technical Provisions for Aeronautical Telecommunication Network (ATN) (Doc 9705) and the Comprehensive ATN Manual (Doc 9739) were subsequently withdrawn.

3.4.17 Following operational requirements which need to be addressed in the AFS were identified by AFSG:

a) Amendment 1 to PANS ATM Doc 4444 – FPL 2012 (15 Nov 2012);
b) xNOTAM using XML (planned in 2012 – 2016); and
c) XML based OPMET (planned 2012/2013)

3.4.18 Following AFTN requirements were identified by AFSG, which will be essential to meet the requirement of new ATM enhancements:

a) Capability for handling long messages (length to be defined);
b) Extended line length (more than 69 characters); and
c) Extended character set (restrictions concerning some control characters)

3.4.19 ATNICG agreed with AFSG view that the current AFTN/CIDIN/AMHS would be able to meet the evolving operational requirements and no other network/technology would be needed, ATNICG however did not agree with AFSG's contention that some of these requirements had already been accommodated on the basis of bilateral agreement and/or had been included in ICAO Annex 10.

3.4.20 Sixth Meeting of ICAO South American Regional Implementation Group (SAM/IG/6) (18 to 22 October, 2010) concluded that implementation dates committed were being shifted and hence the project was getting delayed and adopted a conclusion urging States to request support from system providers to complete successful connection and to get their staff trained.

3.4.21 AMHS Implementation Task Force in AFI region was established by the AFI Planning and Implementation Regional Group (APIRG) through Conclusion 17/17 and a Workshop on AMHS and the First Meeting of the Task Force was organized from 17 to 20 May 2011 at ICAO Nairobi office.

Voice over Internet Protocol

3.4.22 It was informed that Voice over IP (VoIP) Specifications, developed by EUROCAE Working Group 67 had been referred in ICAO Doc 9896. It was suggested that a mechanism should be available for ICAO to have some control over the development of VoIP documentation etc. It was informed that in VoIP, SIP has been used for signaling and for media User Datagram Protocol (UDP) has been used. VoIP applications in ATM include both Air Ground and Ground-Ground uses and it is now well accepted for ATM. In APAC region, point-to-point VoIP should find its application in meeting the requirements of ATS Direct Speech Circuit as given in FASID Table 1D. ATNICG identified the need to develop an ICD for this application based on specifications in EUROCAE Doc. ED 137A, updated version of which was released in 2010 and which will be included in second version of ICAO Doc 9896. Since VoIP cannot use too many hops, so it is required to be kept separate from ATN. ATNICG was of the view that in case, it is decided to migrate to VoIP to replace the voice switching then an ICD will need to be developed. USA agreed to develop ICD for VoIP in due course.

Directory Service Requirements

3.4.23 Application of Directory Service (using X.500) will involve a number of operational aspects including management of data, local availability, synchronization, manageability, support for regional structures and transition. Ideal structure proposes to have three level structures: global level, regional level and national level. It was confirmed that AMC service will continue to be used in the near term and States are required to follow the guidelines provided on the subject. The meeting was informed about many other issues like maintenance of AIRAC cycle, distribution management, routing table which were discussed in ATNICG.

ATN/AMHS Documentation Tree

3.4.24 The meeting noted the ATN/AMHS Documentation Tree updated by ATNICG/6. The updates reflected on the APAC website can be accessed at the following webpage: http://www.bangkok.icao.int/apac_projects/atn/chart/atn_doctree.asp.

Review of Reports of Ad Hoc Working Group

3.4.25 ATNICG had identified that Asia/Pacific requirements for AMHS had been published in several manuals based on different versions of Doc 9705 and EUROCONTROL AMHS Manual. The meeting supported ATNICG's proposal to adopt a single document, that captures the AMHS requirements for the region and that is based on the latest ICAO specifications in this regard. The meeting expressed appreciation for the efficient and good work completed by an Ad Hoc Working Group with members from India, Japan, Singapore, Thailand and USA. The meeting reviewed the APAC AMHS Technical Specifications developed by the ad-hoc group and formulated following draft Conclusion:

Draft Conclusion 15/3 – ASIA/PAC AMHS Technical Specifications

That, the ASIA/PAC AMHS Technical Specifications provided in the **Appendix I** to the Report be adopted.

Note of appreciation

3.4.26 The meeting expressed its gratitude to the MLTM and KAC for hosting ATNICG/6 meeting, the excellent arrangements made and the activities organized during the meeting including a technical visit to the Aeronautical Communication Center at GIMPO Airport. The meeting also noted India's offer to host the next ATNICG Working Group meeting in Jaipur in end September, 2011 and placed on record its appreciation for the offer.

ATN/AMHS Implementation and Operational status in Republic of Korea

3.4.27 Republic of Korea informed the meeting about the completion of ATN/AMHS implementation between Seoul and Beijing on 1 June 2011 and that the implementation between Seoul and Fukuoka, as per regional Air Navigation Plan will be coordinated with Japan. Republic of Korea was congratulated for this achievement and meeting was reminded about the completion of ATS MHS implementation between Singapore and India in March 2011.

Special Implementation Project (SIP) AIDC Seminar

3.4.28 The meeting noted that a Special Implementation Project (SIP) Seminar on ATS Inter-Facility Data Communication (AIDC) was held at ICAO Regional Office, Bangkok, Thailand from 12 to 13 October 2010. The objective of the Seminar was to assist the States in the APAC Region in implementing AIDC as it would have significant favorable effects on the safety of operations and efficiency of air traffic management.

3.4.29 It was recognized that complexities of implementation of AIDC requires common efforts of a team consisting of members with both technical and operational background. It was also noted with interest that the flexibility of implementation exists in the form of a dedicated standalone AIDC server or processor installed separately interconnecting with other ATCC via the AFTN. It fetches the Flight Plan information from the ATM system. A sample of such kind of implementation was presented to the Seminar by Hong Kong China.

3.4.30 The Seminar recommended implementation of AIDC in accordance with the regional air navigation plan and ICD for AIDC. Noting very limited data contained in the AIDC Implementation Planner presented and that a main ACC in a State would have no more 5 AIDC links with ACCs in neighboring States, the meeting did not recommend the planner for adoption by APANPIRG and, the secretariat was requested to urge States to provide required data through a state letter.

Pan Regional ICD for AIDC

3.4.31 USA provided updates on the process to consolidate the Interface Control Document (ICD) for the North Atlantic and Asia/Pacific (APAC) Regions, to provide harmonized Air Traffic Service Inter-facility Data Communications (AIDC). USA has produced a consolidated draft ICD version 0.4 based on Version 3 of APAC ICD for AIDC and NAT CC ICD, v1.2.7 May 2009. The coordination draft "*Pan Regional Interface Control Document for ATS Interfacility Data Communications (PAN ICD)"* with thorough bi-directional tracking of content was presented to the meeting. The comment resolution form was also presented to the meeting. The NAT CNSG/5 will review the draft in its next meeting scheduled for 26 to 30 September 2011 in Bodo, Norway.

3.4.32 The meeting encouraged States to provide comments on the draft version. The meeting also noted one of the principles agreed by NAT SPG as follows: "Since the ICD would apply to oceanic regions only, the title of the future document should be "Pan Regional ICD for Oceanic AIDC". In this regard, the meeting recalled that APANPIRG/21 had adopted Conclusion 21/26 to inform NAT SPG that the title "Pan-regional ICD for Oceanic AIDC" is unacceptable as the ICD for

AIDC is applicable for use by all ATS and ATM facilities in both oceanic and continental areas within the Asia Pacific Region and that the document should be titled as "Pan-Regional ICD for AIDC. USA was requested to forward this comment to the drafting group for further consideration. It was suggested that the specific use of the ICD for Oceanic Area in the NAT Region may be included in the "FORWARD" of the document.

Aeronautical Mobile Service (AMS)

Second Satellite Data-link Operational Continuity (SOCM/2) meeting

3.4.33 To meet the requirements of APANPIRG Conclusion 19/24, First Satellite data-link Operational Continuity Meeting (SOCM/1) was held from 26 to 28 August, 2009. Based on the recommendation made by SOCM/1 to organize second SOCM after receiving inputs from FANS System Improvement Team (FSIT), APANPIRG adopted Conclusion 20/32 inviting ICAO to organize the second meeting in 2010. SOCM/2 could not be organized, because FSIT did not hold their meeting and hence no updates could be received for review by the SOCM/2. Subsequently, APANPIRG decided that the meeting should be organized even if no input from FSIT is received. The meeting also noted that a considerable progress had been made in improving the performance of satellite data-link communication. In view of foregoing, the SOCM/2 meeting has now been scheduled for 15-18 November 2011. Letter of invitation from ICAO APAC Office was issued on 24 June 2011. It has also been decided to organize a one and a half day Seminar on Satellite Data-link Communication in conjunction with the meeting. States were invited to participate in the meeting and the seminar. Consequently, the meeting endorsed following draft Conclusion:

Draft Conclusion 15/4 – Second Satellite Data-link Operational Continuity (SOCM/2) and Seminar on Satellite Data-link Communication

That, States be urged to nominate suitably qualified personnel to participate in the Seminar on Satellite Data-link Communication and the Second Satellite data-link Operational Continuity Meeting (SOCM/2) scheduled from 15 to 18 November, 2011 in Bangkok, Thailand.

Interregional SATCOM Voice Task Force (IRSVTF)

3.4.34 The first meeting of ICAO Inter-Regional SATCOM Voice Task Force (IRSVTF) was held from 25-27 January 2011, in Paris, France. The IRSVTF was established by the North Atlantic Systems Planning Group (NAT SPG Conclusion 46/5) and Asia-Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG Conclusion 21/27) with the objective to produce a globally applicable SATCOM voice guidance material (SVGM) for air traffic service (ATS) communications.

3.4.35 The meeting noted that the IRSVTF plans to complete its work by the end of 2011 and present SVGM edition 1.0 to NAT SPG/48 for approval in June 2012. The ATM/AIS/SAR SG/22 and CNS/MET SG/16 are expected to review the guidance material and make recommendation for consideration by APANPIRG/23 in September 2012.

3.4.36 Draft SATCOM Voice Guidance Material v 0.5TC associated with Master Comment Matrix was provided to the meeting as Attachments to WP/28. States in the Asia and Pacific Regions, in particular member States of IRSVTF were encouraged to participate in IRSVTF/2 meeting and to provide input/comments for the SVGM/2 meeting though ICAO APAC Regional Office.

3.4.37 The meeting noted that the NAT SUPPs proposal for amendment on the use of SATCOM voice was formally approved by the President of ICAO Council on 11 May 2011. This was considered by NAT SPG/47 as an important milestone that would formally enable using the SATCOM voice in the NAT for routine ATS communications. The meeting also noted that one of scenarios considered in the NAT approval is only to allow SATCOM voice as a substitute for the carriage of one of the two required HF Long Range Communication System (LRCS).

3.4.38 Australia presented a paper highlighting SATCOM Voice issues with HF, especially on the North Atlantic routes. A trial in that region was undertaken that led to the subsequent legitimatization of the normal use of one HF set plus one SATCOM on some routes in the European region "**if the ground counterparts (i.e. ATS) in the region are equally suited for SATCOM".** Following points were noted:

a) This is not an approval for SCV to be a stand-alone Long Range Communication System (LRCS);

b) At least one HF must continue to be carried and be serviceable;

c) SCV can only be used in airspace where ATS are capable and authorized to use the capability; and

d) With most ATS infrastructure arrangements, SCV is operated through 'third party' communications protocol that precludes it being suitable for some separation standards.

3.4.39 Informal discussions have indicated that some States in APAC Region have already experienced flights being planned with SCV as only available Long Range Communication System. Given the European approval, further examples of this could be expected and will need to be managed. IFALPA informed the meeting that pilots used SATCOM Voice for communication with ATC in case other preferred means were not available.

SELCAL Code Issue

3.4.40 Australia informed the meeting about existing arrangements for allocating Selective C**a**ll (SELCAL) codes. Under existing arrangements, only 10920 combinations for SELCAL codes are possible using four tones, but 27,285 codes have been allocated to meet the requirements from the user. Hence a situation can arise where two (or more) aircraft operating within the same HF area will have identical SELCAL codes and this can lead to the possibility of one aircraft responding to the call for another aircraft. The meeting was informed that in a teleconference, Aviation Spectrum Resource Inc. (ASRI), the organization responsible for the allocation of SELCAL codes to aircraft operators agreed to institute a programme of recording instances of multiple aircraft responding to the same SELCAL code. A possible solution being discussed is to expand the existing 2 x 2 tone system to a 3 x 2 tone system. The meeting was warned about the requirement of updating the airborne systems in addition to the ground based systems, if this proposal was agreed. After discussing the issue, the meeting formulated following draft Conclusion urging the States using HF voice communication to report instances of two (or more) aircraft operating in the same HF area with identical SELCAL codes.

Draft Conclusion 15/5 – Identical SELCAL Codes

That, ICAO be invited to conduct a survey to assess the instances (per annum) of two (or more) aircraft using identical SELCAL codes in the same HF area.

Data-link Performance Monitoring

3.4.41 New Zealand provided data-link monitoring results from the Auckland Oceanic FIR for last three years. The meeting noted the encouraging results of data-link performance which had shown significant improvement since July 2010. The statistical data collected from December 2008 to June 2011 indicates that the safety targets for network availability are being achieved since July 2010 and data link performance generally shows improvement. While the safety targets for network availability are being achieved at present, it is clear that considerable improvement is necessary if the efficiency target is to be met. The efficiency target supports operational efficiency and orderly flow of air traffic. The nominal times for CPDLC and ADS-C continuity are being achieved, but some improvement is necessary to reach the target for expiration time.

Near term future plan of MTSAT

3.4.42 The meeting was informed that the End of Life (the EOL) of MTSAT-1R is prospected to occur during Japanese Fiscal Year 2014 and the EOL of MTSAT-2 is JFY 2015. A comprehensive study for next generation satellite was conducted in 2010 by JCAB. JCAB did not make a decision to replace MTSAT-1R, but to continue to provide AMSS via MTSAT-2 after the termination of MTSAT-1R AMSS payload. The calculation of remaining fuel showed that MTSAT-2 has an outlook of four year expansion of its life. JCAB believes that MTSAT System by single satellite still meets the Communication Service Provider portion of RCP240 defined in Global Operational Data Link Document (GOLD) mainly due to the high availability of communication satellite and redundancy of ground system.

Contingency Arrangement of Aeronautical Mobil Satellite (Route) Services

3.4.43 Japan presented a case reconfirming the importance of contingency arrangement in aeronautical safety communication infrastructure, based on Japan’s experience in the wake of Big Earthquake in Eastern Japan in March 2011. In order to realize uninterrupted data link communication, the MTSAT system was designed as follows:

- ✓ Safety critical functions of the system are multiplexed.
- ✓ The changeover time of multiplexed systems is second to millisecond orders.
- ✓ Two ASCs are disposed with about 600 km separation on Japan Mainland for space diversity.

3.4.44 The AMSS provided by the MTSAT continued during that the earthquake period. Although electricity recovered in two days, repair and calibration of the equipment took almost one month. Hitachiota ASC went back-on-normal in April 2011. The experience gained from the earthquake in Japan this year shows that a certain level of redundancy of system is needed for the continuity of aeronautical satellite communication. It was concluded that contingency arrangement in the design of global or regional air navigation systems such as AMS(R)S System is one of the salient issues that needs to be considered for the assurance of continuity and availability of air navigation service.

Indonesia FSS Restructurization

3.4.45 The meeting was informed that Indonesia has a plan to restructure its existing 14 Flight Service Sectors (FSS) by the year 2014. FSS will cover airspace under FL245 which is not within VHF coverage. The planned FSS restructurization will have 2 FSS in the Western FIR and 3 FSS in the Eastern FIR and additional centralized FSS units located in Jakarta and Ujung Pandang respectively.

HF Reception Performance over Colombo FIR

3.4.46 Sri Lanka presented the summarized HF reception data observed during 2010/ 2011 within Colombo FIR with specific attention to fading characteristics of HF signals. The meeting noted that the distribution of fading hours concentrate during the period 1930 – 0100hrs (UTC) and higher outages figures were observed during May – September 2010. It was also noted that the outage figures from February 2011 onwards have been significantly lower.

Navigation

Review reports of the Seventh and Eighth Meetings of Performance Based Navigation (PBN) Task Force (TF/7 and TF/8)

3.4.47 The Seventh Meeting of the Performance-Based Navigation Task Force (PBN/TF/7) was held in Bangkok from 1 to 3 September 2010. The Eighth Meeting of the Performance Based Navigation Task Force (PBN/TF/8) was held in conjunction with the PBN Workshop and the PBN Implementation Seminar 2011, which were graciously hosted by the Airports Authority of India (AAI), in New Delhi, India from 9 to 13 May 2011.

3.4.48 The following key subjects and development on PBN implementation were reviewed and noted by the meeting:

- ICAO Assembly Resolution A37-11 allowed the implementation of RNP APCH LNAV approaches if Approaches with vertical guidance (APV) cannot be implemented;

- PBN GO Team activity was noted (a GO Team had been to Thailand);

- ICAO was developing Operational Approval guidance for global application, based to a large degree on the APAC Cooperative Development of Operational Safety and Continuing Airworthiness Programmes (COSCAP) Handbook in cooperation with the Civil Aviation Safety Authority of Australia (CASA);

- out of the 20 current PBN Plans, nine (9) had been assessed by the PBN Plan Review Team as ‘robust’, four (4) were rated as ‘marginal’ and eight (8) were rated ‘incomplete’, which meant that less than one quarter of APAC administrations had adequate plans;

- mechanisms such as the ICAO Asia/Pacific Flight Procedure Programme (FPP) and COSCAPs, assistance by industry stakeholders such as Boeing, Airbus and IATA and workshop/seminars held at locations that can benefit States which need direct assistance were agreed to be of benefit and was to be encouraged (later termed Regional Support Strategy REDI Initiatives);

- Version 3.0 of the Asia/Pacific Performance-Based Navigation Implementation Plan was agreed, with updates to include Basic Planning Elements, Operational Approval material, and examples of specific measurable benefits resulting from States PBN implementation;

- Nepal would write to the Regional Office to formally request a change to Annex 11, removing the words ‘self-contained’ in order to allow area navigation derived RNAV waypoints. (In this connection, it was informed that letter received from Nepal before CNS/MET SG/15 meeting was forwarded to ICAO Headquarters for consideration)

- Based on the proposal made by Australia, PBNTF/8 proposed to include the minimum requirement of GNSS-enabled area navigation systems for all RNP navigation authorizations in the *Strategy for the Provision of Navigation Services in the Asia/Pacific Region.* This had been reflected in the revised Navigation Strategy proposed by the CNS/MET SG/15 meeting. The meeting, after discussion on the subject also formulated following draft Conclusion to support the requirement projected by PBN Task Force:

Draft Conclusion 15/6 – GNSS minimum requirement for RNP Navigation Specifications

That, GNSS-enabled area navigation systems for all RNP navigation specifications be adopted as minimum requirement in the Asia/Pacific Region.

As a result of review of the outcome of PBNTF/7 meeting which were also briefly introduced to APANPIRG/21 meeting, the CNS/MET SG/15 meeting endorsed the following Draft Conclusion:

Draft Conclusion 15/7 - Participation in the ASIA/PAC Flight Procedure Programme

That, States in the ASIA/PAC Region be encouraged to take part in the regional cooperative effort to achieve the safety, access, capacity, efficiency and environmental benefits that are possible with PBN implementation, by joining the Asia-Pacific Flight Procedure Programme (FPP).

Feasibility of Establishing a Regional RAIM Prediction System

3.4.49 GNSS is considered as a main navigation infrastructure supporting PBN operations and is also a critical component of surveillance system, such as ADS-B. The meeting recalled that Annex 10 and PBN Manual require the States and Air Navigation Service Providers (ANSPs) to provide timely warning of GNSS Receiver Autonomous Integrity Monitoring (RAIM) outages to the users of the services like pilots, flight dispatchers, Air Traffic Controllers and Airspace Planners. The meeting was also reminded that APANPIRG Decision 20/38 had tasked PBN Task Force to examine the feasibility of establishing a regional RAIM prediction system.

3.4.49.1 The meeting noted that PBNTF/7 endorsed a Minimal Technical and Operational Requirements for a Regional RAIM Prediction System and a proposal on a regional RAIM prediction concept. The meeting also noted that the APEC GNSS Implementation Team (GIT) meeting in 2009 had expressed its willingness to work cooperatively with ICAO to support the establishment of a regional RAIM prediction service.

3.4.49.2 It was informed that AEROTHAI had approved initial investment for the establishment of the ASIA/PAC Regional RAIM Prediction System to support ABAS. Initial operation for the Bangkok FIR is expected to be implemented near the end of 2011. The system would be capable of providing RAIM prediction services for all participating States within the ASIA/PAC Region in 2012. It was estimated that financial contribution for each participating State will be a monthly fee of less than USD 1,500 with a one-time database set-up cost of less than USD 3,500 per State. The meeting noted that AEROTHAI is willing to assist participating States in fulfilling the established requirements.

3.4.49.3 To encourage States' participation on the regional RAIM prediction service and to harmonize the operational and technical requirements, the meeting endorsed following two draft Conclusions formulated by the PBNTF/7 meeting:

Draft Conclusion 15/8 - Endorsement of Minimum Technical and Operational Requirements for a Regional RAIM Prediction System

That, the Minimum Technical and Operational Requirements for a Regional RAIM Prediction System for the ASIA/PAC Region provided in **Appendix J** to this report be adopted.

Draft Conclusion 15/9 - Regional RAIM Prediction Service Participation

That, States in the ASIA/PAC Region be encouraged to take part in the Regional RAIM Prediction System.

3.4.50 Noting the PBN TF/8 meeting proposal to amend the regional PBN Implementation Plan to include the following elements, the CNS/MET SG formulated following draft Conclusion:

a) Description of the Basic Planning Elements (BPEs);

b) Operational Approval as a BPE;

c) Appendix C to be added to include Operational Approval guidance material; and

d) Updated Appendix D to provide real examples of PBN benefits.

Draft Conclusion 15/10 - Regional PBN Plan Amendment

That, the revised APAC Regional PBN Implementation Plan Version 3.0 provided in **Appendix K** to the Report be adopted and published.

<u>GNSS Implementation and GNSS Implementation Status Survey</u>

3.4.51 The meeting was informed about the concern raised in APANPIRG/21 about slow progress of GNSS implementation in the region. To assess the level of GNSS implementation in the region, a questionnaire was circulated to the States through APAC Office State Letter dated 30 November, 2010. The meeting noted the outcome of the survey presented by the Secretariat. Based on the 24 responses received from the States (response rate 60%), it was informed that some of the States had not developed their GNSS implementation plan. Strategies adopted by the States varied widely on issues like operation approvals, decommissioning of ground based facilities, adoption of GNSS Manual (Doc 9849) for implementation guidance, implementation of augmentations etc. The meeting agreed that GNSS should be considered for inclusion as an ILS component. The meeting agreed to invite ICAO to conduct a workshop to address issues identified through survey and formulated following draft Conclusion:

Draft Conclusion 15/11 – Workshop on GNSS implementation

That, ICAO be invited to organize a Workshop on GNSS implementation to address issues identified through the GNSS implementation survey conducted in 2010.

<u>Ionospheric Data Collection, Analysis and Sharing in Support of GNSS Implementation</u>

3.4.52 Significance of characterizing ionosphere in the region was identified by APANPIRG/20 as a useful step towards the implementation of GNSS. To progress characterization of ionosphere, APANPIRG/21 agreed upon the requirement of cooperative efforts in developing a standard ionospheric model for the region and invited Japan to provide the technical leadership with ICAO providing support. A two day workshop on *'Ionospheric Data Collection, Analysis and Sharing in Support of GNSS Implementation'* was organized on 5 and 6 May, 2011 in Bangkok.

3.4.53 The CNS/MET SG noted a recommendation developed by the Workshop to urge States to share available GNSS data collected to facilitate characterization of ionosphere. The meeting, after deliberating the issue, agreed to formulate following draft Conclusion:

Draft Conclusion 15/12 – Sharing of Ionospheric Data

That, States be urged to coordinate with their relevant national organizations for sharing of available GNSS data with the relevant civil aviation agencies to facilitate characterization of ionosphere to support GNSS implementation in the region.

3.4.54 The meeting assessed the requirement projected in a recommendation of the Workshop and made a Decision establishing an Ionospheric Study Task Force to assess the need of creating a Regional Ionospheric Threat Model for GBAS and SBAS and create it if required.

3.4.55 The meeting noted that the Workshop recommended ICAO Regional Office to coordinate with APEC GIT for the initiative being carried out for ionospheric data collection, analysis and sharing. APEC Economies will be requested to support this initiative by encouraging relevant agencies in each Economy to share data collected with civil aviation. The meeting was informed that a presentation was made to APEC GIT on this recommendation. Report on the APEC GIT meeting and the support that was received from APEC GNSS Implementation Team was noted. Progress made on the development of a template for data collection was also noted by the meeting.

<u>Outcome of APEC GIT/15</u>

3.4.56 The Fifteenth meeting of Asia Pacific Economic Cooperation (APEC) GNSS Implementation Team (GIT/15) was held in Brisbane, Australia from 13 to 17 June, 2011. Team adopted a Strategy which includes collaborating with ICAO, ICG (International Committee on GNSS) and IMO (International Maritime Organization) to explore possibilities of supporting GNSS activities and avoiding duplication of efforts. The meeting discussed two Concept Notes and Project Proposals on GNSS applications, which included a Proposal on 'Performance Based Navigation (PBN) Regulatory Review and Evaluation Programme' sponsored by USA, Thailand and New Zealand. ICAO presented status of GNSS implementation in the region and informed the meeting about the outcome of 'Workshop on Ionospheric Data Collection, Analysis and Sharing to support GNSS Implementation held from 5 to 6 June, 2011. APEC GIT and some States agreed to support the ionospheric data collection activity of ICAO APAC Region.

<u>GNSS Performance Threats</u>

3.4.57 The meeting was informed of potential threats to the performance of GNSS from naturally occurring and manmade sources. The manmade sources were considered in the categories of inadvertent interference and deliberate interference. Inadvertent sources include harmonics, inter-modulation and parasitic oscillations from poorly designed, implement or maintained radio frequency systems. Deliberate threats to GNSS can come from individuals who seek to defeat security and tracking devices on the basis of privacy protection or to facilitate criminal activities. Low cost jammers are available in the market place that target GNSS. These devices will generally effect nearby locations and will have little effect on flying aircraft due to the short exposure time unless the device is carried on to the aircraft. Attention was drawn to technical standards issued by some States and to the legislative provisions that enforce compliance with standards and prohibit the sale, possession and operation jamming devices.

3.4.58 The meeting in seeking to preserve the utility of GNSS to aviation formulated the following conclusion:

Draft Conclusion 15/14 - Protection of aviation utility of GNSS

That, State aviation authorities in partnership with other agencies of the State prohibit malicious and unintentional interference to GNSS and regulate legitimate uses of technology to preserve aviation utility of GNSS.

GBAS

3.4.59 The meeting was informed about the status of GBAS implementation in Australia and Japan. Austraila expects to completion of evaluation of their GBAS (SLS – 4000 SmartPath) by 2012. Both States informed the meeting about the development of CAT III GBAS (GAST-D) in support of Navigation System Panel work programme. The meeting was also informed about the ionospheric studies being carried out by Electronic Navigation Research Institute (ENRI).

Navigation Strategy for the ASIA/PAC Region

3.4.60 The meeting reviewed the Navigation Strategy for the Asia/Pacific Region adopted by APANPIRG/20 meeting in September 2009 under its Conclusion 20/46. Taking into account the development in the navigation field in the region and the recommendation from PBNTF/8 meeting to include the minimum requirement of GNSS-enabled area navigation systems for all RNP navigation authorizations in the Strategy, the meeting endorsed the revised Navigation Strategy for the Asia/Pacific Region as presented by an Ad Hoc working group and formulated following draft Conclusion:

Draft Conclusion 15/15 - Revised Navigation Strategy for the Asia/Pacific Region

That, the revised Navigation Strategy for the Asia/Pacific Region provided in **Appendix M** to the Report be adopted.

SIP Workshop on Performance Framework for Air Navigation Systems

3.4.61 APANPIRG/19 (C19/2) invited States to adopt a national performance framework based on ICAO guidance material and regional and global plans. To support this approach, a Special Implementation Workshop on the development of national performance framework for air navigation systems was hosted in Fiji in March-April 2011. It was reported that the participants gained an improved understanding of the ICAO performance framework and were able to consolidate this through practical exercises during the workshop.

Navigation Systems Panel

3.4.62 A summary of the activities of the Navigation Systems Panel (NSP) was provided to the meeting. The activities of the NSP included the preparation of papers for the 12th Air Navigation Conference, changes to Standards and Recommended Practices (SARP) their additions for SBAS, and reviews of the GNSS Manual, Ionospheric Paper and the Manual of Testing of Radio Navigation Aids. Attention of the meeting was drawn to a regional State Letter which sought from States information on their navigation plans for forwarding to the NSP to assist in the preparation of the Navigation Roadmap in support of the AN Conf/12.

Surveillance

Outcome of ADS-B SITF/10 Meeting

3.4.63 The meeting noted that the Tenth Meeting of Automatic Dependent Surveillance – Broadcast (ADS-B) Study and Implementation Task Force (ADS-B SITF/10) hosted by Civil Aviation Authority of Singapore (CAAS) was held from 26 to 29 April 2011 in Singapore. An information sharing session on ADS-B development and implementation was organized on 26 April in conjunction with the ADS-B SITF/10 meeting. The outcome of deliberations at the information sharing session was taken into consideration at the 10th meeting of the Task Force.

Review of Terms of Reference and Subject/Tasks List

3.4.64 The TOR of ADS-B SITF was considered appropriate and the ADS-B SITF/10 meeting did not propose any changes to the TOR. The meeting reviewed and proposed updated Subject/Tasks List for ADS-B SITF and endorsed following Draft Decision:

Draft Decision 15/16 - Subject/Tasks List of ADS-B Study and Implementation Task Force

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

Guidance Material on building a safety case for ADS-B separation service

3.4.65 The meeting reviewed and endorsed a draft guidance material on building a Safety Case for delivery of an ADS-B separation services developed by the ADS-B SITF. The meeting noted that the ICAO Circular 311 had been pulled out of circulation and replaced by Circular 326 which will be ready for publication by September 2011. The meeting reviewed the structure and contents of the draft Guidance Material and proposed for adoption through a consolidated draft Conclusion 15/17 below.

Sample agreement for data sharing

3.4.66 The meeting noted that the sample agreement was updated based on experience gained by Indonesia and Singapore on the adoption of the agreement. The meeting noted the description of the changes to the original sample agreement and endorsed a revised sample agreement on data sharing through draft consolidated Conclusion 15/17 below.

Amendments to AIGD

3.4.67 The meeting noted that the Amendment No. 1 to the PANS-ATM (Doc 4444) will become applicable on 15 November 2012 and endorsed a proposal for a consequential amendment to the ADS-B Implementation Guidance Document (AIGD). The meeting also agreed to add a guidance material to AIGD which contains 5 recommendations for reliability and availability of ADS-B ground system. In this connection, the meeting endorsed amendment to AIGD through following consolidated draft Conclusion.

Draft Conclusion 15/17 – Development of Guidance Material on ADS-B

That, the following regional guidance materials on ADS-B implementation be adopted and published on the APAC Website.

a) Guidance Material on Building a safety case for the delivery of an ADS-B separation service provided in **Appendix O**;

b) the revised Sample Agreement for Data Sharing contained in **Appendix P**;

c) amendments to the ADS-B Implementation Guidance Document (AIGD) as shown in the **Appendix Q** consequential to amendment to the Flight Plan and **Appendix R** on the reliability and availability for ADS-B ground system.

Radio Frequencies for Provision of VHF Voice Communications

3.4.68 The meeting recalled that APANPIRG/19 urged States to support provision of VHF radio voice communication associated with ADS-B data sharing between adjacent States. In order to enable radar like separation, ADS-B based surveillance service must be complemented by the Direct Controller Pilot Communication (DCPC) such as VHF radio voice communication. Viet Nam made a proposal that APANPIRG should further support the decision for States to provide VHF voice communications facilities for other States by developing a Conclusion. This would help in the domestic approval process for VHF radio frequency assignment. Consequently, the meeting endorsed following draft Conclusion.

Draft Conclusion 15/18 – Coordination for VHF for sharing Voice Communication Capability

That,

a) States be urged to support provision of VHF radio voice air/ground communication infrastructure for use by adjacent States; and

b) States sharing ADS-B data and providing VHF Voice air-ground communication infrastructure to adjacent States should co-ordinate with ICAO Regional Office and their national Telecommunication Regulatory Authority for assignment of specific VHF radio frequencies to be used by the adjacent States.

Requirement for SA Aware

3.4.69 The meeting noted a proposal from IATA to ADS-B SITF/10 meeting that the Australian ADS-B rule should be amended to extend the date of compliance by 2 years. Noting reasons stated and the date 12 December 2013 becoming a generally accepted date among APAC Region States for the commencement of ADS-B mandates, the meeting considered that it would be a reasonable compromise to extend the date for SA aware forward fit compliance to the mandate date, rather than 28 June 2012. In view of the foregoing, the meeting endorsed the recommendation as provided in a draft Conclusion of ADS-B SITF/10 meeting report. It was recommended for consideration by Australia that the existing forward fit requirement in the Australian CAO 20.18 for SA Aware to be incorporated in GNSS receivers providing position source data for ADS-B be extended from 28 June 2012 to 12 December 2013.

Support for DO260B

3.4.70 The meeting recognized that aircraft equipped with ADS-B Out avionics compliant with DO260B are likely to enter Asia Pacific airspace in 2012-2015 timeframe. There will be a need for the States providing ADS-B based surveillance service to include the service to aircraft with DO260B compliant avionics. The meeting therefore endorsed following draft Conclusion as formulated by the ADS-B SITF:

Draft Conclusion 15/19 – Support DO260B Compliant Avionics

That, States providing ADS-B based surveillance services be urged to upgrade their ADS-B ground stations in time (2012-2015) to receive DO260B standard transmissions in addition to those aircraft transmitting ADS-B data compliant with DO260 and DO260A.

Review of the TOR and Name of the SEA ADS-B Implementation Working Group

3.4.71 The meeting noted the outcome of the sixth meeting of the South East Asia ADS-B Implementation Working Group held from 24 to 25 February 2011 in Singapore. The complete report of the meeting is available on the ICAO APAC website:
http://www.bangkok.icao.int/cns/meeting.do?method=MeetingDetail&meeting_id=36

Bay of Bengal/South Asia Sub-regional Project

3.4.72 The meeting noted an initial proposal for the deployment of ADS-B ground stations in the Bay of Bengal and various developments that have taken place regarding ADS-B implementation in the States concerned.

3.4.73 With respect to Work Proramme of the SEA ADS-B working group to cover Bay of Bengal area, meeting considered the need to invite States in the Bay of Bengal area to participate in the working group meeting on a regular basis and agreed to the proposal to change the name of Working Group from SEA ADS-B Working Group to South East Asia and Bay of Bengal ADS-B Implementation Working Group (SEA/BOB ADS-B WG) as proposed by the ADS-B SITF and endorsed following draft Decision.

Draft Decision 15/20 – Name and Terms of Cooperation of ADS-B Implementation WG

That, Recognizing the need to expedite ADS-B implementation and surveillance data sharing in the Bay of Bengal area, the South East Asia Sub-regional ADS-B Implementation Working Group be renamed as “South East Asia and Bay of Bengal Sub-regional ADS-B Implementation Working Group”. Revised Terms of Cooperation and work programme based on the existing one for the SEA Sub-regional ADS-B Implementation Working Group be further developed by the new Working Group.

ADS-B Collaboration Project in the South China Sea Area

3.4.74 The meeting noted that Indonesia, Singapore and Viet Nam are collaborating in the South China Sea Project to benefit traffic along routes L642 and M771 and agreed with the need to harmonize equipage requirement and timeline for ADS-B mandate. Noting progress of ADS-B Implementation made by States in the South China Sea area, the meeting encouraged States concerned to expedite implementation of the project and endorsed following Draft Conclusion:

Draft Conclusion 15/21 – Expedite ADS-B implementation project in South China Sea area

That, States concerned with ADS-B implementation in the South China Sea area be urged to expedite required actions and coordination to achieve the implementation.

Australia-Indonesia Data Sharing Project

3.4.75 The meeting noted that a satellite datalink between Australia and Indonesia was established to exchange the ADS-B data using multicast and using ASTERIX Category 21 Version 0.23. A Deed of Agreement to support ADS-B data sharing was signed on 20 September 2010. Full operation was achieved on 1 February 2011, with ADS-B data from adjacent FIRs on screen in both Brisbane and Makassar ATC centers.

ADS-B Seminar in Myanmar and the Philippines

3.4.76 The meeting noted that an ADS-B seminar was organized by CANSO for DCA Myanmar in Yangon on 22 February 2011 and a similar seminar was conducted for the CAA of the Philippines in Manila in August last year. Both these seminars were conducted by CANSO to provide latest updates on ADS-B and to reach out to as many participants as possible from the ANSPs of the DCA/CAA as well as their regulators and airlines.

Note of appreciation

3.4.77 The meeting expressed appreciation and gratitude to the Civil Aviation Authority of Singapore for hosting the Tenth Meeting of ADS-B Study and Implementation Task Force (ADS-B SITF/10) and the Sixth Meeting of the SEA ADS-B Working Group in 2011 and for the excellent arrangements including all activities organized during the meeting.

Time and Venue of Next Meeting

3.4.78 The seventh meeting of SEA/BOB ADS-B Implementation Working Group is scheduled for November 2011. The next ADS-B Study and Implementation Task Force meeting is scheduled for April or May 2012. The meeting appreciated the kind offer made by the Republic of Korea to host the Eleventh ADS-B Study and Implementation Task Force meeting in Republic of Korea.

Review of Regional Surveillance Strategy

3.4.79 The meeting reviewed the regional Surveillance Strategy for Asia/Pacific Regions which was updated by the ADS-B SITF/9, CNS/MET SG/14 and adopted by APANPIRG/21 in 2010 under Conclusion 21/41. The Strategy was considered appropriated and the meeting did not identify the need to amend the strategy.

Amendment to Regional Supplementary Procedure on ADS-B

3.4.80 Australia proposed to initiate amendment to Regional Supplementary Procedures (Doc7030) MID/SIA to include requirement for aircraft operators to disable 1090 ES ADS-B transmissions that are misleading or are non compliant. The purpose of the proposal is to ensure that safety of air-air and air-ground operations is maintained. One state (Australia) promulgated regulations in 2007 that prohibits misleading and non compliant ADS-B transmissions. The regulation became effective in 2007 and applies to all Australian airspace at all flight levels. The proposed wording for the amendment is provided in **Appendix S** to this report.

3.4.81 As result of discussion, the meeting generally supported the proposal and formulated following draft Conclusion for consideration by APANPIRG/22.

Draft Conclusion 15/22 – Amendment to Regional Supplementary Procedures on ADS-B

That, the Regional Supplementary Procedure Doc7030 MID/ASIA Chapter 5 be amended in accordance with the established procedure to include regional requirements on ADS-B as provided in the A**ppendix S** to this report.

Surveillance and Broadcast Services (SBS) Programme in USA

3.4.82 USA informed the meeting about the status of Surveillance and Broadcast Services (SBS) office implementation programme for both the air traffic control (ATC) separation service (also known as 'ADS-B critical services') and the up-linking of Traffic Information Services - Broadcast (TIS-B) and Flight Information Services – Broadcast (FIS-B) to the equipped aircraft. It was informed that approximately 300 ground stations had been installed across the National Airspace System (NAS) as on date and a total of 321 ground stations were scheduled to be installed later this year. The ground station deployment will be completed across the NAS, approximately everywhere there is radar coverage by 2013. In response to a query as to what standards will be used for the critical service before ADS-B mandate in 2020, it was informed that a fusion of radar and ADS-B surveillance would be used for separation service.

Regional Preparations for ITU WRC 2012

3.4.83 Continuation of existing aeronautical services and development of new aeronautical applications are dependent on the availability of adequate spectrum. Process of international competition between expanding aeronautical and non-aeronautical radio services takes place in ITU World Radiocommunication Conference (WRC) held at the interval of approximately every four years. Next WRC is scheduled to be held from 23 January to 17 February 2012.

Updated ICAO position on WRC-2012

3.4.84 ICAO position on WRC-2012 (then 2011) Agenda Items of critical interest to civil aviation was circulated through State Letter dated 30 June 2009. States have been urged to project and support this position both in their national and regional positions through various APANPIRG Conclusions, ICAO Assembly Resolutions and DGCA Recommendations. Updated ICAO Position on WRC-12 Agenda Items of critical interest to Civil Aviation was approved by ICAO Council in its third meeting of its 193rd Session on 15 June 2011 and was circulated through ICAO State Letter SL 2011/59 dated 22 July 2011. Main points addressed by the updates to ICAO Position are listed in **Appendix T.** The States were urged to use this updated position to ensure its support in their national/regional position.

Protection of AMS(R)S Bands

3.4.85 Japan presented a paper on the issues related to the protection of AMS(R) S Bands in general and the related Agenda Item (Item 1.7) of ITU WRC-2012 in particular. The significance of the services provided in this band and the importance of long-term and stable access to this band, taking into account the future air traffic demand in the region was described and emphasized. States were encouraged to well coordinate with their communication administrations to make their national/regional positions to protect aeronautical spectrum. A power point presentation on this Agenda Item has been included in the paper for supporting the States in projecting and protecting ICAO Position on Agenda Item 1.7. Some States extended full support to ICAO Position on this Agenda Item and it was reminded that this Item is related to the provisions of very safety critical services - the ADS and CPDLC and hence any allocation in the relevant band needs to be very transparent and protection to the safety services for civil aviation need to be ensured. States were urged to take a very firm stand on the issue of transparency and protection of civil aviation services.

Preferred CPM Methods

3.4.86 Describing the organization of the ITU-R conference preparatory work for WRC-2012, Secretariat informed the meeting about the role of Conference Preparatory Meeting for WRC-2012 (CPM-12) report in WRC-12 deliberations. Role of 'Methods' described in the CPM Report for individual Agenda Items was explained and it was informed that Aeronautical Communication Panel (ACP) Working Group F had reviewed CPM Report and had developed a Matrix showing which Methods in the report were in line with ICAO Position and which were not. Matrix mentioned is placed in **Appendix U.** The meeting was urged to note the ICAO preferred Methods in the CPM Report for each Agenda Item and support them in their national/regional position. A draft Conclusion 15/23 was formulated urging States to support Methods recommended in the Matrix.

Third and Fourth Meeting of APT Conference Preparatory Group

3.4.87 Secretariat presented a comprehensive report on the outcome of Third and Fourth Asia-Pacific Telecommunity (APT) Conference Preparatory Group (APG/3 and APG/4) meetings held from 8 to 12 March in Bangkok and from 13 to 18 December, 2010 in Hong Kong respectively. The meeting expressed concern over very low level of participation from State civil aviation organizations in both these meeting. It was informed that ICAO participated in both these meetings and presented Information Papers projecting and defending ICAO position on Agenda Items of critical interest to civil aviation. It was expressed that the tentative position adopted by APG was more or less in line with ICAO position. The Fifth and also the last meeting of APG for WRC-2012 is scheduled from 29 August to 3 September, 2011 in Busan, Republic of Korea. It was informed that the regional common position carries a lot more weight than individual national positions and hence the meeting was urged to make sure that the State civil aviation organizations are sufficiently represented in APG/5 meeting to make sure that ICAO position is adequately presented and included in the regional common position.

3.4.88 Some States appreciated the updated marked up copy (with the updates marked in different color) of ICAO Position on WRC-12 Agenda Items of critical interest to civil aviation circulated to the nominated Contact Focal Points and found it useful while dealing with the national regulatory authorities. Based on the discussions above, following integrated draft Conclusion was formulated by the meeting.

Draft Conclusion 15/23 – ICAO Position on WRC-12 Agenda Items of critical interest to civil aviation

That, States be urged to:

a) coordinate with their communication administrations to ensure support for updated ICAO Position on WRC-12 Agenda Items of critical interest to civil aviation circulated through ICAO State Letter SL 2011/59 dated 22 July 2011 in the development of their national/regional position;

b) actively and cooperatively participate in WRC-12 and preparatory meetings and encourage coordination between the focal contact points nominated by Administrations; and

c) support ICAO position provided in the Table at **Appendix U** on the preferred Methods in CPM-12 Report on WRC-12 Agenda Items.

<u>Development of Part II of ICAO Frequency Spectrum Handbook</u>

3.4.89 The meeting was informed that at the Twenty Fourth meeting of Aeronautical Communication Panel (ACP) Working Group F (ACP WG-F/24) held in Paris in April 2011, proposed Part II of the Frequency Spectrum Handbook (Doc 9718) was reviewed. Structure of the proposed Part II was described.

3.4.90 The member States of CNS/MET SG were urged to review and provide comments to the ICAO Regional Office on the Part II of the Handbook (Doc 9718) on frequency assignment planning which is provided in **Appendix V** to this report. It was also agreed to reflect this into the list of subject/tasks of the Sub-group.

Regional Implementation of World Area Forecast System (WAFS)

<u>Implementation issues associated with cessation of ISCS-G2</u>

3.4.91 The CNS/MET SG/15 Meeting recalled the cessation of International Satellite Communication Service – Generation 2 (ISCS-G2) on 1 July 2012 and reviewed the implementation of the WAFS Internet File Service (WIFS) in the APAC Region. It was noted that States, only under the ISCS-G2 footprint have to transition to WIFS preferably by March 2012. States under both SADIS and ISCS-G2 footprints that choose to access WIFS as a primary or backup service also need to transition to WIFS preferably by March 2012.

3.4.92 Noting that a State registered as an ISCS-G2 user did not necessarily translate to the number of WIFS accounts for that State, States were invited to provide updates to the table (Appendix W to the CNS/MET SG/15 report) that indicates the number of ISCS and WIFS accounts as well as point of contacts that includes one main point of contact (POC) for each State to serve as a single approving officer with associated contact information for respected organization/State.

3.4.93 Brunei and Vanuatu, had not yet registered for WIFS accounts (http://aviationweather.gov/wifs/) and were encouraged to do so as soon as possible. It was also noted that some States have registered, but remain as inactive users (e.g. Nauru, Samoa and the Solomon Islands) and continued efforts by those States to transition to WIFS were considered essential.

3.4.94 The CNS/MET SG/15 Meeting further noted that WIFS users need to have their WIFS software updated to use one common Uniform Resource Locator (URL) as opposed to the current site-specific URL. This URL is specified in version 4.1 of the WIFS Users Guide (www.aviationweather.gov/wifs/data) under Section 5 – Data Retrieval Process. . The WIFS Provider State had also encouraged users to access WIFS Advisory page for any interim updates to the WIFS Users Guide as it will be the first location indicating changes to WIFS. Furthermore, the WIFS service provider will generate a WIFS Admin message (NOXX10KKCI) containing the same information as that on the WIFS Advisory page. Given the above, the CNS/MET SG/15 Meeting formulated the following draft Conclusion.

Draft Conclusion 15/24 – Accessibility to WIFS and currency of WIFS User Guide and Administrative Messages

That,

a) States be advised to monitor administrative messages on WIFS and to periodically access the WIFS Advisories page for any interim updates to the WIFS Users Guide for changes in the operations of WIFS; and

b) States be urged to use the single common URL (www.aviationweather.gov/wifs/data), and transit to the common URL as soon as possible as required

Progress of trial gridded forecasts and related implementation issues

3.4.95 Gridded forecasts of cumulonimbus (CB), icing and turbulence in GRIB2 data format are currently provided for trial use only, thus labeled as ‘trial forecasts’. The CNS/MET SG/15 Meeting noted a conclusion of the WAFSOPSG/6 Meeting that the label ‘trial forecasts’ was expected to be removed in Amendment 76 to Annex 3 in anticipation of the expected successful harmonization of the WAFS gridded data sets from the two WAFCs, the expected positive results of the forthcoming verification of the forecasts at WAFSOPSG/7, as well as the provision of updated guidance material on the new gridded data (WAFSOPSG/6 C6/18 refers).

3.4.96 It was also noted that even though different numerical weather prediction models are being used, the harmonization processes would result in identical products for the user (some results of harmonization expected by the end of 2011). At this time, verification for turbulence products was being conducted by WAFC London while verification of the icing product was being performed by WAFC Washington.

3.4.97 Additional information with regard to verification of WAFS gridded forecasts of icing using aircraft observations was provided by Hong Kong China. Further harmonization and verification based on aircraft observations was expected in light of the fact that special aircraft observations of moderate icing became available at the WAFCs since Amendment 75 of Annex 3. The use of observations would also assist in producing guidance material on the use of these products. The CNS/MET SG/15 Meeting strongly supported the harmonization and verification of WAFS gridded forecasts of CB, icing and turbulence (WAFSOPSG/6 Conclusion 6/15 refers), guidance on the interpretation of these forecasts (WAFSOPSG/6 Conclusion 6/12refers) and subsequent training requirements (WAFSOPSG/6 Conclusion 6/13 refers) before their operational use.

Other WAFS (ISCS & SADIS) implementation issues

3.4.98 The CNS/MET SG/15 Meeting noted developments associated with the WAFS since the CNS/MET SG/14 Meeting held from 19-22 July 2010 in Jakarta, Indonesia.

3.4.99 It was noted that clarification on the access policy in obtaining WAFS forecasts and products via Internet (SADIS FTP/ Secure SADIS FTP and WIFS) was being developed in coordination with the WAFSOPSG, SADISOPSG and SCRAG. A description of how a State should obtain access to WAFS data via SADIS FTP/Secure SADIS FTP or WIFS is provided in Appendix Y to the CNS/MET SG/15 report.

3.4.100 The CNS/MET SG/15 Meeting recognized the need to conduct a regional survey on the download speed of the Secure SADIS FTP, noting that its speed was found to be significantly lower than that of WIFS in a test, and that .more users are expected to transition from SADIS FTP to Secure SADIS FTP after cessation of the SADIS FTP service in November 2012. It was agreed that in order to assist in determining the users' needs for presentation at the SADISOPSG/17 Meeting, a survey on bandwidth needs for Secure SADIS FTP would be conducted and a paper through coincidental membership would be developed by the WAFS/I TF. In view of the above, the CNS/MET SG/15 Meeting formulated the following draft Conclusion.

Draft Conclusion 15/25 – Secure SADIS FTP download speed

That,

a) The WAFS/I TF survey APAC States to determine if an upgrade to Secure SADIS FTP download speed is considered beneficial; and

b) If APAC States indicate an upgrade is beneficial, SADISOPSG Member State on behalf of WAFS/I TF will submit a paper on the regional survey results to the SADISOPSG/17 Meeting.

3.4.101 With a view to facilitating the resolution of the discrepancies observed in respect of the availability of SIGMET from the WAFCs during the existing mechanisms of SIGMET monitoring and/or tests (e.g. biannual EUR SIGMET monitoring by the EUR Data Management Group, annual APAC SIGMET tests), the CNS/MET SG/15 Meeting formulated the following draft Conclusion.

Draft Conclusion 15/26 – Improvement of WAFS SIGMET availability

That, the SADIS and ISCS States be invited to participate in regional SIGMET monitoring exercises and/or regional SIGMET tests in the APAC Region in an effort to improve the availability of SIGMET.

3.4.102 It was noted that with regard to the problem associated with the presentation of information on radioactive clouds in SIGWX charts, future improvements would be expected after the IAVWOPSG/6 Meeting in September 2011.

3.4.103 With reference to the reception of GRIB2 Products from SADIS FTP and WIFS, it was observed by Hong Kong, China that not all of the bulletins in each set of GRIB2 Product were received via WIFS, whereas all bulletins were received via SADIS FTP during the monitoring period of 17-26 June 2011. It was recognized that ISCS Provider State was required to improve availability of GRIB2 Products. In view of the above, the CNS/MET SG/15 Meeting formulated the following draft conclusion.

Draft Conclusion 15/27 - Improvements to WIFS availability of GRIB2 data

That, the ISCS Provider State be invited to improve the availability of GRIB2 data on the WAFS Internet File Service (WIFS) in light of the current operational status and cessation of ISCS-G2 on 1 July 2012.

Note: contingent upon Hong Kong China and WIFS evaluation

3.4.104 It was recognized that in order to overcome some problems identified in the forecasts on SIGWX charts, WAFCs should be notified of discrepancies to assist in ongoing improvements to the service. It was agreed that the WAFSOPSG should be invited to request WAFCs to provide SIGWX verification results to ensure accuracy of SIGWX charts. The CNS/MET SG/15 Meeting also noted that SIGWX charts were designed for flight planning and that in-flight tactical decision making should be derived from SIGMET as SIGWX charts are created 17 hours in advance of validity time. IATA noted that SIGWX charts were provided for pre-flight planning, but were also used in the cockpit due to the user friendly graphic summary of significant weather. Given the above, the CNS/MET SG/15 Meeting formulated the following draft Conclusion.

Draft Conclusion 15/28 – Improvement of WAFC SIGWX charts

That, the WAFSOPSG be invited to request the WAFC Provider States to provide SIGWX chart verification results, if any, to illustrate the degree of accuracy of their SIGWX charts.

3.4.105 The CNS/MET SG/15 Meeting noted a survey on the implementation status of WAFS in the APAC Region and WAFS training needs for APAC States in early 2011. The CNS/MET SG/15 Meeting agreed that the results of this survey indicated the need for clarification on issues such as transition from GRIB1 to GRIB2 and the APANPIRG WAFS Service Reference Document would assist in this effort.

3.4.106 The CNS/MET SG/15 Meeting reviewed the WAFS Implementation Plan and Procedures and made amendment, as required. In addition, the decision made in this regard to amend the work programme and composition of the APAC WAFS Implementation Plan and the WAFS Implementation Task Force was noted (reference: Appendix Z to the CNS/MET SG/15 report).

Regional Implementation of International Airways Volcano Watch (IAVW)

<u>Regional contingency plans</u>

3.4.107 The CNS/MET SG/15 Meeting noted that the Meteorological Advisories and Warnings Implementation Task Force (METWARN/I TF) was established to develop a framework of regional contingency plan for weather phenomenon that includes volcanic ash, tropical cyclone, radioactive cloud and Tsunami. The Terms of Reference of the METWARN/I TF provide a link to the Meteorology/Air Traffic Management Task Force (MET/ATM TF).

3.4.108 In light of the fact that the International Volcanic Ash Task Force (IVATF) ATM sub group had not yet produced a regional template on contingency for volcanic ash at the time of the METWARN/I TF/1 Meeting (March 2011), the METWARN/I TF/1 Meeting agreed that developing a framework of contingency was the first step in developing contingency plans. As a result, a draft framework for contingency plans that included volcanic ash, tropical cyclone, Tsunami and radioactive cloud was developed and coordinated with the ATM/AIS/SAR/SG/22.

3.4.109 IATA reiterated its position on operating in or near volcanic ash should be left to the airlines noting that through safety risk assessment and standard operating procedures as approved by the respective regulator has proven successful over the years in that no fatalities were associated with the volcanic ash hazard. To conduct the proper safety risk assessment, it was noted that accurate, timely information related to volcanic ash was necessary.

Distribution of radioactive cloud information

3.4.110 Notification of radioactive material is sent by the International Atomic Energy Agency (IAEA) in Vienna, Austria to 1) VAAC London to notify ACCs and 2) to WMO Regional Specialized Meteorological Centres (RSMC) for further distribution to MWOs (through national meteorological centres).

VAAC London – notification of radioactive release to ACCs

3.4.111 The CNS/MET SG/15 Meeting discussed regional developments associated with the International Airways Volcano Watch (IAVW), in particular, issues related to radioactive cloud. One issue for review by the group was to validate the 8-character AFTN addresses for Area Control Centres (ACCs) in the ASIA/PAC Region that is used by RSMC collocated with VAAC London in notifying ACCs of a radioactive material release (Amendment 75 to Annex 3). The CNS/MET SG/15 Meeting noted that 95% of the addresses have been obtained and included in a global database for the dissemination of radioactive cloud information to ACCs by VAAC London. The CNS/MET SG/15 Meeting noted the AFTN address of the Colombo ACC, VCCCZRZX, to be used for dissemination of radioactive cloud information. In addition, Japan was in the process of providing their ACC AFTN addresses.

3.4.112 The CNS/MET SG/15 Meeting noted collaborative decision making (CDM) approach in Australia in response to volcanic ash transported from southern Chile that impacted the Melbourne FIR beginning 9 June 2011. The National Operations Centre Meteorological Unit (NOC-MET) coordinated discussions involving VAAC Darwin, Qantas and Virgin Australia meteorological units as well as Airservices Australia and the airlines (the latter two through briefings). Coordination amongst VAACs Darwin, Toulouse and Wellington was performed and agreed that each VAAC would issue volcanic ash advisories for their respective areas of responsibility (in accordance to IAVW, noting the responsibility of VAAC Darwin and Wellington was expected to be aligned to the Australian FIRs at the IAVWOPSG/6 Meeting in September 2011 to mitigate confusion).VAAC Darwin considered airlines' desire to provide volcanic ash concentration charts as well as longer duration forecasts at greater frequency, however, outcomes of the IVATF/2 Meeting showed VAAC Darwin is unable to produce volcanic ash concentration charts given the current level of accuracy of volcanic ash forecasts and further work was expected at the global level in coordination with the VAACs to meet the users' needs.

3.4.113 Qantas Airlines commissioned Environment Research Agency, Adelaide to take measurements of the event for future analysis of volcanic ash concentrations which could be used in the future for more real-time verification for use by operators and VAACs. Training of pilots on recognizing volcanic ash would be conducted by Air New Zealand. IFATCA informed the CNS/MET SG/15 Meeting that simulators were also used in recognizing and responding to volcanic ash. Continued pilot training was considered essential in the overall reduction of risk by the airlines.

Regional Implementation of International Tropical Cyclone Watch (ITCW)

3.4.114 The CNS/MET SG/15 Meeting recalled the introduction of graphical advisories on tropical cyclone from tropical cyclone advisory centres (TCACs) in Amendment 75 to Annex 3 which became applicable 18 November 2010. The CNS/MET SG/15 Meeting was informed that TCAC Darwin was in the process of implementing graphical advisories on tropical cyclone for the next cyclone season. TCAC Darwin was also coordinating with TCAC Nadi on meeting this provision and would offer the software package to provide the graphics. Furthermore, TCAC Tokyo has implemented this provision and was available at the published URL.

3.4.115 The CNS/MET SG/15 Meeting was briefed on the latest developments of a pilot project of the World Meteorological Organization (WMO) on Aviation-weather Disaster Risk Reduction (ADRR), under the lead of Hong Kong China, for aviation users in the Asia and South-West Pacific Regions as well as the Bay of Bengal and the Arabian Sea. To assist in disaster risk reduction, forecasts of tropical cyclones for 24-48 hours were provided at the ADRR website (http://adrr.caem.wmo.int). The website also provides products taking into consideration the wider terminal area associated with the Meteorological Service in the Terminal Area (MSTA) initiative.

Implementation of SIGMET and warnings

Review of METWARN/I TF/1 Meeting

3.4.116 The First Meeting of the Meteorological Advisories and Warnings Task Force (METWARN/I TF/1) was held in Bangkok, Thailand from 23-24 March 2011. The METWARN/I TF/1 report covered the topics that include SIGMET tests and SIGMET advisory trial, difficulties in formulating SIGMET on radioactive cloud, lack of clarity in utilizing Tsunami warnings for aviation purposes, issues related with volcanic ash advisories such as confusion associated with the use of color code for eruption and the development of regional contingency plans. The full report may be accessed at the following website:
http://www.bangkok.icao.int/Meetings/2011/metwarni_tf1/Index.html.

3.4.117 One of the main tasks of METWARN/1 TF included the development of regional contingency plans that includes volcanic ash, tropical cyclone, radioactive cloud, and Tsunami. TheTask Force attributes can be found at the following link:
http://www.icao.or.th/edocs/apanpirg/apanpirg_sg/met/MET_WARNITF.pdf. The METWARN/I TF/1 Meeting proposed its TORs to include Singapore as a member and adjust the development of contingency plans to consider outcomes from global ICAO groups and WMO. The CNS/MET SG/15 Meeting decided to adopt changes to the TOR and the work Programme as proposed.

3.4.118 CDM has proven to be a valuable method of determining ATM measures necessary for events (e.g. volcanic ash, tropical cyclone, disasters such as earthquake and Tsunami) that impact international flight. IATA agreed to the sharing of information by VAACs as this would help reduce the differences between VAACs noting some have less capability than others. In addition, IATA supported the concept of choice by the operator and the policy of not prohibiting airspace.

Review SIGMET tests

3.4.119 The CNS/MET SG/15 Meeting noted the results of the SIGMET tests conducted in November 2010 The equatorial region was highlighted since the Port Moresby, Nauru and Honiara FIRs were large and situated in a zone plagued with CB and possible volcanic ash. States were informed of the errors identified in the SIGMET tests and encouraged to continue participation.

3.4.120 It is noted that other OPMET such as METAR, SPECI and TAF, are prepared in WMO code forms, which reduces the risk of errors in format. A similar arrangement for the presentation of SIGMET information could also reduce the risk of errors in the format of SIGMETs noting it is difficult to trace accepted formats such as ending the SIGMET with the equal sign and that many States still lack Quality Management. IATA expressed that the current deficiencies in SIGMET were unacceptable. In view of the above, the CNS/MET SG/15 Meeting formulated the following draft Conclusion.

Draft Conclusion 15/31 – SIGMET code

That, ICAO invite WMO to consider the feasibility of developing a code form for SIGMET information.

SIGMET and warnings implementation issues

3.4.121 The CNS/MET SG/15 Meeting recalled the 9.0 earthquake in Japan on March 11, 2011 that resulted in a Tsunami of approximately 10 metres and accidental release of radioactivity at the Fukushima Dai-ichi nuclear power plant. Japan informed the CNS/MET SG/15 Meeting that the Tsunami impacted the Sendai Airport and stranded 1400 staff and passengers for two days. Due the urgency of Tsunami information at the aerodromes in Japan due to fault lines very nearby, Tsunami warnings were issued by the Japan Meteorological Agency (JMA) within3 minutes after the earthquake occurred. This information was provided to ATS providers and/or airport authorities of Japan directly, without repackaging as aerodrome warnings on Tsunami. Japan has strongly encouraged States in the APAC Region to identify aerodromes in the possible path of a Tsunami and provide timely information on Tsunami to those associated with those aerodromes.

3.4.122 Japan recommended that products from the RSMCs be further verified and harmonized amongst RSMCs and guidance on the use of these products be provided. It was noted that IAVWOPSG/6 will be addressing these issues in September 2011 and a joint paper would be submitted by Canada and the U.S. that should assist in providing guidance.

3.4.123 The CNS/MET SG/15 Meeting recalled the initiative by the METWARN/I TF/1 Meeting to conduct a survey to determine the current capabilities of States in providing aerodrome warnings on Tsunami to identify training and guidance needs and to assist in the development of frameworks for regional contingency plans.

3.4.124 It was noted that various Tsunami messages were described and dissemination of the messages via Global Telecommunications System (GTS) utilizing WMO headers. Dissemination of these warnings should be by AFTN for international aviation purposes noting other methods such as the Internet should only be used for backup purposes as this is time critical information.

Review METWSG SIGMET advisory

3.4.125 The CNS/MET SG/15 Meeting was informed of the developments with regard to the feasibility study on the regional issuance of SIGMET advisories for thunderstorms, severe turbulence, severe icing and severe mountain wave for selected regional centres.

3.4.126 With reference to the APAC Region, China was in the process of hosting the SIGMET advisory trial for 9 States (Bangladesh, Cambodia, DPR Korea, Lao PDR, Mongolia, Myanmar, Nepal, Thailand and Viet Nam). In preparation for this trial, China organized and conducted (April 2011) a Regional Seminar on Asian Aeronautical Meteorology Services where eleven delegates from participating States mentioned attended as well as participants from China.

3.4.127 SIGMET advisories were being issued by China for thunderstorms, severe turbulence, severe icing and severe mountain wave that occurred or expected to occur above FL100 every 4 hours with a period of validity no greater than 6 hours. Additional advisories on the non-designated times were expected when conditions warranted a SIGMET advisory.

3.4.128 Statistics on the issuance of SIGMET during the advisory trial was expected to be compiled by the ad-hoc group in January 2012. Displaying Volcanic Ash Graphics (VAG) on the global SIGMET monitoring website was also considered as a future enhancement.

Update on Regional SIGMET Guide

3.4.129 Recent small volcanic eruptions in the South Pacific resulted in the ash plumes dissipating within a few hours following the eruptions. SIGMETs issued for these events included information on the observed ash. However, because the ash was expected to dissipate by the end of the SIGMET validity period, it was not possible to include information on the forecast position of the ash at the end of the SIGMET validity period, i.e, in the forecast section of the SIGMET. The SIGMET template included in Annex 3 does not provide any guidance on how such a situation should be reported in a SIGMET. Similarly, there is no guidance or any SIGMET example for this particular situation in the Asia Pacific SIGMET guide. In view of the foregoing, the CNS/MET SG/15 Meeting drafted the following draft Conclusion.

Draft Conclusion 15/32 – SIGMET template and example for no VA expected

That,

a) ICAO consider modifying the SIGMET template in Annex 3 to include an example to report a situation when no ash is expected in the forecast section of a SIGMET; and

b) The APAC SIGMET Guide be amended accordingly with an example of a SIGMET satisfying the condition in a)

Review outcomes of Wind Shear Systems Acquisition Workshop

3.4.130 The CNS/MET SG/15 Meeting noted that the ICAO APAC Wind Shear Systems Acquisition Workshop was held in Bangkok, Thailand from 1-3 December 2010 as part of an ICAO Special Implementation Project (SIP). The objective of the workshop was to provide States information on different types of wind shear systems in order to assist States in the acquisition of wind shear systems that would satisfy Annex 3, Chapter 7 and Appendix 6. The executive summary of the workshop included information on wind shear SARPs, Aircraft and pilot responses to wind shear, wind shear detection systems abilities and resulting matrix, steps in selection process and ICAO service to assist in the acquisition process. The full report may be accessed at http://www.bangkok.icao.int/meetings/2010/icao_wssa/Index.html.

Issues associated with SIGMET for radioactive clouds (including guidance for MWOs, and the inclusion of radioactive cloud symbol in SIGWX charts)

3.4.131 In light of the recent accidental release of radioactive material associated with the Fukushima nuclear power plant, issues related to the issuance of SIGMET and NOTAM on radioactive material such as SIGMET compliance with ICAO Annex 3 is necessary for ingest systems used for flight briefings. Classification of airspace used in NOTAMs was also discussed and compliance to definitions provided in Annex 15 supported by CNS/MET SG. The AFTN addresses for ACCs used in the notification of the release of radioactive material was also supported by the group.

3.4.132 Since SIGMET on radioactive cloud is in the current provisions, it was decided to task the METWARN/1 TF to develop guidance material in consultation with the IAVWOPSG and WMO for the issuance of RDOACT CLD SIGMET.

Implementation of the issuance of observation, TAF and OPMET exchanges

Review of OPMET/M TF/9 Meeting

3.4.133 The CNS/MET SG/15 Meeting was informed about the significant outcomes of the Ninth Meeting of the APAC OPMET Management Task Force (OPMET/M TF/9) held in Bangkok, Thailand, from 21 to 23 March 2011. The latter meeting overlapped with the METWARN/I TF/1 Meeting on 23 March 2011 to review SIGMET issues. The executive summary of the OPMET/M TF/9 Meeting includes topics of discussion such as OPMET availability and regularity, 30-hour TAF implementation. Other issues, such as successful backup test by RODB Bangkok for RODB Singapore, implementation of WIFS and XML, and reexamination of RODB structure with consideration of XML implementation were also covered. The full report may be accessed at the following website: http://www.bangkok.icao.int/Meetings/2011/opmet_tf9/Index.html.

3.4.134 The OPMET/M TF/9 Meeting proposed to add China, Hong Kong – China, Indonesia and New Zealand as members of the OPMET/M TF. The CNS/MET SG/15 Meeting decided to revise the TOR and the work programme of the OPMET/M TF.

Implementation of Amendment 74 and 75

3.4.135 It was noted that the format of TAF and the cessation of dissemination of 9- and 12-hour TAF, the Region were near full implementation with the exception of Mongolia.

3.4.136 The CNS/MET SG/15 Meeting noted that implementation of 30-hour TAF in accordance to FASID Table MET 1A is continuing to increase, but at a slower pace.

Other OPMET implementation issues

3.4.137 The CNS/MET SG/15 Meeting noted OPMET monitoring results provided by IATA for the period 12 June 2011 to 07 July 2011. In particular, timeliness, availability and regularity of APAC OPMET data as received at SADIS and ISCS was noted. to The RODBs and Provider States were encouraged to coordinate to ensure that OPMET data was received in time by both SADIS and ISCS.

3.4.138 With reference to TAF, IATA identified that some transmission times associated with TAF exceeded 30 minutes, which was unacceptable (noting TAF should be created and disseminated and received in approximately 25 minutes). It was noted that transmission times appeared larger for SADIS than for ISCS, however, again this contradicted the study conducted by RODBs Singapore and Tokyo. Some TAF were only on one system (SADIS or ISCS) and once again, RODBs and Provider States were invited to focus on these aerodromes for providing TAF on both SADIS and ISCS. It was therefore agreed to request States to implement the standardized procedures for the issuance of OPMET data as specified in paragraph 7.5.1 of the ROBEX Handbook. In view of the above the CNS/MET SG/15 Meeting formulated the following draft Conclusion.

Draft Conclusion 15/35 – Improvement of timeliness, regularity and availability of OPMET data on the SADIS and ISCS broadcast

That ICAO be invited,

a) to request States to implement the standardized procedures for the issuance of OPMET data as specified in - the ROBEX Handbook ; and

b) to inform States of the details provided in the IATA monitoring for the ASIA/PAC region.

Update on ROBEX Handbook and ICD

3.4.139 The CNS/MET SG/15 Meeting noted the two amendments to the ROBEX Handbook since the CNS/MET SG/14 Meeting in July 2010. The August 2010 amendment to the ROBEX Handbook contained changes associated with Amendment 75 to Annex 3 that became applicable 18 November 2010. Specifically, section 9 of the ROBEX Handbook noted that collectives of AIREPS by voice communication at MWOs are no longer necessary and Table D is no longer referenced. Explanations on the dissemination of the various air report types were also provided in this amendment. The ROBEX Handbook can be accessed at the following website: http://www.bangkok.icao.int/edocs/robex2004_e12.pdf.

3.4.140 The CNS/MET SG/15 Meeting was informed of updates to the Asia/Pacific OPMET data banks interface control document (ICD) to reflect the current RODB operations of non scheduled exchange of OPMET data in the Region. Specifically, RODBs Bangkok, Singapore and Tokyo updated their respective appendices A, D and E to the ICD for the June 2011 amendment. The ASIA/PAC ICD is posted on the APAC website:
http://www.bangkok.icao.int/edocs/OPMET_DataBanksICD2004.pdf.

Review of regional procedures contained in the ANP/FASID (MET Part)

3.4.141 The CNS/MET SG/15 Meeting noted the importance of maintaining the Regional Air Navigation Plan and associated FASID Tables MET referenced whose purposes include: (1) regional planning by operators, (2) measurement of implementation which allows for proper focus in implementation strategies by many entities (Operations, States and ICAO); and (3) input to cost-recovery of MET Services provided for international aviation (as referenced in the *Manual on Air Navigation Services Economics*, Doc 9161, 4th edition, 2007). Therefore, an annual review of the latest Basic ANP and FASID Tables MET was strongly encouraged.

3.4.142 The CNS/MET SG/15 Meeting recalled that amendment proposals in the previous year aligned the Basic ANP and FASID to Amendment 75 to Annex 3, and in particular that routine voice reporting of weather by pilots was no longer required. States inputs such as 30-hour TAF implementation were included. The CNS/MET SG/15 Meeting was made aware that the proposal to reserve FASID Table MET 5 for future regional requirements was not implemented since some other regions have to maintain this placeholder. In addition, the global database for MWOs was deferred until the end of 2011.

Regional MET support to ATM

Review of MET/ATM Seminar 2011 & MET/ATM TF/2 Meeting

3.4.143 The CNS/MET SG/15 Meeting reviewed the outcomes of the ICAO/WMO APAC MET/ATM Seminar held in Fukuoka, Japan from 24-26 January 2011. The objective of the seminar was to exchange information on MET developments for ATM Following the Seminar, the MET/ATM TF/2 Meeting was held in Fukuoka, Japan from 27-28 January 2011. The full report to each event can be found at the following websites: (Seminar)

3.4.144 http://www.bangkok.icao.int/meetings/2011/METATM_Seminar/METATM_Seminar-rpt.pdf and (TF/2)
http://www.bangkok.icao.int/meetings/2011/METATM_TF2/METATM_TF2rpt.pdf.

3.4.145 Collaborative Decision Making (CDM) was deemed important to the MET/ATM TF/2 Meeting such that the TORs of the MET/ATM TF/2 were proposed to include the monitoring of CDM in other regions for future applications in the APAC Region. Additional membership of Singapore and the Russian Federation was also agreed. In view of the foregoing the CNS/MET SG/15 Meeting decided to revise the TOR of the MET/ATM TF.

3.4.146 As provisions are developed on MET products and services for ATM, the MET/ATM TF/2 Meeting provided input to the WMO Expert Team on MSTA as to where the provisions would reside. Annex 3 would have high level provisions while guidance would contain the more dynamic information such as use of probabilistic forecasts, verification method, methodology, etc. and could be housed in Procedures for Air Navigation Service document for MET (PANS-MET) and Manuals for PANS-MET.

3.4.147 It was noted that the information provided at the MET/ATM TF/2 Meeting has been forwarded to the AMOFSG ad-hoc group for consideration in developing MET in support of global ATM and Performance Based Navigation (PBN). Coordination between the WMO expert team of MSTA, ICAO AMOFSG ad-hoc group and Air Traffic Management Requirements and Performance Panel (ATMRPP) on MET support for ATM resulted in a reiteration that the MSTA initiatives continue development from the perspective of PBN.

3.4.148 It was noted that MSTA was to provide MET services for ATM use for the terminal area and beyond. IATA reiterated that the MSTA initiative was several years away from implementation and designed for high density terminal airspace that would provide impact products at a time and location within the range of MSTA and that operators would assess the risk of utilizing certain airspace that would likely assist in ATM measures (if many flights cancelled in advance of a high risk forecast, less ATM measures would be needed).

Exchange of information on MET support for operations at aerodromes, terminal areas and en-route

3.4.149 The CNS/MET SG/15 Meeting was provided with a description of the Typhoon Wind Distribution Map provided by Japan since 23 June 2011 to meet the needs of stakeholders in that wind gust forecast information is updated more frequently (every 3 hours versus 6 hours by the tropical cyclone advisory centre) and represents the possible wind speed an aircraft may encounter. These surface winds were provided for 12 and 24 hours and derived from numerical weather models.

Review of ATFM 2010 Survey

3.4.150 The CNS/MET SG/15 Meeting noted that the Air Traffic Flow Management (ATFM) survey that includes a MET component was conducted in 2010 in accordance to APANPIRG/20 Conclusion 20/13. The updated survey results were provided by Malaysia and the United States and the overall survey results updated.

Other MET issues (QMS)

3.4.151 The CNS/MET SG/15 Meeting noted the initiative by Australia to enhance the verification of aviation forecasts. Specifically, the Australian Bureau of Meteorology, in consultation with industry, was developing a new aviation forecast verification scheme (AVS2) in order to improve forecast services. The AVS2 utilizes lightning strikes in the verification of thunderstorms and provides short and long term forecast verifications for different categories. This was expected to assist in determining forecasting shortfalls and focus training to meet formulated benchmarking strategies. The U.S. also offered States assistance in automated forecast verification tools.

Performance Framework Forms in the CNS and MET fields

3.4.152 The CNS/MET SG/15 Meeting reviewed and discussed the Performance Objectives adopted for the region and recalled that the Performance Framework Forms (PFFs) were adopted by APANPIRG/20 under Conclusion 20/2. The CNS/MET SG/15 Meeting also noted that Air Navigation Commission supported APANIRG conclusion 21/3 and requested the Secretariat to develop a common set of metrics applicable to all regions along with guidance for the collection of data.

3.4.153 The CNS/MET SG/15 Meeting reviewed and updated the regional Performance Framework Forms (PFFs) for the CNS and MET fields that were adopted by APANPIRG/21 through Conclusion 21/51. The CNS/MET SG/15 Meeting suggested the reference to global developments use the term *consideration* in the PFF. Updated PFF are being presented through a separate consolidated Working Paper for the consideration of APANPIRG.

Review of CNS/ATM Implementation and Planning Matrix

3.4.154 The Secretariat presented the updated matrix reflecting implementation status of CNS/ATM systems in Asia/Pacific Regions. CNS/ATM Implementation Matrix, developed in accordance with APANPIRG Conclusion 11/37 reflects the status of implementation of major CNS/ATM elements in the region which includes ATN, AIDC, CPDLC, GNSS, ADS-C and ADS-B. The CNS/MET SG/15 Meeting was informed that the Matrix was updated by the ADS-B SITF/10 meeting held in April and the Sixth meeting of ATN Study and Implementation Task Force held in May 2011.

3.4.155 The CNS/MET SG/15 Meeting reviewed and updated the information in the Matrix. The updated Matrix is provided in **Appendix A10** to this Report.

Review Performance-based communication and surveillance compliance requirements

3.4.156 New Zealand proposed development of a framework for performance-based communications and surveillance within the ICAO Asia/Pacific region that will complement the existing performance-based navigation framework. The performance-based communications and surveillance framework will apply performance specifications to FANS1/A controller-pilot data link communications (CPDLC), automatic dependent surveillance contract (ADS-C), satellite communications (SATCOM) voice and HF for air traffic control.

3.4.157 It was noted that communication and surveillance performance requirements were, in fact, already in place for various separation standards in use in oceanic and remote continental airspace. These are identified, *inter alia*, in the Global Operational Datalink Document (GOLD). The CNS/MET SG/15 Meeting reviewed and endorsed the TOR as proposed for an ad hoc working group and formulated the following draft Conclusion.

Draft Decision 15/38 – Performance-based communication and surveillance requirements

That, an Ad Hoc Working Group with TOR provided in **Appendix A11** to the report be established to review regional performance-based communication and surveillance compliance requirements for different separation minima, and if necessary, develop mitigations as needed. The outcome of this working group be presented to APANPIRG for consideration through CNS/MET SG in consultation with RASMAG and ATM/AIS/SAR SG.

3.4.158 The CNS/MET SG/15 Meeting agreed that members of Ad Hoc working group should initially communicate through electronic means and meet in conjunction with one of the above sub-group meetings when it is required. New Zealand, Australia and Singapore expressed willingness to join the ad hoc working group and the CNS/MET SG/15 Meeting invited additional participants to be nominated by other States.

Review of deficiencies in the CNS and MET fields:

3.4.159 Updated list of deficiencies, along with the details of their current status is being presented through a separate consolidated Working Paper for consideration by APANPIRG/22.

Outcome of APANPIRG Contributory Bodies Structure Review Task Force

3.4.160 The CNS/MET SG/15 Meeting noted the recommendations developed by the APANPIRG Contributory Bodies Structure Review Task Force, established by APANPIRG (ABSRTF) in its meeting held in Bangkok from 23 to 24 May 2011.

Amendment to Part IV BANP

3.4.161 Giving the background information on Asia Pacific Basic Air Navigation Plan (BANP), the CNS/MET SG/15 Meeting was briefly introduced to the structure of the document. Part IV, Volume I of the document contains basic planning principles, operational requirements and planning criteria related to communications, navigation and surveillance (CNS) systems. It was informed that Part IV of Volume I was last updated in 2006 and it had become necessary to update it again to incorporate subsequent developments that have taken place. After a protracted discussion on the proposed amendment, the CNS/MET SG/15 Meeting formulated following draft Conclusion recommending adoption of updates to Part IV, Volume I of regional Air Navigation Plan.

Draft Conclusion 15/42 – Amendment to Intro Text of Part IV of Asia/Pacific BANP

That, the amendment proposed to Part IV – CNS of the Asia Pacific Regions Air Navigation Plan (Doc 9673), Volume 1, Basic ANP provided in **Appendix A14** be adopted and incorporated in the Plan in accordance with the established procedure.

Fellowship training programme

3.4.162 Republic of Korea informed the CNS/MET SG/15 Meeting about MOU, they had signed with ICAO in August, 2009 to train 390 aviation professionals over three year period from 2010 to 2012. The paper presented the details of the enhanced fellowship training programme for developing countries and informed the CNS/MET SG/15 Meeting that they had trained 477 fellows from 95 countries since 2001. The CNS/MET SG/15 Meeting was informed about the training infrastructure available in ROK and the updated programmes being undertaken. States were invited to take benefit of the fellowship programme. The CNS/MET SG/15 Meeting was also informed about the recent changes introduced in the management of these training programmes.

Air Navigation Inspectors Course

3.4.163 Indonesia informed the CNS/MET SG/15 Meeting about the establishment of Air Navigation Inspectors course by ICAO to meet and satisfy findings through USOAP, particularly in respect of air navigation safety oversight. Indonesia's requirements for HR/air navigation inspectors were explained and expectation from ICAO to organize and conduct continuity air navigation course was expressed. The CNS/MET SG/15 Meeting was informed about the TRAINAIR and TRAINAIR Plus programmes of ICAO and availability of Standard Training Packages (STP) on various subjects. States were invited to access ICAO website for further information on the subject or write to ICAO APAC Office requesting for specific information.

Training for Air Traffic Safety Electronics Personnel (ATSEP)

3.4.164 International Federation of Air Traffic Safety Electronics Associations (IFATSEA) brought to the notice of ICAO the fact that the personnel involved in the technical operation and installation of CNS/ATM systems were trained and qualified under various standards in different States. It was appreciated that the Air Traffic Electronics Personnel (ATSEP) responsible for the provision and maintenance of these systems should be trained to uniform requirements on a worldwide basis. To develop a guidance addressing the training needs of ATSEP, IFATSEA and ICAO worked together from 2000 to 2004 and produced a document, which was published as

Part E-2, Training Manual (Doc 7192) for the Air Traffic Electronics Personnel (ATSEP). Secretariat described in details the principle duties and responsibilities of the personnel who will be covered by this document. Licensing issue was discussed in 36th ICAO Assembly in 2007 and the concept of "establishing licensing requirements for ATSEP" was endorsed in principle. Japan presented the licensing structure that has been adopted in JCAB. It was also expected that the regional effort for achieving uniformity and harmonized training system for ASTEP will build up the aviation safety in the region and eventually lead to the entire enhancement of aviation safety at a global scale. Appreciating the concept behind implementing uniform training standards for the ASTEP, the CNS/MET SG/15 Meeting strongly supported the proposal and formulated following draft Conclusion.

Draft Conclusion 15/43 – Training Manual (Doc 7192) Part E-2

That, States be urged to develop their training programme for the Air Traffic Safety Electronics Personnel (ATSEP) in line with the guidance provided in the Training Manual (Doc 7192) Part E-2.

<u>Support for XML Based Applications</u>

3.4.165 Status of extensible markup language (XML) developments as it relates to ICAO and WMO requirements was provided to the CNS/MET SG/15 Meeting. The CNS/MET SG/15 Meeting noted that the Ninth Meeting of the ASIA/PAC OPMET Management Task Force (OPMET/M TF/9) held from 21 to 23 March 2011 and the Sixth Meeting of ICAO AIS-AIM Implementation Task Force (AAITF/6) held from 15 to 17 March 2011 also reviewed the requirements for exchange of XML based data. MET Authorities or meteorological service providers were urged to provide operational requirements so that capability of AFTN/AMHS to handle XML based data could be studied. Requirements of Regional Operational Data Bank (RODB) for disseminating OPMET data was also proposed to be taken into account. States were requested to coordinate within their Administrations for collection of information necessary for implementation of XML, such as file size, target timeline and interface needed. Understanding of the requirements would assist in planning implementation of XML based applications supported by AMHS. States capable to do so were encouraged to conduct trials for transmitting XML based application over AMHS. Based on discussions at ATNICG/6 meeting and information provided, the CNS/MET SG/15 Meeting formulated following draft Conclusion:

Draft Conclusion 15/44 - Trials on XML based data over AMHS

That, States be urged to identify the characteristics such as file size, target timeline and interface needed for exchange of OPMET and Digital NOTAM using XML code and conduct trials to promote early provision of a communication medium for exchange of MET and AIM data in XML format over AMHS.

<u>GANIS and AN-Conf/12</u>

3.4.166 In an effort to promote greater integration and harmonization of air navigation system improvement programmes of the States and service providers, a Workshop and Global Air Navigation Industry Symposium (GANIS) is being organized in Montreal from 20 to 23 September, 2011. It was informed that further information related to the Symposium, including agenda/programme, general information, registration fees and procedures, information about hotels etc. will soon be available on the Symposium website http://www.icao.int/ganis. Participants were encouraged to make travel arrangements and hotel reservations at the earliest.

3.4.167 The CNS/MET SG/15 Meeting was also informed that Air Navigation Commission had agreed that Contracting States and appropriate International Organizations be consulted on the convening of an air navigation conference to discuss subjects related to air navigation systems. Detailed information on GANIS and Air Navigation Conference was presented to the CNS/MET SG/15 Meeting through a separate Working Paper.

FATS Working Group

3.4.168 Update on Activities of the FAA-JCAB Future Air Transportation System Working Group (FATS WG) was presented jointly by USA and Japan. It was informed that US Federal Aviation Administration (FAA) and Civil Aviation Bureau of Japan (JCAB) signed an agreement in 2006 to implement the arrangement to harmonize future air transportation systems and concepts. This agreement established Future Air Transportation Systems Working Group (FATS WG). The WG coordinates harmonization of future systems development for the US Next Generation Air Transportation System (NextGen) and the Japanese Collaborative Actions for Renovation of Air Traffic Systems (CARATS) in areas which include:

- Concept development and validation
- Simulation and modeling
- Research and development
- Technology demonstration
- Systems architecture; and
- Strategic planning

Updates on NextGen

3.4.169 USA provided updates on the Generation Air Transportation System (NextGen) programme. Six NextGen Transformational Programmes are being developed, which will change the way air traffic is managed. These programmes are Automatic Dependent Surveillance – Broadcast (ADS-B), Collaborative Air Traffic Management Technology (CATM-T), Data Communication (DataComm), National Airspace System Voice Switch (NVS), NextGen Network Enabled Weather (NNEW) and System Wide Information Management (SWIM). USA is working with ICAO to identify CNS/ATM programmes and requirements that need to undergo due process of Standards, Recommended Practices and Procedure development and also to ensure that NextGen integrates harmoniously into the global air navigation system. The linkage between NextGen and ICAO proposed concept of block upgrades was also explained. NextGen planning documents and expectations for future equipage are available on FAA website www.faa.gov/nextgen .

Next Meeting

3.4.170 It was agreed that the Sixteenth Meeting of the CNS/MET Sub Group should be scheduled tentatively for 23-27 July 2012 at the ICAO Regional Office, Bangkok. The dates are to be confirmed by the APANPIRG/22 meeting.

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Reference: WP/53 and WP/58 – On Regional Airspace Operation Concept

While discussing a draft Conclusion (WP/53 of CNS/MET SG/15) formulated by ATM/AIS/SAR SG/21 and WP58 presented by IATA on the proposed concept of operations, following suggested changes were endorsed by CNS/MET SG/15 the meeting:

Draft Conclusion SG 21/8− Asia/Pacific Air Navigation Concept of Operations

That, the Asia/Pacific Air Navigation Concept of Operations be adopted ~~included~~ and published on the APAC website as a regional guidance material for ~~State~~ air navigation facility, service and avionics ~~airline~~ equipage planning. ~~(and States be advised of the Concept of Operations accordingly).~~

Draft Asia/Pacific Air Navigation Concept of Operations

The following principles supporting an APAC Concept of Operations are intended to be the 'default' operations environment so that States can specify implementation requirements for the expected facilities, services and standards ~~in accordance~~ with a specified timeframe to enable~~,so~~ airspace users ~~airlines~~ ~~could~~ plan for the appropriate equipage.

- The delivery of CNS/ATM services should be based primarily on the CNS/ATM capability. It is understood that a transition period for the enablement of capabilities and or enhancements may be necessary.

- **Flight Information Regions**: FIR boundaries should not limit the delivery of surveillance and separation services (this requires Letters of Agreement and data sharing to facilitate seamless Transfer of Control). Where possible the number of FIRs should be minimized particularly along traffic flows. FIRs should not necessarily be based strictly on the boundaries of sovereign territories.

- **Special Use Airspace:** SUA should only be established[1] after due consideration of the impact on civil air traffic, and must be regularly reviewed by the appropriate State Airspace Authority to ensure that it is:
  - being used for the purpose that it was established;
  - being used regularly;
  - as small as possible; and
  - activated only when it is being utilised in accordance with the Flexible Use Airspace concept.

[1] Restricted areas must not be established over the high seas or over waters of undetermined sovereignty (reference: Annex 11 definition of restricted areas).

- **Communication**: Airspace ~~areas~~being not under coverage of ~~where~~ VHF (Very High Frequency) communications ~~are not possible~~ must be provided with a minimum communications services based on CPDLC (Controller Pilot Datalink Communications) capability, backed up by HF voice (High Frequency) complemented by ~~or~~ SATCOM Voice (Satellite Voice Communications).

- **Navigation**: air-routes above FL195 and within terminal controlled airspace (CTA and CTR) associated with major international aerodrome shall also ~~must~~ be PBN based with an appropriate specification determined by the Airspace Authority (such as en-route RNP2, terminal RNP1/0.3) based on the GANP and the Regional Navigation Strategy.

- **Surveillance**: in areas where the provision of direct ATS surveillance is possible, ATC separation must be based on these surveillance systems (i.e. radar, multilateration and ADS-B). In areas where direct surveillance is not possible, ADS-C surveillance (and associated with CPDLC capability) must be enabled providing reduced horizontal separations (i.e. RNP4 30/30 and planning for RNP2).

- Establishing equipage mandates requiring operators to equip with a specific technology is an acceptable concept provided the timeline for compliance is developed after due consultation and the benefits in equipage are clearly identified and agreed[2].

- **Safety Nets**: powered aeroplanes operating above FL195 and within terminal controlled airspace (CTA and CTR) associated with major international aerodrome must have an operable mode S transponder, ACAS (airborne collision avoidance system), and the AT ATM Automation ~~S surveillance~~ systems must be fitted with STCA (Short Term Conflict Alert) and MSAW (Minimum Safe Altitude Warning).

- **Priority**: in each case where a minimum aircraft equipage is specified for this Concept, any aircraft that does not meet these requirements should receive a lower priority, except where prescribed (such as for State aircraft). States should require State aircraft to conform with the Concept of Operations wherever possible.

- **ATM Systems:** ATM system design should enable appropriate ATC capabilities including Conflict Prediction and Resolution (CPAR), AIDC (ATS Inter-facility Datalink Communications), and A/D-MAN (Arrival/Departure Management).

- **ATFM**: flow management requirements to enhance capacity should be implemented for all major traffic flows and major aerodrome terminal operations, using bi-lateral and multi-lateral agreements, as well as CDM (Collaborative Decision-Making) procedures.

1.1 The APAC Concept of Operations should be applied against the Major Traffic Flows identified in the GANP (Global Air Navigation Plan).

[2] Examples of this concept are the ADS-B mandate established by Australia, and those being established by Hong Kong China and Singapore.

The following table is not part of the Concept of Operations itself but is an example of how concepts could be applied with the expectation that the navigation specification would deliver appropriate separation standards.

Areas (AR)	**Homogeneous ATM areas/ Major Traffic Flows/Routes**	**Operational Concept**
AR1	Asia/Australia and Africa	RNP4 based on ADS-C/CPDLC and planned RNP 2
AR2	Asia (Indonesia north to China, Japan and the Republic of Korea), Australia/New Zealand	RNAV5/RNAV2 based on direct surveillance/ VHF and planned RNAV1/RNP2
AR3	Asia and Europe via north of the Himalayas	RNAV5/RNAV2 based on direct surveillance/ VHF and planned RNAV1/RNP2
AR4	Asia and Europe via south of the Himalayas	Combination of: • RNP4 based on ADS-C/ CPDLC and planned RNP 2 • RNAV5/RNAV2 based on direct surveillance/ VHF and planned RNAV1/RNP2
AR5	Asia and North America via the Russian Far East and the Polar Tracks via the Arctic Ocean and Siberia	RNP4 based on ADS-C/CPDLC and planned RNP 2
AR6	Asia and North America via the Central and North Pacific	RNP4 based on ADS-C/CPDLC and planned RNP 2
AR7	New Zealand/Australia and South America	RNP4 based on ADS-C/CPDLC and planned RNP 2
AR8	Australia/New Zealand, the South Pacific Islands and North America	RNP4 based on ADS-C/CPDLC and planned RNP 2
AR9	South-East Asia and China, Republic of Korea, and Japan	RNAV5/RNAV2 based on direct surveillance/ VHF and planned RNAV1/RNP2

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Approved Terms of Reference (ToRs) in 2005

Title and Terms of Reference

Title: **Aeronautical Telecommunication Network Implementation Co-ordination Group (ATNICG)**

Terms of Reference (TORs)
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.

THE REVISED TERMS OF REFERENCE RECOMMENDED BY THE MEETING

Title and Terms of Reference

Title: **Aeronautical Telecommunication Network Implementation Co-ordination Group (ATNICG)**

Terms of Reference (TORs)

Coordinate implementation of ATN and those services identified and assigned by APANPIRG and ICAO in the Asia and Pacific Regions to satisfy ATM operational requirements, achieve inter-operability and address regional implementation and operation related issues.

Composition

The Group will be composed of experts nominated by all ICAO member states in the Asia and Pacific Regions.

Reporting

The Group will present its report to APANPIRG through the CNS/MET Sub-group.

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No.	PERFORMANCE OBJECTIVE	ICAO Srategic Objective	Associated GPI	Tasks/Strategy	Benefits	Deliverables	Target Date	Leader	Supporting Members	ATNICG/6 Update
1	**ATN Implementation Coordination**	**D. Efficiency**	**GPI-17, GPI-19, GPI-22**	**(1) Review of implementation problems and develop co-ordinated solutions (2) Coordinate/compile the regional implementation schedule (3) Monitor Implementation**	**Expedite implementation activities, ensure system compatibility through out the region**	**(1) Co-ordination Report (2) Waterfall schedule (3) Monitor AMHS Implementation Planner**	**(1)Ongoing/Semi-annually (2) Schedule 09/2009 (3) On going**	**Kapoor (India) Hong Kong**	**All members**	**(1)Updated the information in the ATN Router and AMHS planning tables and the implementation status (2) Completed, maintain the AMHS Implementation Planner.**
2	**ATN Operational Procedures**	**D. Efficiency**	**GPI-17, GPI-19, GPI-22**	**(1) Development of Interim Database for Directory Services**	**Make available real time and quality assurance addresses for ATN message delivery**	**(1) Interim Database**	**(1) (2007)**	**Robert Hallman (USA)**	**Thailand, Hong Kong China, Japan**	**Completed. The database was demonstrated. Aerothai will maintain the database on behalf of the regional ICAO Office. Aerothai will serve as POC for AMC coordination between Asia/Pac States and Eurocontrol. ATN Operational Procedures is completed and adopted.**
				(2) Develop the operational database management procedures		**(2) Operational Procedures**	**(2) (2007)**			**Completed.**

No.	PERFORMANCE OBJECTIVE	ICAO Srategic Objective	Associated GPI	Tasks/Strategy	Benefits	Deliverables	Target Date	Leader	Supporting Members	ATNICG/6 Update
3	ATN Certification & Validation Process	D. Efficiency	GPI-17, GPI-19, GPI-22	(1) Develop conformance procedures and checklist for AMHS and ATN routers	Expedite implementation activities, ensure global system compatibility	(1) Checklist	(1) (2007)	Sin Hie Sng (Singapore)	China, Hong Kong China, Indonesia,ROK,USA,	Completed
				(2) Develop validation process document		(2) Conformance Document	(2) 2007			Completed and forward to CNS/MET SG and APANPIRG/20 for review and adoption
						(3) Update to Conformance Document	(3) Ongoing until 2010			Completed
4	(1) ATN Documentation (2) Review all documents adopted by ATNICG and ATNTTF	D. Efficiency	GPI-17, GPI-19, GPI-22	(1) Study DIR objects/attributes proposed in ACP and follow development within other groups (2) Update document tree/establish tracking table for suspended dates (3) Standardized Report form and Guidance Material	Expedite implementation activities, ensure global system compatibility	(1) Directory Report (2) Tracking table/Updated documentation tree (3) AMC report (4)Report Form and Report Guidance	(1) Annually (3) Periodically (4) 2010	Chonlawit B. (Thailand)	USA	Update the database. AMC mandated by ICAO. Training completed. Directory Service will be implemented in coordination with ACP and phases will be developed
				(2) Development AIDC documentation (including ICD) and follow development within other groups		(2) AFTN AIDC/ATN Gateway Specification ATN AIDC ICD	(2) 2008 (ACP-dependent)	(Thailand)	Thailand	Task Closed in view of the removal of provision from Doc 9880

No.	PERFORMANCE OBJECTIVE	ICAO Srategic Objective	Associated GPI	Tasks/Strategy	Benefits	Deliverables	Target Date	Leader	Supporting Members	ATNICG/6 Update
				(3) Update of AMHS ICD to comply with SARPs 3rd Edition		(1) Report differences between existing ICD and requirements for Edition 3 of Doc 9705 (3) Updated AMHS ICD	(1) Sept 2011(3) (2007)	US	Japan	Adhoc group formed to develop AMHS ICD to be presented to CNS/MEG SG/15.
				Managing PDR	Update ICAO Documents (9880/9896)	PDR filing and tracking	On-going	US	All the Member States	Additional Task proposed in ATNICG/5. PDR filing procedure already circulated.
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	Final Draft of the Document complete. Will be presented.
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	Fiji	USA, Thailand, New Zealand, Japan, Australia	Complete. AMC has been adopted by ICAO. Aerothai has been designed as POC for Asia/Pac region.
				(2) Directory Service - Implementation Strategy	Enhancing the operation	Requirement Analysis Report & Implementation Strategy	(1) 2011 (2) 2012	Thailand		Closed in view of the implementation of AMC

No.	PERFORMANCE OBJECTIVE	ICAO Srategic Objective	Associated GPI	Tasks/Strategy	Benefits	Deliverables	Target Date	Leader	Supporting Members	ATNICG/6 Update
				ATN/IPS Implementation Plan	**Inter-regional and intra regional network compatibility**	**(1) ATN/IPS router ICD (2) IPS addressing plan (3) ATN/OSI - ATN/IPS Transition Plan (4) ATN/IPS routing policy (5) Update FASIS Tables to accommodate IPS (6) IDRP over IP subnet - ICD**	**(1) 2011 (2) 2011 (3) 2011 (4) 2012 (5) 2011 (6) 2011**	**USA**	**Australia, China, India, Fiji, HongKong, China, Japan, and USA**	**Proposed an additional task 1) ongoing 2) IPv4 addressing plan has been adopted**
				Providing support for emerging requirements of OPMET, AIS/AIM, AIDC etc.	**Enhancing the service**	**Task Report on XML based messages over AMHS platform**	**2011**	**USA**	**Hong Kong China,**	**Additional Task proposed in ATNICG/5**
				(5) Study for transition of AFTN-based AIDC as an alternative to ATN 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 AFTN AIDC/ATN Gateway Specification**	**(5) (2008)**	**Thailand**	**India, Indonesia, New Zealand, USA,**	**A Draft specification of AFTN AIDC/ATN Gateway was presented. Completed. Task closed in view of removal of provision from Doc 9880**

No.	PERFORMANCE OBJECTIVE	ICAO Srategic Objective	Associated GPI	Tasks/Strategy	Benefits	Deliverables	Target Date	Leader	Supporting Members	ATNICG/6 Update
		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 2008**	**Mark Brown (Japan)**	**Australia, Fiji, HongKong China, New Zealand and USA**	**Completed. Action Items developed at ATNICG/2 for follow-up at WG meetings.**

No.	PERFORMANCE OBJECTIVE	ICAO Srategic Objective	Associated GPI	Tasks/Strategy	Benefits	Deliverables	Target Date	Leader	Supporting Members	ATNICG/6 Update
7	Security	B. Security	GPI-17, GPI-19, GPI-22	(1) Develop ATN System 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	Adopted by APANPIRG/19
				(2) Develop ATN System Security Guidance		(2) Guidance Document	(2) (2011)			On-Going review and update
				(3) Develop ATN System Security Solution for Initial and Enhanced Services		(3) Security, Technical, Management and Operational Control	(3) (2008)			Completed
				(4) Co-ordinate and monitor ACP working group and other regions including Directory Service, PDRs		(4) Report	(4) Semi-Annually		Thailand	On-Going review and update
				(5) Develop IPS Security Policy and update the relevant guidance documents		Policy and updated guidance documents	2011			Proposed additional task to facilitate ATN/IPS
				(6) Develop ATN System Security Check List based on Security Control and Regional Incident Response Plan and Contingency Plan		(5) Check List, Regional Incident Response Plan and Contingency Plan	(5) (2009)			Forward to CNS.MET SG and APANPIRG for review and adoption

No.	PERFORMANCE OBJECTIVE	ICAO Srategic Objective	Associated GPI	Tasks/Strategy	Benefits	Deliverables	Target Date	Leader	Supporting Members	ATNICG/6 Update
8	**ATN Service Enhancements (supporting amended ICAO Flight Plan and ATS Message Formats)**	**D - Efficiency**	**GPI - 17, GPI - 19, GPI - 22**	**(1) Review the impact of the impleemntation of Amendment 1 to 15th Edition of Doc. 4444 effective 15 Nov. 2012 (PANS ATM Chapter 4 and Appendix 3 relating to the ICAO Flight Plan and associated ATS Message formats to the AFS**	**Enhancing the service**	**(1) Report on capability of existing and planned AFS systems to the revised ICAO Flight Plan and ATS Message Format**	**(1) Annually until 2011**	**USA**	**Fiji India Hong Kong New Zealand Singapore USA**	**Pending result from ICAO Flight Plan and ATS Message TF. Monitor the developments.**
				(2) Indentify the new requirements for AMHS/AFTN to support new message format	**Enhancing the operation**	**(2) Report on impact of New ATS message format in AMHS**	**(2) 2010**	**Thailand**	**Fiji India Hong Kong New Zealand Singapore USA**	**Completed**
					Enhancing the operation	**Develop Voice over IP point-to-point ICD**	**2012**	**USA, Japan, India**		**Task created in ATNICG/6**

No.	PERFORMANCE OBJECTIVE	ICAO Srategic Objective	Associated GPI	Tasks/Strategy	Benefits	Deliverables	Target Date	Leader	Supporting Members	ATNICG/6 Update
				(3) Identify the link control procedure using the AMHS to support the revised ATS message format to the ATC automation system	**Enhancing the service**	**(3) Report whether special link control procedure is required**	**(3) 2010**	**Thailand**	**Fiji India Hong Kong New Zealand Singapore USA**	**Completed. No special link envisaged.**

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)

IV-CNS 1B-1

TABLE CNS 1B

AERONAUTICAL TELECOMMUNICATION NETWORK (ATN) ROUTER PLAN

EXPLANATION OF THE TABLE

Column

1 Administration – the name of the Administration, State or Organization responsible for management of the router

2 Location of Router

3 Type of Router:

BBIS - Backbone Boundary Intermediate System
BIS - Boundary Intermediate System

4 Type of Interconnection:

Inter – Regional -Connection provided with stations in other ICAO regions
Intra – Regional - Connection provided between BBIS stations
Sub – Regional - Connection provided between a BBIS station and a BIS station

5 Interconnection, Connected to router of: name of the location of the correspondent router

6 Link Speed – Speed requirements of the interconnecting link

7 Link Protocol – Protocol requirements for the interconnecting link

8 Target Date of Implementation – date of implementation of the router

TBD- To be determined

9 Remarks

Administration	Location of Router	Type of Router	Type of Interconnection	Interconnection, Connected to router of:	Link Speed	Link Protocol	Target date of Implementation	Remarks
1	2	3	4	5	6	7	8	9
Afghanistan	Kabul	BIS	Sub-Regional	Pakistan	9600 bps	IPS	TBD	Intra-domain
		BIS	Inter-Regional	Iran	9600 bps	IPS	TBD	
American Samoa	Pago Pago			United States				Intra-domain
Australia	Brisbane	BBIS	Intra-regional	Fiji	64000 bps	CLNP/IP-SNDCF	2011	
		BIS	Sub-Regional	Indonesia	9600 bps	X.25	TBD	Not Implemented
		BBIS	Intra-Regional	Japan	64000 bps	TDB	2012	Not implemented
		BIS	Sub-Regional	New Zealand	TDB	TDB	TDB	Not implemented
		BBIS	Inter-Regional	South Africa	TDB	TDB	TBD	Not implemented
		BBIS	Intra-Regional	Singapore	64000 bps	CLNP/IP-SNDCF	2011	
		BBIS	Inter-Regional	United States	64000 bps	TDB	2012	
Bangladesh	Dhaka	BIS	Sub-Regional	India	9600 bps	X.25	2010-2011	(India)
		BIS	Sub-Regional	Thailand	9600 bps	X.25	2010-2011	(Thailand)
Bhutan	Paro	BIS	Sub-Regional	India	9600 bps	X.25	TBD	(India)
Brunei Darussalam	Brunei	BIS	Sub-Regional	Malaysia	64000 bps	X.25	2010	(Malaysia) circuit implemented
		BIS	Sub-Regional	Singapore	9600 bps	X.25	2010	(Singapore)
Cambodia	Phnom Penh	BIS	Sub-Regional	Thailand	9600 bps	X.25	2009-2010	(Thailand)
China	Beijing	BIS	Sub-Regional	DPR Korea	9600 bps	X.25	2010	ATN/AMHS Implemented
		BBIS	Intra-Regional	Hong Kong, China	64000 bps	X.25	2011	ATN/AMHS Implemented
		BBIS	Intra-Regional	India	64000 bps	X.25	2011	ATN/AMHS Implemented
		BBIS	Intra-Regional	Japan	64000 bps	X.25	TBD	ATN/AMHS Implemented

Administration	Location of Router	Type of Router	Type of Interconnection	Interconnection, Connected to router of:	Link Speed	Link Protocol	Target date of Implementation	Remarks
1	2	3	4	5	6	7	8	9
		BBIS	Inter-Regional	Kuwait	64000 bps	X.25	TBD	ATN/AMHS Implemented
		BIS	Sub-Regional	Macau, China	64000 bps	X.25	TBD	ATN/AMHS Implemented
		BIS	Sub-Regional	Mongolia	9600 bps	X.25	2010	ATN/AMHS Implemented
		BIS	Sub-Regional	Myanmar	9600 bps	X.25	2010	ATN/AMHS Implemented
		BIS	Sub-Regional	Nepal	9600 bps	X.25	2010	ATN/AMHS Implemented
		BIS	Sub-Regional	Pakistan	9600 bps	X.25	2010	ATN/AMHS Implemented
		BIS	Sub-Regional	Republic of Korea	64000 bps	X.25	2011	ATN/AMHS Implemented
		BBIS	Inter-Regional	Russian Federation	19200 bps	X.25	TBD	ATN/AMHS Implemented
		BBIS	Intra-Regional	Thailand	64000 bps	X.25	TBD	ATN/AMHS Implemented
		BIS	Sub-Regional	Vietnam			TBD	(Vietnam)
	Taibei	BIS	Sub-Regional	Hong Kong, China	9600 bps	X.25	2009	
		BIS	Sub-Regional	Japan	9600 bps	X.25	2009	
Hong Kong, China	Hong Kong	BBIS	Intra-Regional	China	64000 bps	X.25	2011	
		BIS	Sub-Regional	Macau, China	64000 bps	X.25	2009	Implemented
		BBIS	Intra-Regional	Japan	64000 bps	X.25	TBD	
		BIS	Sub-Regional	Philippines	9600 bps	X.25	2011	
		BIS	Sub-Regional	Taibei	9600 bps	X.25	2012	
		BBIS	Intra-Regional	Thailand	64000 bps	X.25	Implemented	
		BIS	Sub-Regional	Viet Nam	9600 bps	X.25	TBD	

Administration	Location of Router	Type of Router	Type of Interconnection	Interconnection, Connected to router of:	Link Speed	Link Protocol	Target date of Implementation	Remarks
1	2	3	4	5	6	7	8	9
Macau, China	Macau	BIS	Sub-Regional	China	64000 bps	X.25	TBD	
		BIS	Sub-Regional	Hong Kong, China	64000 bps	X.25	2009	Implemented
Cook Islands	Rarotonga			New Zealand		IPS	2012	Intra-domain
DPR Korea	Pyongyang	BIS	Sub-Regional	China	9600 bps	X.25	2010	(China)
Fiji	Nadi	BBIS	Intra-Regional	Australia	64000 bps	IPS	2010	Circuit implemented
				Kiribati		VPN	2011	Intra-domain
		BIS	Sub-Regional	New Caledonia		TBD	TBD	Intra-domain
				Tuvalu		VPN	2011	Intra-domain
		BBIS	Inter-Regional	United States	9600 bps	X.25	2010	Circuit implemented
				Wallis Islands		VPN	TBD	Intra-domain
French Polynesia	Papeete			New Zealand		IPS	TBD	Intra-domain
India	Mumbai	BIS	Sub-Regional	Bangladesh	9600 bps	X.25/IPS	TBD	
		BIS	Sub-Regional	Bhutan	9600 bps	X.25/IPS	TBD	
		BBIS	Intra-Regional	China	64000 bps	X.25	2011	Trial being conducted
		BIS	Inter-Regional	Kenya	19200 bps	X.25/IPS	TBD	
		BIS	Sub-Regional	Nepal	9600 bps	X.25/IPS	TBD	
		BIS	Inter-Regional	Oman	19200 bps	IPS	2011	Presently AFTN over TCP/IP on AMHS Gateway
		BIS	Sub-Regional	Pakistan	9600 bps	IPS	2011	Trial being conducted
		BBIS	Intra-Regional	Singapore	64000 bps	IPS	March 2011	Commissioned
		BIS	Sub-Regional	Sri Lanka	~~9600~~	X.25/IPS	~~TBD~~ 2012	

Administration	Location of Router	Type of Router	Type of Interconnection	Interconnection, Connected to router of:	Link Speed	Link Protocol	Target date of Implementation	Remarks
1	2	3	4	5	6	7	8	9
					64000 bps			
		BBIS	Intra-Regional	Thailand	64000 bps	IPS	~~2012~~ TBD	Awaiting readiness from Thailand
Indonesia	Jakarta	BIS	Sub-Regional	Australia	9600 bps	X.25	2010	
		BIS	Sub-Regional	Singapore	19200 bps	IP	2012	
Japan	Tokyo	BBIS	Intra-Regional	Australia	64000 bps	X.25	TBD	
		BBIS	Intra-Regional	China	64000 bps	X.25	TBD	
		BBIS	Intra-Regional	Hong Kong, China	64000 bps	X.25	TBD	
		BBIS	Inter-Regional	Europe	64000 bps	X.25	TBD	
		BIS	Sub-Regional	Republic of Korea	64000 bps	X.25	TBD	
		BBIS	Inter-Regional	Russian Federation	64000 bps	X.25	TBD	
		BBIS	Intra-Regional	Singapore	64000 bps	X.25	TBD	
		BIS	Sub-Regional	Taibei	64000 bps	X.25	TBD	
		BBIS	Inter-Regional	United States	64000 bps	X.25	Implemented	
Kiribati	Tarawa	BIS	Sub-Regional	Fiji	9600 bps	VPN	2011	Intra-domain
Lao PDR	Vientiane	BIS	Sub-Regional	Thailand	9600 bps	X.25	2011	(Thailand)
		BIS	Sub-Regional	Viet Nam	9600 bps	X.25	TBD	(Vietnam)
Malaysia	Kuala Lumpur	BIS	Sub-Regional	Brunei	64000 bps	X.25	TBD	
		BIS	Sub-Regional	Singapore	64000 bps	X.25	2007	Circuit Implemented
		BIS	Sub-Regional	Thailand	64000 bps	X.25	2012	
Maldives	Male’	BIS	Sub-regional	Sri Lanka	64000 bps	X.25/IPS	~~2010~~ 2012	

Administration	Location of Router	Type of Router	Type of Interconnection	Interconnection, Connected to router of:	Link Speed	Link Protocol	Target date of Implementation	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Micronesia Federated State of	Chuuk			United States				Intra-domain
	Kosrae			United States				Intra-domain
	Ponapei			United States				Intra-domain
	Yap			United States				Intra-domain
Mongolia	Ulaanbaatar	BIS	Sub-Regional	China	9600 bps	X.25	2010	(China)
Myanmar	Yangon	BIS	Sub-Regional	China	9600 bps	X.25	2010	(China)
		BIS	Sub-Regional	Thailand	9600 bps	X.25	2009-2010	(Thailand)
Nauru	Nauru			Australia				Intra-domain
Nepal	Kathmandu	BIS	Sub-Regional	China	9600bps	X.25	2010	(China)
		BIS	Sub-Regional	India	9600bps	X.25	TBD	(India)
New Caledonia	Noumea			Fiji			TBD	Intra-domain
New Zealand	Christchurch	BIS	Sub-Regional	Australia	9600 bps	IPS	2012	
				Cook Is				Intra-domain
				French Polynesia	9600 bps	X.25	TBD	Intra-domain
				Niue	9600 bps	IPS	2012	Intra-domain
				Samoa	9600 bps	IPS	2012	Intra-domain
				Tonga	9600 bps	IPS	2012	Intra-domain
		BIS	Inter-Regional	USA	9600 bps	IPS	2012	
Niue Islands	Niue			New Zealand	9600 bps	X.25		Intra-domain

Administration	Location of Router	Type of Router	Type of Interconnection	Interconnection, Connected to router of:	Link Speed	Link Protocol	Target date of Implementation	Remarks
1	2	3	4	5	6	7	8	9
Pakistan	Karachi	BIS	Sub-Regional	China	64000 bps		2011	Discussed in ATNICG-5 with China delegation. For ATN/AMHS coordination will be mad soon, for bilateral meeting/agreement.
		BIS	Sub-Regional	Afghanistan	64000 bps	IPS	TBD	AFTN line already working but intermittent. For ATN/AMHS coordination will be made after proper contact person at Kabul, Afghanistan.
		BIS	Sub-Regional	India	64000 bps	IPS	End 2010	Ping test completed Feb. 2010. Configuration at both end in progress.
		BIS	Inter-Regional	Oman	-	-	TBD	New line to be established with prior bilateral agreement/coordination.
		BIS	Inter-Regional	Iran	64000 bps	-	TBD	AFTN line already working for ATN/AMHS Coordination will be made, as soon as AMHS installed in Iran.

Administration	**Location of Router**	**Type of Router**	**Type of Interconnection**	**Interconnection, Connected to router of:**	**Link Speed**	**Link Protocol**	**Target date of Implementation**	**Remarks**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
		BIS	Inter-Regional	Kuwait	64000 bps	-	TBD	AFTN line already working for ATN/AMHS Coordination will be made soon for bilateral meeting/agreement
Papua New Guinea	Port Moresby			Australia				Intra-domain
Philippines	Manila	BIS	Sub-Regional	Hong Kong, China	9600 bps	X.25	2009	Circuit Implemented
		BIS	Sub-Regional	Singapore	32000 bps	X.25	2009	Not yet implemented
Republic of Korea	Seoul	BIS	Sub-Regional	China	64000 bps	X.25	2011	ATN/AMHS Implemented
		BIS	Sub-Regional	Japan	64000 bps	X.25	2011	
Singapore	Singapore	BBIS	Intra-Regional	Australia	64000 bps	X.25/IPS	2009	
		BBIS	Inter-Regional	Bahrain	64000 bps	IPS	2012	
		BIS	Sub-Regional	Brunei	9600 bps	X.25	TBD	
		BBIS	Intra-Regional	India	64000 bps	X.25	2011	Implemented
		BIS	Sub-Regional	Indonesia	19200 bps	IPS	2012	Circuit Implemented
		BBIS	Intra-Regional	Japan	64000 bps	X.25	TBD	
		BIS	Sub-Regional	Malaysia	64000 bps	X.25	2012	
		BIS	Sub-Regional	Philippines	32000 bps	X.25	2012	
		BIS	Sub-Regional	Sri Lanka	64000 bps	X.25/IPS	2013	
		BBIS	Intra-Regional	Thailand	64000 bps	X.25	2013	

Administration	Location of Router	Type of Router	Type of Interconnection	Interconnection, Connected to router of:	Link Speed	Link Protocol	Target date of Implementation	Remarks
1	2	3	4	5	6	7	8	9
		BBIS	Inter-Regional	United Kingdom	64000 bps	IPS	2012	
		BIS	Sub-Regional	Viet Nam	9600 bps	X.25	2013	
Solomon Islands	Honiara			Australia	VPN		2008	(Australia) Intra-Domain
Sri Lanka	Colombo	BIS	Sub-Regional	India	64000 bps	X.25/IPS	~~2010~~ 2012	
		BIS	Sub-Regional	Maldives	64000 bps	X.25/IPS	~~2010~~ 2012	
		BIS	Sub-Regional	Singapore	64000 bps	X.25/IPS	2013	
Thailand	Bangkok	BIS	Sub-Regional	Bangladesh	9600 bps	X.25	2009-2010	
		BIS	Sub-Regional	Cambodia	9600 bps	X.25	2009-2010	
		BBIS	Intra-Regional	China	64000 bps	X.25	2009	
		BBIS	Intra-Regional	Hong Kong, China	64000 bps	X.25	Implemented	
		BBIS	Intra-Regional	India	64000 bps	X.25	2009-2010	Circuit Implemented
		BBIS	Inter-Regional	Italy	64000 bps	X.25	TBD	Circuit Implemented
		BIS	Sub-Regional	Lao PDR	9600 bps	X.25	2009-2010	
		BIS	Sub-Regional	Malaysia	64000 bps	X.25	2009-2010	
		BIS	Sub-Regional	Myanmar	9600 bps	X.25	2009-2010	
		BBIS	Intra-Regional	Singapore	64000 bps	X.25	2009-2010	Circuit Implemented
		BIS	Sub-Regional	Viet Nam	9600 bps	X.25	2009-2010	
Timor Leste	Dili			Australia				Intra-domain
Tonga	Tongatapu			New Zealand	9600 bps	IPS	2012	Intra-domain
Tuvalu	Funafuti			Fiji			TBD	Intra-domain

Administration	Location of Router	Type of Router	Type of Interconnection	Interconnection, Connected to router of:	Link Speed	Link Protocol	Target date of Implementation	Remarks
1	2	3	4	5	6	7	8	9
United States	Atlanta	BBIS	Inter-Regional	Australia	64000 bps	IP	2012	
				American Samoa				Intra-domain
	Salt Lake City	BBIS	Inter-Regional	Fiji	9600 bps	X.25	2011	Circuit Implemented
	Salt Lake City	BBIS	Inter-Regional	Japan	64000 bps	X.25	2006	Circuit Implemented
				Marshall Islands				Intra-domain
				Micronesia, Federated State of				Intra-domain
	Salt Lake City	BIS	Inter-Regional	New Zealand	9600 bps	IP	2012	
				Palau				Intra-domain
Vanuatu	Port Vila			Australia	VPN		2012	Intra-domain (Australia)
Viet Nam	Ho Chi Minh/Hanoi	BIS	Sub-Regional	China			TBD	
		BIS	Sub-Regional	Hong Kong, China	9600bps	X.25	2010	
		BIS	Sub-Regional	Lao PDR	9600bps	X.25	2010	
		BIS	Sub-Regional	Singapore	9600bps	X.25	2010	
		BIS	Sub-Regional	Thailand	9600bps	X.25	2010	
Wallis Islands	Wallis			Fiji		X.25	TBD	Intra-domain

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Table CNS 1C

AMHS ROUTING PLAN

EXPLANATION OF THE TABLE

Column

1	Administration – the name of the Administration, State or Organization responsible for management of the facility
2	Location of Facility
3	Facility Type: AMHS UA (Location of AMHS)
4	Target Date of Implementation – date of implementation of the ATSMHS TBD – To be determined
5	Remarks

Note: AMHS – ATS Message Handling System which may include Message Transfer Agents and AFTN/AMHS gateways services.

Administration	Location of Facility	Facility Type	Target Date of Implementation	Remarks
Afghanistan	Kabul	AMHS	TBD	
American Samoa	Pago Pago	UA (Salt Lake City)	2010	
Australia	Brisbane	AMHS	2006	Implemented
Bangladesh	Dhaka	AMHS	2011	
Bhutan	Paro	UA (Mumbai)	2010	
Brunei Darussalam	Brunei	AMHS	2012	
Cambodia	Phnom Penh	AMHS	2010	
China	Beijing	AMHS	2010	Implemented
	Taibei	AMHS	2010	
Hong Kong, China	Hong Kong	AMHS	2009	Implemented
Macau, China	Macau	AMHS	2009	Implemented
Cook Island	Rarotonga	UA (Christchurch)	2012	
DPR Korea	Pyongyang	AMHS	2010	
Fiji	Nadi	AMHS	2010	
French Polynesia	Papeete	AMHS	TBD	
India	Mumbai	AMHS	Mar. 2011	Implemented
Indonesia	Jakarta	AMHS	2012	
	Ujung Pandang	AMHS	2012	
Japan	Fukoka	AMHS	Implemented	
Kiribati	Tarawa	UA (Nadi)	2011	
Lao PDR	Vientiane	AMHS	2011	
Malaysia	Kuala Lumpur	AMHS	2012	
Maldives	Male	AMHS	2010	

Administration	Location of Facility	Facility Type	Target Date of Implementation	Remarks
Marshall Island	Majuro	UA (Salt Lake City)	2010	
Micronesia Federated State of	Chuuk	UA (Salt Lake City)	2006	UA Implemented
	Kosrai	UA (Salt Lake City)	2006	UA Implemented
	Ponapei	UA (Salt Lake City)	2006	UA Implemented
	Yap	UA (Salt Lake City)	2006	UA Implemented
Mongolia	Ulaanbaatar	AMHS	2010	
Myanmar	Yangon	AMHS	2010	
Nauru	Nauru	UA (Brisbane)	2010	
Nepal	Kathmandu	AMHS	2010	
New Caledonia	Noumea	AMHS	TBD	
New Zealand	Christchurch	AMHS	2012	
Niue Is	Niue	UA (Christchurch)	2010	
Pakistan	Karachi	AMHS	July 2009	Implemented. All Domestic Network working on AMHS through about 50 User Agents and all International AFTN Circuits are working through AFTN/AMSH Gateway.
Palau	Koror	UA (Salt Lake City)	2006	UA Implemented
Papua New Guinea	Port Moresby	UA (Brisbane)	2010	
Philippines	Manila	AMHS	2012	
Republic of Korea	Seoul	AMHS	2011	
Samoa	Faleolo	UA (Christchurch)	2012	
Singapore	Singapore	AMHS	2011	Implemented (India-Singapore 1st link)
Solomon Is	Honiara	UA (Brisbane)	2010	
Sri Lanka	Colombo	AMHS	2011	
Thailand	Bangkok	AMHS	2012	

Administration	Location of Facility	Facility Type	Target Date of Implementation	Remarks
Timor Leste	Dili	UA (Brisbane)	2010	
Tonga	Tongatapu	UA (Christchurch)	2012	
Tuvalu	Funafuti	UA (Nadi)	2011	
United States	Atlanta	AMHS	Implemented	
	Salt Lake City	AMHS	Implemented	
Vanuatu	Port Vila	UA (Brisbane)	2010	
Viet Nam	Ho Chi Minh	AMHS	2012	2010 for Test, 2012 for deployment
Wallis Is.	Wallis	AMHS	TBD	

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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.

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.2.0
				AFTN/AMHS	TBD	
		Auckland ACC	New Zealand	AFTN	Implemented	ICD V.2.0
				AFTN/AMHS	TBD	
		Melbourne	Australia	AFTN	Implemented	ICD V.2.0
				AFTN/AMHS	TBD	
		Makassar ACC	Indonesia	AFTN	2010	ICD V.2.0
				AFTN/AMHS	TBD	
		Nadi ACC	Fiji	AFTN	Implemented	ICD V.2.0
				AFTN/AMHS	TBD	
	Melbourne ACC	Brisbane ACC	Australia	AFTN	Implemented	ICD V.2.0
				AFTN/AMHS	TBD	
		Jakarta ACC	Indonesia	AFTN	TBD	ICD V.2.0
				AFTN/AMHS	TBD	
		Mauritius ACC	Mauritius	AFTN	Implemented	ICD V.2.0
				AFTN/AMHS	TBD	
BANGLADESH	Dhaka ACC	Kolkata ACC	India	AFTN/AMHS	TBD	
		Yangon ACC	Myanmar	AFTN/AMHS	2012	Subject to concurrence with Myanmar
BHUTAN						
BRUNEI DARUSSALAM						
CAMBODIA	Phnom Penh ACC	Bangkok ACC	Thailand	AFTN	2010	
CHINA	Beijing ACC	Incheon ACC	Republic of Korea	AFTN	TBD	
	Sanya ACC	Hong Kong ACC	Hong Kong, China	AFTN	Implemented	
		Ho Chi Minh ACC	Vietnam	AFTN	TBD	
	Guangzhou ACC	Hong Kong ACC	Hong Kong, China	AFTN	TBD	
	Taibei ACC	Hong Kong ACC	China	TBD	2012	
	Shanghai ACC	Fukuoka ATMC	Japan	TBD	TBD	

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/AMHS	2013	
		Sanya ACC	China	AFTN	Implemented	
		Manila ACC	Philippines	AFTN/AMHS	2013	
		Taibei ACC	China	AFTN/AMHS	2013	
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	2010	
		Brisbane ACC	Australia	AFTN	Implemented	ICD V. 1.0
				AFTN/AMHS	2010	
		Oakland ARTCC	USA	AFTN	Implemented	ICD V.1.0
				AFTN/AMHS	2010	
FRANCE						
French Polynesia	Papeete ACC	Auckland ACC	New Zealand	AFTN	Implemented	ICD V. 2.0
New Caledonia						
INDIA	Kolkata ACC	Dhaka ACC	Bangladesh	AFTN	TBD	Subject to co-ordinate between Administrations
	Mumbai ACC	Karachi ACC	Pakistan	AFTN	Trial Operations	
INDONESIA	Jakarta ACC	Melbourne	Australia	AFTN/AMHS	TBD	
	Makassar ACC	Brisbane ACC	Australia	AFTN	2010	ICD V.1.0
				AFTN/AMHS	TBD	

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
JAPAN	Fukuoka ATMC	Anchorage ACC	USA	AFTN	Implemented	ICD V.2.0
		Incheon ACC	Republic of Korea	AFTN	Implemented	ICD V.1.0
		Oakland ARTCC	USA	AFTN	Implemented	ICD V.2.0
		Taibei ACC	Taibei, China	AFTN	2012	ICD V.3.0
KIRIBATI						
LAO PEOPLE'S DEMOCRATIC	Vientiane ACC	Bangkok ACC	Thailand	AFTN	2010	TBD
MALAYSIA	Kuala Lumpur ACC	Bangkok ACC	Thailand	AFTN	2012	TBD
		Singapore	Singapore	AFTN	2012	
		Kota Kinabalu	Manila	AFTN	2012	
		Kota Kinabalu	Ujung Padang	AFTN	2012	
MALDIVES	Male ACC	Colombo ACC	Sri Lanka	AFTN	~~2010~~ 2013	
MARSHALL ISLANDS						
MICRONESIA (FEDERATED STATE OF)						
MONGOLIA						
MYANMAR	Yangon ACC	Bangkok ACC	Thailand	AFTN	2010	ICD V.1.0
		Dhaka ACC	Bangladesh	AFTN	2011	
NEPAL	Kathmandu ACC	Kolkata ACC	India	AFTN	2010	
				AFTN/AMHS		
		Banaras ACC	India	AFTN	2010	
				AFTN/AMHS		
		Lhasa ACC	China	AFTN	2010	
				AFTN/AMHS		

<table>
<tr><th rowspan="2">State/Administration</th><th rowspan="2">Location of AIDC end system</th><th colspan="2">AIDC Pair</th><th rowspan="2">AIDC standard used</th><th rowspan="2">Target date of Implementation</th><th rowspan="2">Remarks</th></tr>
<tr><th>Correspondent location</th><th>Correspondent State/Administration</th></tr>
<tr><th>1</th><th>2</th><th colspan="2">3</th><th>4</th><th>5</th><th>6</th></tr>
<tr><td rowspan="4">NAURU</td><td rowspan="4">Brisbane ACC</td><td rowspan="2">Oakland ARTCC</td><td rowspan="2">USA</td><td>AFTN</td><td>Implemented</td><td rowspan="2">ICD V.1.0</td></tr>
<tr><td>AFTN/AMHS</td><td>TBD</td></tr>
<tr><td rowspan="2">Nadi ACC</td><td rowspan="2">Fiji</td><td>AFTN</td><td>Implemented</td><td rowspan="2">ICD V.1.0</td></tr>
<tr><td>AFTN/AMHS</td><td>2010</td></tr>
<tr><td rowspan="7">NEW ZEALAND</td><td rowspan="7">Auckland ACC</td><td rowspan="2">Brisbane ACC</td><td rowspan="2">Australia</td><td>AFTN</td><td>Implemented</td><td rowspan="2">ICD V.1.0</td></tr>
<tr><td>AFTN/AMHS</td><td>2010</td></tr>
<tr><td rowspan="2">Nadi ACC</td><td rowspan="2">Fiji</td><td>AFTN</td><td>Implemented</td><td rowspan="2">ICD V.1.0</td></tr>
<tr><td>AFTN/AMHS</td><td>2010</td></tr>
<tr><td rowspan="2">Oakland ARTCC</td><td rowspan="2">USA</td><td>AFTN</td><td>Implemented</td><td rowspan="2">ICD V.2.0</td></tr>
<tr><td>AFTN/AMHS</td><td>2010</td></tr>
<tr><td>Papeete ACC</td><td>French Polynesia</td><td>AFTN</td><td>Implemented</td><td>ICD V.2.0</td></tr>
<tr><td rowspan="16">PAKISTAN</td><td rowspan="12">Karachi</td><td rowspan="2">Mumbai ACC</td><td rowspan="2">India</td><td>AFTN</td><td rowspan="2">~~TBD~~ Trials Operation</td><td rowspan="16">Tentatively 2011 depending on bilateral agreement and syste-to-system matching.</td></tr>
<tr><td>AFTN/AMHS</td></tr>
<tr><td rowspan="2">Muscat ACC</td><td rowspan="2">Oman</td><td>AFTN</td><td>TBD</td></tr>
<tr><td>AFTN/AMHS</td><td></td></tr>
<tr><td rowspan="2">Tehran ACC</td><td rowspan="2">Iran</td><td>AFTN</td><td>TBD</td></tr>
<tr><td>AFTN/AMHS</td><td></td></tr>
<tr><td rowspan="2">Delhi ACC</td><td rowspan="2">India</td><td>AFTN</td><td>TBD</td></tr>
<tr><td>AFTN/AMHS</td><td></td></tr>
<tr><td rowspan="2">Ahmadabad ACC</td><td rowspan="2">India</td><td>AFTN</td><td>TBD</td></tr>
<tr><td>AFTN/AMHS</td><td></td></tr>
<tr><td rowspan="2">Kabul ACC</td><td rowspan="2">Afghanistan</td><td>AFTN</td><td>TBD</td></tr>
<tr><td>AFTN/AMHS</td><td></td></tr>
<tr><td rowspan="4">Lahore</td><td>Delhi ACC</td><td>India</td><td>AFTN</td><td>TBD</td></tr>
<tr><td>Urumqui</td><td>China</td><td>AFTN/AMHS</td><td></td></tr>
<tr><td>Tajakistan</td><td>Tajakistan</td><td>AFTN</td><td>TBD</td></tr>
<tr><td>Kabul ACC</td><td>Afghanistan</td><td>AFTN/AMHS</td><td></td></tr>
</table>

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
	Karachi	Lahore	Pakistan between Domestic ACCs. Karachi and Lahore	AFTN	end 2010	
PALAU						
PAPUA NEW GUINEA						
PHILIPPINES	Manila ACC	Hong Kong ACC	Hong Kong, China	AMHS	2013	
		Singapore ACC	Singapore	AMHS	2013	
		Taibei	Taibei, China	AMHS	2013	
		Makassar ACC	Indonesia	AMHS	2013	
		Ho Chi Minh ACC	Viet Nam	AMHS	2013	
		Oakland ARTCC	USA	AMHS	2013	

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<tr><th>Correspondent location</th><th>Correspondent State/Administration</th></tr>
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Subject to concurrence from States</td></tr>
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<tr><td>ATN</td><td>TBD</td></tr>
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<tr><td>SRI LANKA</td><td>Colombo ACC</td><td>Male ACC</td><td>Maldives</td><td>AFTN</td><td><s>2010</s> 2013</td><td><s>will inform later</s> AFTN/AMHS gateway to be used initially</td></tr>
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<tr><td>Yangon ACC</td><td>Myanmar</td><td>AFTN</td><td>TBD</td><td></td></tr>
</table>

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
TONGA						
UNITED STATES	Oakland ARTCC	Auckland OAC	New Zealand	AFTN	Implemented	ICD V.2.0
		Fukuoka ATMC	Japan	AFTN	Implemented	ICD V.2.0
		Nadi ATMC	Fiji	AFTN	Implemented	ICD V.2.0 (04/2010)
		Brisbane ATSC	Australia	AFTN	Implemented	ICD V.1.0 and Block Altitudes
		Tahiti ACC	Tahiti	AFTN	Implemented	ICD V.2.0
		Anchorage ARTCC	United States	AFTN	Implemented	ICD V.2.0
	Anchorage ARTCC	Fukuoka ATMC	Japan	AFTN	Implemented	ICD V.2.0
		Oakland ARTCC	United States	AFTN	Implemented	ICD V.2.0
VIET NAM	Ho Chi Minh ACC	Sanya ACC	China	AFTN/AMHS	TBD	
		Pnom Penh ACC	Cambodia	AFTN/AMHS	TBD	Subject to Concurrence from Cambodia
		Vientiane ACC	Lao PDR	AFTN/AMHS	TBD	Subject to Concurrence from Lao PDR
	Ho Chi Minh ACC	Singapore ACC	Singapore	AFTN/AMHS	2011	Subject to concurrence from Singapore
		Manila	Philippines	TBD	2011	Subject to concurrence from Philippines
		Bangkok ACC	Thailand	AFTN	2010	

INTERNATIONAL CIVIL AVIATION ORGANIZATION

ASIA AND PACIFIC OFFICE

ASIA/PAC Technical Specification of the Air Traffic Services Message Handling System (AMHS)

ABSTRACT

This document is the ASIA/PAC Specification for the ATS Message Handling System (AMHS). The objective is to define precise means of compliance to the essential AMHS requirements to ensure interoperability of AMHS systems in the Asia/Pacific Region. Implementations that comply with the mandatory provisions of this specification will be compliant to the essential requirements for AMHS endorsed by APANPIRG.

EXECUTIVE SUMMARY

This document is the ASIA/PAC Specification for the Air Traffic Services Message Handling System (AMHS). It has been developed by the ATNICG Working Group under APANPIRG. The objective is to define precise means of compliance to the essential AMHS requirements to ensure interoperability of AMHS systems in the Asia/Pacific Region. Implementations that comply with the mandatory provisions of this specification will be compliant to the essential requirements for AMHS endorsed by APANPIRG. This ASIA/PAC Specification refines and augments the detailed technical specifications for AMHS in ICAO Annex 10 and associated ICAO technical manuals. This ASIA/PAC Specification is based on the EUROCONTROL Specification for the Air Traffic Services Message Handling System (AMHS). The goal is to enable support of specific profiles of Basic and Extended service of the ATS Message Handling Service (ATSMHS), as defined by ICAO. The Extended service includes:

a) support for binary information transfer,

b) use of standard message heading extensions to convey Air Traffic Services (ATS) header information,

c) migration to the use of an on-line X.400 based directory at a future date if required.

Note. – ASIA/PAC will use an off-line directory (AMC).

d) migration to the use of digitally signed secure messages at a future date if required.

An initial transition step supporting migration from the AFTN to the Basic ATSMHS level of service is anticipated.

The anticipated next step is to add support for binary information transfer and use of heading extensions.

Longer term, ASIA/PAC may migrate to use of Directory and support for Security.

The specific timing for this migration strategy will be developed in coordination with APANPIRG as part of the overall ATN Implementation strategy.

The provisions of this ASIA/PAC Specification are applicable to air navigation service providers (ANSPs) in the Asia/Pacific Region. Specifically, the provisions apply to the parts of an ANSP's organization responsible for providing, directly or by outsourcing, data messaging services to end users both within and between States.

Compliance with this ASIA/PAC Specification is achieved once implementations comply with all requirements of the normative Annexes.

1. INTRODUCTION

1.1 Document Structure

1.1.1 This ASIA/PAC Specification is organized as a number of Chapters and Annexes. The chapters in the main body of the document provide contextual guidance and explanatory material and point to the annexes which contain the normative requirements. The main body is structured as follows:

- The present Chapter includes introductory material describing the purpose and scope of the ASIA/PAC Specification, its structure, and a description of the document conventions, abbreviations, definitions and the interoperability target.
- Chapter 2 describes the basic level of interoperability for the Air Traffic Services Message Handling Service (ATSMHS) in the Asia/Pacific Region.
- Chapter 3 contains explanatory material concerning the Extended ATSMHS functionality.
- Chapter 4 describes additional requirements relating to implementation options, testing and validation.
- Chapter 5 describes some of the transition and coexistence issues.
- Chapter 6 contains a list of documents which are referenced from the main body and annexes by means of reference numbers contained in square brackets.

1.1.2 Detailed interoperability and compliance requirements are specified in Annexes, which form an integral part of this ASIA/PAC Specification:

- Annex A (normative) contains detailed requirements for the Air Traffic Services (ATS) Message Handling functionality at the level of the Basic ATSMHS. It identifies the systems that are deployed in order to provide those services, the system level requirements, and the external standards and documents applicable to each system.

- Annex B (normative) contains detailed requirements for the ATS Message Handling functionality at the Extended ATSMHS level of service, requiring support of Functional Groups (FG) for the Basic ATSMHS (Basic FG), use of file transfer body parts for binary data exchange (FTBP FG), use of interpersonal messaging heading extensions (IHE FG). Use of Directory (DIR FG) and support of AMHS Security (SEC FG) is foreseen in the future.

1.1.3 Under the X.400 standards compliance requirements are provided where possible in the form of protocol implementation conformance statement (PICS) tables giving a detailed statement of functional and protocol compliancy. These tables are generally contained in ICAO standards and the base standards and ISPs referenced from this ASIA/PAC Specification.

1.2 Purpose

1.2.1 This ASIA/PAC Specification on the Air Traffic Services Message Handling System (AMHS) is developed to ensure interoperability among AMHS implementing systems.

1.2.2 This ASIA/PAC Specification is organized as a number of chapters and normative annexes. Therefore compliance with this ASIA/PAC Specification is achieved once implementations comply with all requirements of the normative Annexes.

1.3 Background Context

1.3.1 The exchange of ATS messages, as part of the Aeronautical Fixed Service (AFS) defined in ICAO Annex 10 Volume II [3] is an essential function to the safety of air navigation and to the regular, efficient and economical operation of ATS provision.

1.3.2 The Aeronautical Fixed Telecommunications Network (AFTN) has provided an effective store-and-forward messaging service for the conveyance of text messages, using character-oriented procedures, for many years. However AFTN technology is now becoming obsolescent, and is not sufficiently flexible to support messaging functions found in modern messaging systems (such as transfer of binary information.)

1.3.3 It is intended that existing AFTN users and systems will transition to the architecture of the Aeronautical Telecommunication Network (ATN), and this is enabled in part by the ATSMHS application, which has been defined by ICAO to replace the AFTN telegraphic style of working with a modern store-and-forward Message Handling System based on international Standards.

1.3.4 Standards and Recommended Practices (SARPs) for the ATSMHS application are specified in ICAO Annex 10 to the Convention on International Civil Aviation. These SARPs refer to detailed specifications in the relevant technical Manual (ICAO Doc 9705, superseded by ICAO Doc 9880 Part IIB [5].

1.3.5 The technical provisions in ICAO Doc 9880 Part II [5] define two fundamental levels of service within the ATSMHS; the Basic ATSMHS and the Extended ATSMHS. Additionally, ICAO Doc 9880 (Part II, section 3.4) outlines various subsets of the Extended ATSMHS, to which conformance can be claimed.

1.3.6 The Basic ATSMHS performs an operational role similar to the AFTN with a few enhancements, while the Extended ATSMHS provides more advanced features. The Extended level of service includes the Basic level of service capability; in this way it is ensured that users with Extended Service capabilities can interoperate, at a basic level, with users having Basic Service capabilities and vice-versa.

1.3.7 The ATSMHS is provided by a set of ATN End Systems, which collectively comprise the ATS Message Handling System (AMHS), and which co-operate to provide users (human or automated) with a data communication service.

The AMHS network is composed of interconnected ATS Message Servers that perform message switching at the application layer (Layer 7 in the basic reference model for open systems interconnection (OSI)). Direct users connect to ATS Message Servers by means of ATS Message User Agents. An ATS Message User Agent supporting the Extended level of service will use the Basic level of service to allow communication with users who only support the Basic ATSMHS. To support the transition from AFTN,

AFTN/AMHS Gateways provide interfaces between the AMHS and the AFTN. The AMHS network makes use of an underlying network infrastructure that allows data interchange to be performed.

1.3.8 Implementation of the Extended ATSMHS implies the existence of various support functions, which are not necessarily exclusively dedicated to messaging. These include optional on-line Directory support and (if secure messaging is implemented) public key management functions.

1.4 Scope

1.4.1 The scope of this document covers the Basic and Extended levels of the ATSMHS. Specifically, support for functional groups Basic, FTBP, and IHE is specified. Functional groups DIR and SEC are outlined as an indication of future requirements.

1.4.2 This ASIA/PAC Specification is intended to provide the requirements for AMHS systems. As such, for each external standard, it identifies the baseline version of that standard and the changes to those standards that are required. Each identified change that is incorporated into this specification includes the original reference.

1.4.3 The specification applies to the following Asia/Pacific systems:

- Ground communication and display systems, including user interfaces and end systems concerned with message submission, transfer, delivery and (in the case of AFTN interworking) conversion;

- Ground data logging and recording systems, which, in general, will be an integral part of the communication subsystems.

1.4.4 Compliance with this ASIA/PAC Specification would be mandated in a call for tender for an AMHS End System. However, this ASIA/PAC Specification is not intended to be a complete system specification sufficient for procurement purposes.

1.4.5 Topics addressed by this ASIA/PAC Specification include:

- The interoperability aspects between implementations of the Basic ATSMHS, with its functional components, and implementations conforming to the provisions of this ASIA/PAC Specification;

- The interoperability aspects of AFTN/AMHS gateways within the transition phase from AFTN to AMHS;

1.5 Conventions

1.5.1 Only the minimum subset of requirements necessary for the correct and harmonized implementation of the ASIA/PAC Specification is specified. Mandatory items within the ASIA/PAC Specification are clearly separated from non-mandatory items.

1.5.2 Every requirement and recommendation in this specification is preceded by a structured identifier which can be used to reference uniquely the requirement / recommendation from associated documents and traceability tools. Such identifiers have the form:

AMHS-[Fn]-[Ann]

where:

[Fn]: is a sequence of characters to identify the operational procedure or category to which the requirement applies.

[Ann]: is the Annex identifier followed by a number, unique within a given [Fn].

1.5.3 Conventions for denoting requirements in the normative Annexes A and B are as follows:

• 'Shall' **-** indicates a statement of specification, the compliance with which is mandatory to achieve the implementation of the ASIA/PAC Specification. It indicates a requirement which must be satisfied by all systems claiming conformity to the specification. Such requirements are intended to be testable and their implementation auditable.

• 'Should' **-** indicates a recommendation or best practice, whose use is encouraged, but which may or may not be satisfied by all systems claiming conformity to the specification.

• 'May' – indicates an optional feature.

• 'Will' – is meant in its normal English usage to indicate a forward-looking statement or statement of intent.

1.6 Abbreviations and Definitions

1.6.1 Abbreviations

The following abbreviations are used throughout this Main Body and associated Annexes:

84IW	1984 Interworking (MHS functional group)
ACP	ICAO Aeronautical Communications Panel
ACSE	Association Control Service Element
ADEXP	ASIA/PAC Standard for ATS Data Exchange Presentation
AF-Address	AFTN-form address
AFS	Aeronautical Fixed Service
AFSG	Aeronautical Fixed Service Group (ICAO EUR Regional group)
AFTN	Aeronautical Fixed Telecommunication Network
AIRAC	Aeronautical Information Regulation And Control
AMC	ATS Messaging Management Centre
AMHS	ATS Message Handling System
AMHxx	Application profile for MHS standards
ANSP	Air Navigation Service Provider
API	Application Programming Interface
ASN.1	Abstract Syntax Notation One
ATM	Air Traffic Management

ATN	Aeronautical Telecommunication Network
ATS	Air Traffic Services
ATSMHS	ATS Message Handling Service
AU	Access Unit
BC	Business Class
CA	Certificate Authority
CAAS	Common AMHS Addressing Scheme
CFMU	Central Flow Management Unit
CIC	Content Integrity Check
CIDIN	Common ICAO Data Interchange Network
CLNP	Connectionless Network Protocol
CNS/ATM	Communications Navigation and Surveillance / Air Traffic Management
COM	Communication
COTS	Commercial-off-the-Shelf
CSV	Comma Separated Values
CV	Conversion
DAP	Directory Access Protocol
DAP/CSP	Directorate ATM Programmes / Communications Systems and Programmes
DIB	Directory Information Base
DIR	Directory
DISP	Directory Information Shadowing Protocol
DIT	Directory Information Tree
DL	Distribution List
DMD	Directory Management Domain
DMZ	De-militarized Zone
DN	Distinguished (Directory) Name
Doc	ICAO Document
DOP	Directory Operational Binding Protocol
DSA	Directory System Agent
DSP	Directory System Protocol
DUA	Directory User Agent
EANPG	ICAO European Air Navigation Planning Group
EATMN	European Air Traffic Management Network
EC	European Community
ED	EUROCAE Document
EIT	Encoded Information Type
ER	Exempted Recipients (MHS context)
ER	Essential Requirement (SES context)
ETSI	European Telecommunications Standards Institute
EU	European Union
EUR	ICAO European Region
EUROCAE	The European Organization for Civil Aviation Equipment
FG	Functional Group
FHA	Functional Hazard Assessment
FIPS	Federal Information Processing Standard
FTBP	File Transfer Body Part
HMI	Human-Machine Interface
IA5	International Alphabet Number 5
ICAO	International Civil Aviation Organisation
ICS	Implementation Conformance Statement

Id	Identifier
IEC	International Electro-technical Commission
IETF	Internet Engineering Task Force
IHE	IPM Heading Extension
IP	Internet Protocol
IPM	Interpersonal Message
IPN	Interpersonal Notification
IPS	Internet Protocol Suite
IPsec	Internet Protocol Security (RFC 4301)
IPv4	Internet Protocol version 4 (RFC 791)
IPv6	Internet Protocol version 6 (RFC 2460)
ISO	International Organization for Standardization
ISP	International Standardized Profile
ITU-T	International Telecommunication Union – Telecommunications Sector
LD	Latest Delivery
LDAP	Lightweight Directory Access Protocol
LDIF	LDAP Data Interchange Format (RFC 2849)
MD	Management Domain
MF-Address	MHS-form address
MHS	Message Handling System
MS	Message Store
MTA	Message Transfer Agent
MTCU	Message Transfer and Control Unit
MTS	Message Transfer Service
NAT	ICAO North Atlantic Region
NATO	North Atlantic Treaty Organisation
NB	Notified Body
NIST	USA National Institute of Standards and Technology
NOTAM	Notice to Airmen
NRN	Non-Receipt Notification
O/R	Originator / Recipient
OHI	Optional Heading Information
OID	Object Identifier
OSI	Open Systems Interconnection
OU1	Organizational Unit One (in AMHS address)
P1	MHS Protocol for message transfer
P2	MHS Protocol for interpersonal messaging
P3	MHS Protocol for message submission and retrieval between UA and MTA
P7	MHS Protocol for message indirect submission and retrieval from MS
PD	Physical Delivery
PDR	Proposed Defect Report (on ICAO Doc 9705)
PICS	Protocol Implementation Conformance Statement
PKI	Public Key Infrastructure
PRL	Profile Requirements List
QoS	Quality of Service
RCP	Required Communication Performance
RDN	Relative Distinguished Name
RED	Redirection
RFC	Request For Comments (IETF)
RN	Receipt Notification

RoC	Return Of Content
ROSE	Remote Operations Service Element
RTSE	Reliable Transfer Service Element
SARPs	ICAO Standards and Recommended Practices
SDG	Specification Drafting Group
SEC	Security
SNMP	Simple Network Management Protocol (RFC 1157)
SV	Sub-Volume of ICAO Doc 9705
TCP/IP	Transmission Control Protocol / Internet Protocol
TP0 ISO	Transport Protocol Class 0
TP4 ISO	Transport Protocol Class 4
UA	User Agent
WAN	Wide Area Network
X.400	ITU-T message handling recommendations
X.500	ITU-T Directory recommendations
X.509	ITU-T Recommendation defining public key certificate format
XF-Address	Translated-form address
XMIB	Cross-Domain Management Information Base

1.6.2 Definitions

This section defines the terms specific to this document, as well as some common terms which are included for ease of reference. Other definitions may be included by reference to other documents.

AMHS - The set of end systems providing the ATSMHS. In this document, “AMHS” refers only to that part of the global AMHS which is implemented unless otherwise stated, including the interfaces at boundaries with third countries. The AMHS comprises a set of ATN End Systems of type:

- ATS Message Server, which includes an MTA and optionally one or more MS(s);
- ATS Message User Agent which includes a UA;
- AFTN/AMHS Gateway which includes an MTA, and an AU.

AMHS Component - One of the functional objects identified in ICAO Doc 9880 Part II [5] which form part of an AMHS End System; i.e. an MTA, UA, MS, or AU.

AMHS End System - An ATN End System participating in the provision of the ATSMHS; an ATS Message Server, ATS Message User Agent or AFTN/AMHS Gateway.

ANSP (Air Navigation Service Provider) **-** A body that manages flight traffic on behalf of a company, region or country. It is a provider of air traffic control services.

ATN End System - A computer system that supports one of the ATN applications identified in ICAO Annex 10 Volume III Part I Chapter 3 [26] “Aeronautical Telecommunication Network”.

ATSMHS - The air traffic services message handling service (ATSMHS) application aims at providing generic messaging services over the Aeronautical Telecommunication Network (ATN). Two levels of service are defined within the ATSMHS:

- The Basic ATSMHS;

- The Extended ATSMHS.

1.7 Interoperability Target

1.7.1 In a generic specification such as this it is impossible to foresee all possible messaging configurations. The actual environment will have to be elaborated as part of the detailed specification for each individual implementation.

1.7.2 The functional environment specification includes:

• Required gateway functionality;

• Messaging systems that are to be interconnected;

• Available communications and network infrastructure.

1.7.3 A messaging system in terms of this ASIA/PAC Specification may be required to interwork with:

•ATS Message Servers within a State or in other States, implementing the ATSMHS over ATN/IPS transport services;

•ATS Message User Agents, for the local submission and delivery of messages by "direct" ATSMHS users;

• AFTN/AMHS Gateways, for the transition of AMHS messages into the AFTN, and vice-versa;

1.7.4 Possible interworking with other message handling systems is a local matter,outside the scope of this ASIA/PAC Specification.

1.7.5 To ensure seamless operation, there are interoperability requirements at a number of distinct levels:

• Geographical
The ATSMHS is applicable within and between countries. The ATS Message Server topology needs to be optimized for efficient routing in this context.

• Procedural
The ATSMHS must be used in a consistent way to ensure a seamless service. Procedures must be specified for day-to-day configuration and operation of the message handling service, as well as for orderly transition from legacy systems.

• Human-machine interface (HMI)

For direct AMHS users in the human user subgroup, the HMI must offer the required input capabilities and display the required information. However, human factors / ergonomics are out of scope of this ASIA/PAC Specification.

• Communication protocols

Ground end systems must interwork at the technical level. End systems must interwork with logically adjacent end systems (e.g. an ATS Message User Agent must interwork with an ATS Message Server for message submission and delivery) as well as with peer end systems (i.e. interworking between AMHS users, both direct and indirect). The end system includes:

-Application entities (e.g. MTA, MS, UA, DUA, DSA)
-Upper Layers (above transport layer)
-Lower Layers (transport layer and below)

1.7.6 Figure 1 illustrates the interoperability target for AMHS.

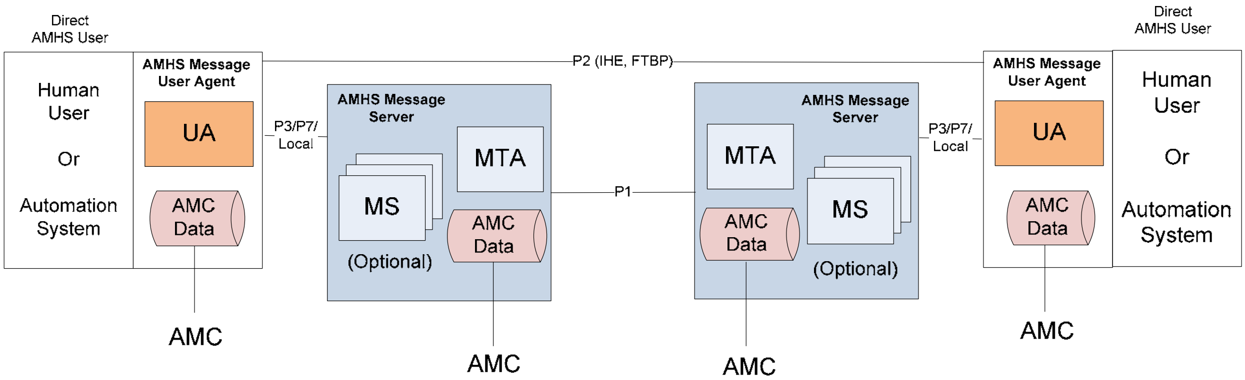

Figure 1: AMHS Interoperability Target

1.7.7 The ATS Message User Agent is a logical component that may or may not be physically identifiable in an implementation. It may be either logically collocated or remote from the ATS Message Server with which it is associated. When logically remote from the ATS Message Server, it will use the P7 protocol if using a Message Store (MS), or the P3 protocol if communicating directly with the Message Transfer Agent (MTA). The MS is an optional component of the ATS Message Server.

1.7.8 If end-to-end message security services are implemented, the user agent (UA) components would need additional functionality for generating and verifying the content integrity check and digital signature, and there would need to be additional infrastructure to support the management of public key certificates.
Note that there are also security measures applied to ATS Message Servers and DSAs, as well as link level security.

1.7.9 The AMC Database provides supporting functions such as address lookup and enabling a message originator to determine the capability of an intended recipient (direct AMHS user) before initiating the message exchange.

1.7.10 During the transition phase, which may take a number of years, legacy AFTN systems and terminals will need to be supported, both within States and between States. A State which has an operational AMHS may still support legacy AFTN users within that State (indirect AMHS users), and will also need to interwork with States that do not have operational AMHS deployments.

1.7.11 The goal is for interoperability between end users. Clearly, the degree of interoperability possible will depend upon the capability of the end user's system. For example, an AFTN terminal would not be expected to interoperate with an ATS Message User Agent for the exchange of binary encoded weather maps. However, basic interoperability at the level of ATS message exchange (textual rendition of flight plan, etc. messages) would be supported, and would be achieved through the use of an AFTN/AMHS gateway.

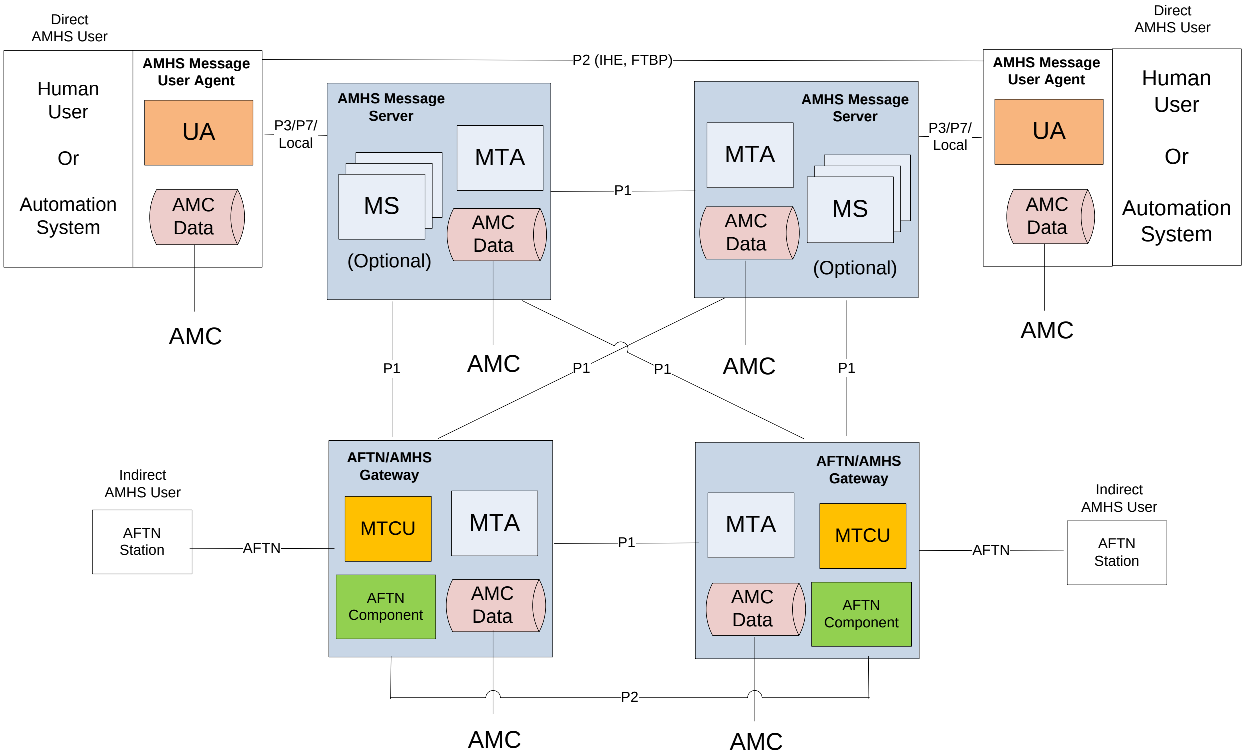

Figure 2: AMHS Interoperability Target (transitional phase)

1.7.12 Figure 2 illustrates the elements which are needed for transition, and represents the initial Interoperability Target.

1.7.13 At a future date, when the transition from AFTN is complete, and no legacy AFTN stations remain, the AFTN/AMHS Gateways will no longer be required. The ultimate interoperability target for AMHS is for all end users to become Direct AMHS users.

2. AMHS INTEROPERABILITY – BASIC ATSMHS

2.1 General

2.1.1 This chapter contains guidance and explanatory material for the AMHS Interoperability requirements in Annex A, which apply to the Basic ATSMHS level of service as defined in ICAO Doc 9880 Part II [5].

2.2 Standards Baseline

2.2.1 The standards baseline in Annex A defines the standards which through reference constitute part of the ASIA/PAC Specification.

2.2.2 The approach is to reference ICAO material where available, noting deviations where required and specifying additional functionality where necessary.

2.2.3 ICAO Annex 10 Volume III refers to the detailed technical specifications for the ATSMHS in ICAO Doc 9880 Part II [5]. These provisions in turn make reference to International Standardized Profiles (ISPs) published by the International Organization for Standardization (ISO).

2.2.4 In the MHS base standards (ISO/IEC 10021 and ITU-T X.400), a subset of the OSI Upper Layer protocols (ROSE, RTSE, ACSE, Presentation and Session layers) is used to support communications between the MHS components (MTA, UA, AU and MS). The use of OSI upper layers is specified in a common ISP applicable to each MHS component.

2.2.5 The referenced ISPs also include profiles for common messaging and for inter-personal messaging (IPM).

2.2.6 However, there remain some options and implementation choices in the AMHS technical specifications in ICAO Doc 9880 Part II [5]. These include support of the Extended and/or Basic ATSMHS, support for different body part types, message size constraints, etc.

2.2.7 The Asia/Pacific Region has adopted the ATS Messaging Management Center (AMC).

2.3 Network Support

2.3.1 This section describes interoperability between the AMHS components (MTA, UA, etc.) and the supporting network infrastructure. In general, there will be network level security features such as firewalls to control access to the infrastructure. Security protocols such as IPsec can be used to ensure that only named servers can connect to one another. However, these are not specific to the messaging system and are not described further.

2.3.2 As specified in ICAO Doc 9880 Part II [5], an AMHS End System can make use of the connection mode transport service provided by either or both of the ATN/OSI or the ATN/IPS. In the former case, it operates over the ATN internet communications service, based on a TP4/CLNP protocol stack, while in the latter case it operates over a TCP/IP protocol stack.

2.3.3 Implementations by ANSPs in the Asia/Pacific Region will make use of a backbone ground-ground network infrastructure based on TP4/CLNP.

2.3.4 TP4/CLNP is specified for interconnections between Backbone MTAs of different ANSP international COM Centers within the Asia/Pacific Region; however, the TCP/IP lower layer profile may be used within an ANSP's local systems or to connect to Non-Backbone MTAs or to MTAs in other regions.

2.4 Message Transfer Service Interoperability

2.4.1 This section is concerned with MTA-to-MTA interoperability requirements.

2.4.2 The Message Transfer Service (MTS) is provided by MTAs communicating via the message transfer protocol P1. The profile requirements for MTAs in the Asia/Pacific Region shall be as specified in ICAO Doc 9880, Part II B [5], section 3.2.2

2.4.3 A backup ATS Message Server may be specified to take over from an international ATS Message Server if the primary system becomes unavailable.

2.5 End-to-End Interoperability of Direct AMHS Users

2.5.1 This section is concerned with UA-to-UA interoperability requirements.

2.5.2 A direct AMHS user is a human or automated system that uses an ATS Message User Agent for message submission and delivery.

2.5.3 The ATSMHS is based on the standards for the interpersonal messaging protocol (P2), i.e. ISO/IEC 10021-7 | ITU-T Recommendation X.420, using message content type 22.

2.5.4 Users of the Basic ATSMHS are able to send and receive simple text messages using a single ia5-text body part containing a structured ATS Message Header.

2.6 Interoperability between AFTN and AMHS

2.6.1 This section is concerned with AFTN/AMHS Gateway requirements.

2.6.2 During the transition phase from AFTN to the AMHS, the interoperability between AFTN and AMHS is achieved by the use of AFTN/AMHS gateways.

2.6.3 Interconnection between the AFTN and the AMHS in the Asia/Pacific Region will be by means of AFTN/AMHS Gateways directly interfacing with the AFTN application supported by ASIA/PAC COM Centers.

2.6.4 Technical provisions for the AFTN/AMHS gateway are specified in ICAO Doc. 9880 Part II [5], section 4.

2.7 Ground Recording of Messages

2.7.1 Annex A elaborates on the information required to be recorded by AMHS End Systems, in accordance with ICAO recording requirements. These are minimum requirements for recording the message exchanges for audit and incident investigation purposes.

2.8 Naming and Addressing

2.8.1 Annex A includes requirements for specifying, maintaining and disseminating unambiguous name and address information required for safe and efficient operation of the communications system.

2.8.2 ICAO Doc 9880 Part II [5] section 2.5.1.4 requires each AMHS management domain to implement an AMHS addressing scheme policy. The management domain may implement either a MHS-form (MF) addressing scheme, or a locally defined addressing scheme, or a combination of both. Two alternative MF-addressing schemes are defined: the Common AMHS Addressing Scheme (CAAS) and the Translated-form (XF) addressing scheme.

2.8.3 Adoption of the ASIA/PAC AMHS Naming Plan will simplify address management and hence aid seamless operations. Under the AMHS Naming Plan the CAAS is recommended for the Asia/Pacific Region. This is consistent with ICAO Doc 9880 Part II, section 2.5.1.4.1.5.

2.8.4 However, for interoperability purposes, all components of Basic and Extended ATSMHS systems must support all of the AMHS address formats identified in ICAO Doc 9880, including XF-addresses. This does not require any form of address translation by an ATS User Agent or an ATS Message Server.

2.9 Interoperability with Systems External to ASIA/PAC

2.9.1 Within the ASIA/PAC Backbone, AMHS communication will be based on ATN/OSI lower layers. Elsewhere in the world, it is possible that AMHS communication could be based on ATN/IPS lower layers. ICAO Annex 10 Volume III requires that regional air navigation agreements will specify the area in which the communication standards for the ATN/OSI or the ATN/IPS are applicable.

2.9.2 The decoupling that exists in an AMHS End System between upper layers and lower layers (transport and network services) allows an ATS Message Server to communicate using different lower layers with different adjacent MTAs. Such lower layer stacks can include ATN/OSI and ATN/IPS protocol stacks.

2.9.3 The ability to implement AMHS end systems with multiple lower layer stacks may be used if needed to ensure global interoperability at the application layer. In this model, one ATS Message Server could be nominated as the boundary system for interfacing the ASIA/PAC AMHS to the AMHS in third countries.

2.9.4 In such a case, the requirements applicable to AMHS End Systems within the ASIA/PAC may not be applicable to those system elements responsible for interfacing with external systems, e.g. in terms of performance or protocol support.

2.9.5 Provisions for AMHS interworking at boundaries with countries external to ASIA/PAC will normally be concentrated in Boundary ATS Message Servers. If the external systems support only ATN/IPS lower layer protocols, the implementation of dual stacks can be proposed as the interworking solution. Other solutions may also be possible, but are outside the scope of this ASIA/PAC Specification.

2.9.6 The ASIA/PAC AMHS Backbone will make use of an ISO TP4 transport service implemented over a CLNP stack. If needed, boundary ATS Message Servers in selected boundary COM centers will implement dual stack systems to allow interconnection with ATN/IPS AMHS systems external to the ASIA/PAC.

2.9.7 It is envisaged that such boundary ATS Message Servers will be implemented as a Common Facility for the benefit of the whole ASIA/PAC network, to provide AMHS connectivity towards other countries.

3. EXTENDED ATSMHS

3.1 General

3.1.1 This section contains explanatory material for the requirements in Annex B concerning the Extended ATSMHS.

3.1.2 The Extended ATSMHS is an enabler for ATS operational improvements. It will provide significant operational benefits, improvement of ATS capacity and performance.

3.1.3 The requirements for Extended ATSMHS are in addition to those for Basic ATSMHS.

3.2 Standards Baseline

3.2.1 The standards baseline in Annex B defines the standards which through reference constitute part of the ASIA/PAC Specification concerned with the Extended ATSMHS.

3.3 Extended ATSMHS Functionality

3.3.1 All AMHS End Systems supporting the Extended ATSMHS must conform to the relevant requirements of the Basic ATSMHS.

3.3.2 In addition, implementations which support the Extended ATSMHS include functionality which can conveniently be described in terms of the following functional groups:

a) Use of File Transfer Body Parts (FTBP). This functional group enables the transfer of binary data between direct AMHS users. When binary files can be transferred it is important to include virus protection in the architecture, associated with the ATS Message Server and/or ATS Message User Agent; however this is out of scope of this ASIA/PAC Specification.

b) Use of IPM Heading Extensions (IHE). This functional group uses standard message fields instead of the AMHS-specific ATS Message Header which is required in the Basic ATSMHS.

c) AMHS Security (SEC). This functional group enables support of the AMHS security policy, providing message origin authentication and content integrity assurance between direct AMHS users.

d) Use of Directory (DIR). This functional group enables support of the ATN Directory through the use of a DUA included in the AMHS End System.

3.3.3 An implementation of an ATS Message User Agent or of an ATS Message Server claiming full conformance to ICAO Doc 9880 Part II [5] for the Extended ATSMHS is required to support all of these functional groups.

3.3.4 ICAO Doc 9880 Part II [5] also allows an implementation of an ATS Message User Agent or of an ATS Message Server to claim conformance for a subset of the Extended ATSMHS.

3.3.5 If different AMHS End Systems in ASIA/PAC were to support different combinations of functional groups this would be detrimental to full functional interoperability and seamless operations (although interoperability would be possible at least at the Basic ATSMHS level).

3.3.6 Conformance to this ASIA/PAC Specification for the Extended ATSMHS requires implementation of a configuration of the Basic, IHE, and FTBP functional groups.

3.3.7 Note that the future migration to support the DIR and SEC functional groups may be foreseen, but is not currently required for compliance with this ASIA/PAC Specification.

3.3.8 For the AFTN/AMHS Gateway, ICAO Doc 9880 Part II does not specify any distinct functional groups; an implementation may or may not support the Extended ATSMHS as a whole. In practice, FTBP is not relevant for an AFTN/AMHS Gateway; if an AMHS message containing an FTBP body part were received it would unconditionally be rejected by the gateway according to ICAO Doc 9880 Part II, paragraph 4.5.2.1.4.b). SEC would be applicable in the AMHS-to-AFTN direction. IHE and DIR would be supported by an AFTN/AMHS Gateway that supports the Extended ATSMHS.

3.4 End-to-End Interoperability of Direct AMHS Users

3.4.1 Users of the Extended ATSMHS have access to advanced features that are not available to users of the Basic ATSMHS. These include binary data transfer using file transfer body part. The profile requirements for UAs in ASIA/PAC are as specified in ICAO Doc 9880 [5].

3.4.2 Interoperability issues may arise when a user supporting the Extended ATSMHS wishes to communicate with a user supporting the Basic ATSMHS. In such cases, interoperability will only be possible at the Basic ATSMHS level of service.

3.4.3 For example, if a direct user wishes to send a file transfer body part, this will only be meaningful if all of the addressed recipients can process such body part types correctly, i.e., they support the FTBP Functional Group of the Extended ATSMHS. For the sake of robustness, even an ATS Message User Agent supporting only the Basic level of service is expected to be able to receive a message containing unsupported body parts without aborting or malfunctioning.

3.5 Naming and Addressing

3.5.1 In the Extended ATSMHS, the O/R name of an AMHS user is required to comprise both the MF-address (O/R address) and the directory name (distinguished name form) of the AMHS user (see ICAO Doc 9880 Part II [5] section 2.5.1.1.2).

3.5.2 This implies conveyance of both MF-address and directory name in the message envelope and IPM heading. In practice, a UA, MTA, or Gateway receiving a message has no use for the received directory names, as it never needs to look anything up in the directory (except possibly a user's certificate, if secure messaging is implemented). Theoretically, support for IPM Use of Directory requires a UA to be able to display the directory component in a received O/R Name (ISO ISP 12062-1 A.2.3).

4. ADDITIONAL AMHS REQUIREMENTS

4.1 Testing and Verification

4.1.1 The ASIA/PAC AMHS Manual specifies a set of testing requirements, conformance, interoperability and pre-operational tests covering the Basic ATSMHS requirements. There is the need to augment the test coverage in such a way as to include the additional functionality of the relevant elements of the Extended ATSMHS.

5. TRANSITION / COEXISTENCE ISSUES

5.1 AFTN to AMHS Transition

5.1.1 As a first step, the Basic ATSMHS can be deployed in ASIA/PAC simply to replace AFTN. Subsequently, it is envisaged that ANSPs will continue to implement other elements of the Extended ATSMHS.

5.1.2 As aging AFTN switches are replaced with ATS Message Servers, AFTN end users will become AMHS indirect users, supported by the AFTN/AMHS Gateway.

5.1.3 The ultimate goal is to phase out the AFTN terminal equipment in favor of ATS Message User Agents. At this stage, all users will be AMHS direct users. The AFTN/AMHS Gateways can only be decommissioned when all indirect users connected to the switch (terminals and applications) are migrated to AMHS. Note that such decommissioning depends also on the migration of all communicating ASIA/PAC countries from AFTN to AMHS.

5.1.4 Systems sending and receiving AFTN messages must be considered. As long as these systems expect AFTN formatted messages, the AFTN/AMHS Gateways will have to remain.

5.1.5 There are a number of transition steps to achieving this end state. Timescales for migration and transition are outside the scope of this ASIA/PAC Specification.

5.1.6 The migration from AFTN to AMHS requires the development of AMHS Operational Procedures, to ensure that transition steps are performed smoothly and without service disruption.

5.1.7 Common facilities, and specifically the routing management function, are of utmost importance to the performance of these AMHS Operational Procedures. It is one of the main goals of the AMC to provide support to the transition to AMHS.

5.1.8 During transition from AFTN to AMHS, existing AFTN routes will be "concatenated" with direct AMHS routes in AMHS Gateways at the borders between the remaining AFTN and the growing AMHS islands.

5.2 Basic ATSMHS to Extended ATSMHS Transition

5.2.1 The Basic ATSMHS may be implemented as a transition step to full Extended ATSMHS. ICAO Doc 9880 Part II [5] notes: It is intended that eventually the Extended ATS Message Handling Service will be supported by all ATS Message Handling Service users, so that the Basic ATS Message Handling Service will not be required anymore. However the latter may be maintained for transition purposes as long as required.

5.2.2 Coexistence between the two levels of service is facilitated by the use of the AMC service by users to determine the capabilities of intended message recipients.

5.3 Deployment of Directory

5.3.1 Updates to ASIA/PAC ATS messaging configuration and addressing information are published each AIRAC cycle and distributed by the AMC.

6. LIST OF REFERENCES

[1] ASIA/PAC ATN Ground-Ground Transition Plan, 2nd Edition (March 2004)

[2] ASIA/PAC AMHS MTA Routing Policy, 1st Edition (April 2005)

[3] ICAO Convention on International Civil Aviation, Annex 10 - Aeronautical Telecommunications, Volume II — Communication Procedures including those with PANS status, Sixth edition – October 2001, incorporating Amendment 83 (20/07/2008)

[4] ICAO Convention on International Civil Aviation, Annex 11 – Air Traffic Services, Thirteenth edition - July 2001, incorporating Amendment 45 (16/07/2007)

[5] ICAO Doc. 9880-AN/466 Manual on Detailed Technical Specifications for the Aeronautical Telecommunication Network (ATN) using ISO/OSI standards and protocols, Part II – Ground-Ground Applications – ATS message handling service (ATSMHS), 1st edition, 2010

[6] [ATN SEC] ICAO Doc. 9705-AN/956 – Manual of Technical Provisions for the Aeronautical Telecommunications Network (ATN) Third Edition (2002), Sub-Volume VIII – ATN Security.

[7] [ATN DIR] ICAO Doc 9880-AN/466 – Manual on Detailed Technical Specifications for the Aeronautical Telecommunication Network (ATN) using ISO/OSI standards and protocols, Part IV – Directory Services, 1st edition, 2010

[8] ASIA/PAC AMHS Manual, Version 3.0 (September 2009)

[9] ASIA/PAC AMHS Naming Plan, 3rd Edition (April 2005)

[10] ASIA/PAC System Management Policy, 1st Edition (April 2005)

[11] ASIA/PAC ATN System Security Policy, 2nd Edition (September 2008)

ANNEX A – SPECIFICATION OF AMHS BASIC INTEROPERABILITY REQUIREMENTS

A.1 EXPLANATORY MATERIALS

This normative Annex is an integral part of this ASIA/PAC Specification. It specifies requirements for AMHS End Systems that support the Basic ATSMHS as defined in ICAO Doc 9880 Part II [5].

This Annex must be read in conjunction with the Main Body of this ASIA/PAC Specification, which provides definitions, document references, and contextual information. References given in square brackets are defined in section 6 of the Main Body.

The Basic ATSMHS is intended as a transition step providing interoperability with existing AFTN equipment and supporting the migration from AFTN to AMHS technology. As such, it supports existing data flows and concepts of operation for applications based on the interchange of ATS messages.

The Basic ATSMHS provides only for the exchange of simple text messages, including a formatted ATS Message Header field. It does not support new concepts of operation requiring the general exchange of binary data or files and does not provide strong authentication or data integrity services. Further, the Basic ATSMHS does not benefit from a standardized directory function, which in the Extended ATSMHS can be used to enhance seamless operation by ensuring the up-to-date dissemination of address and configuration information.

This Annex is structured such that requirements common to all AMHS End Systems are specified in section A.2.1, followed by requirements specific to each AMHS End System type. Compliance is conditional upon the type of AMHS End System under consideration (e.g. section A.2.2 on ATS Message Server is not applicable when considering requirements for ATS Message User Agents).

A.2 REQUIREMENTS

A.2.1 Common Requirements

A.2.1.1 Standards Baseline

[AMHS-BAS-A03] AMHS End Systems shall comply with the requirements specified in ICAO Doc 9880 Part II [5] applicable to the Basic ATSMHS, except where explicitly stated otherwise.

[AMHS-BAS-A04] In the event of conflicting requirements not explicitly identified, the specification in ICAO Doc 9880 Part II [5] shall take precedence.

[AMHS-BAS-A05] Due account shall be taken of any published defect resolutions relating to the ICAO AMHS documentation.

Note. Any outstanding defect reports and/or amendment proposals need to be analyzed when preparing an ANSP's system specification. Any that affect interoperability would be required to be implemented in the supplied system.

[AMHS-BAS-A07] Compatibility with the current version of referenced standards and any relevant corrigenda should be taken into account.

A.2.1.2 General Requirements

[AMHS-GEN-A01] The AMHS shall enable the exchange of messages between the following types of users:

- Direct AMHS user to Direct AMHS user;
- Direct AMHS user to Indirect AMHS user;
- Indirect AMHS user to Direct AMHS user;
- Indirect AMHS user to Indirect AMHS user.

[AMHS-GEN-A02] AMHS Backbone Systems shall be able to communicate using the ATN/OSI Transport Service, as specified in ICAO Doc 9880 Part II [5], section 3.2.2.2

[AMHS-GEN-A04] Wherever possible, AMHS Component implementations should make use of common and standardized interfaces.

Note: Such interfaces are specified for example in IETF RFCs.

[AMHS-GEN-A05] Specifically, standardized interfaces where available for message submission, transfer and delivery, system management, etc. shall be used as a means of enhancing Interoperability between system components.

[AMHS-GEN-A07] AMHS End Systems shall be capable of interworking with independent implementations of AMHS End Systems in accordance with the permissible combinations listed in ICAO Doc 9880 Part II [5], section 1.2.

Note: Such interworking includes correct interoperation representing the services explicitly and implicitly requested by either end user.

[AMHS-GEN-A08] AMHS End Systems supporting the Basic ATSMHS should be designed to accommodate the evolution to support the Extended ATSMHS, e.g. by including well-defined interfaces and software hooks in areas where future extensions are foreseen.

A.2.1.3 Performance Requirements

[AMHS-PER-A08] AMHS End Systems should be capable of supporting the peak rate hour's performance, which corresponds to at least 20% of the daily traffic requirements for that AMHS End System.

A.2.1.4 Naming and Addressing

[AMHS-NAM-A01] AMHS End Systems shall support the ASIA/PAC AMHS Naming Plan [9]

A.2.1.5 Logging

[AMHS-LOG-A01] Data exchanges using the ATSMHS shall be recorded in accordance with the following ICAO standards applicable to the ground-based recording function of data link communications:

- Section 3.5.1.5 of ICAO Annex 10 Volume II [3];
- Section 6.2 of ICAO Annex 11 [4].

[AMHS-LOG-A03] AMHS End Systems shall support the relevant requirements for traffic logging as described in sections 2.7, 3.2.3 and 4.3.1 of ICAO Doc 9880 Part II [5].

[AMHS-LOG-A04] All operator inputs shall be recorded and traceable for a configurable period (e.g. 30 days).

A.2.1.6 Availability, Reliability, Maintainability

A.2.1.6.1 Availability

[AMHS-ARM-A04] Precise constraints for the restart time are dependent on the configuration of the system and specific modes of failure, but for guidance a target restart time of less than 5 minutes should be assumed.

[AMHS-ARM-A06] AMHS End Systems shall be designed such that processing of messages during recovery does not overload the system or degrade the performance below the performance targets.

A.2.1.6.2 Reliability

[AMHS-ARM-A07] AMHS End Systems shall be designed to minimize the effect of a failure of an AMHS End System or component thereof on the function of the entire system.

Note: This requires an audit of design documentation to ensure that factors such as redundancy of components, alternative routings, etc. have been considered.

[AMHS-ARM-A08] AMHS End Systems and their functional components shall be designed to avoid loss of messages.

A.2.1.6.3 Maintainability

[AMHS-ARM-A09] Commercial Off-the-Shelf (COTS), industry standard software, should be used as widely as possible, in order to enable an upward compatible growth path.

[AMHS-ARM-A10] AMHS End System implementations should be modular in nature and by using a series of industry standard interfaces provide a flexible and expandable combination of communication services.

A.2.1.7 System Management

[AMHS-SYM-A01] AMHS End Systems shall support ASIA/PAC System Management Policy. [10]

A.2.1.8 Security Management

[AMHS-SCM-A01] AMHS End Systems shall support the ASIA/PAC ATN System Security Policy. [11]

A.2.2 ATS Message Server Requirements

An ATS Message Server supporting the Basic ATSMHS includes an MTA and optionally one or more MSs, as specified in ICAO Doc 9880 Part II [5] sections 3.2.2 to 3.2.4.

[AMHS-AMS-A01] An ATS Message Server shall route, store and forward ATS Messages, taking into account the applicable performance requirements and routing configuration.

[AMHS-AMS-A02] An ATS Message Server shall be able to support the routing of messages according to a non-hierarchical addressing plan, as well as the MF-Addressing Schemes specified in ICAO Doc 9880 Part II [5] section 2.5.1.4.

[AMHS-AMS-A03] An ATS Message Server should have the capability to import data from the AMC.

[AMHS-AMS-A04] MTAs shall implement the P1 MTS transfer profile as specified in ICAO Doc 9880 Part II [5](profile AMH11 plus AMHS-specific features) for communication with other ATS Message Servers.

[AMHS-AMS-A05] MTAs shall implement the P1 IPM requirements profile as specified in ICAO Doc 9880 Part II [5] (profile AMH22 plus AMHS-specific features) for IPM communication with other ATS Message Servers.

[AMHS-AMS-A07] The ATS Message Server should support a common and standardized interface for the submission and delivery of messages.

[AMHS-AMS-A09] MTAs may support the Distribution List (DL) and Exempted Recipients (ER) functional group as a local matter.

Note: The DL+ER (Exempted Recipients) class of the DL functional group is outside the scope of this ASIA/PAC Specification. It may be supported according to local requirements.

[AMHS-AMS-A10] It is recommended that the ATS Message Server should have the capability to open multiple associations between each pair of communicating MTAs

Note: This means that there is no guarantee that messages are transferred in their received order, only that the start of transfer is independent of message size.

A.2.2.1 ASIA/PAC Boundary Requirements

[AMHS-AMS-A12] ASIA/PAC boundary ATS Message Servers shall additionally have the capability to communicate with ATS Message Servers external to ASIA/PAC, subject to bilateral agreement.

A.2.3 ATS Message User Agent Requirements

In the AMHS architecture defined in ICAO Doc 9880 Part II [5], each direct AMHS user is provided with an ATS Message User Agent to access the message transfer service. ATS Message User Agents include a UA to perform submission of messages to the message transfer service and delivery of messages from the message transfer service.

The logical architecture includes an optional AMHS Message Store component for storing, on behalf of local direct AMHS users, messages received from other users as well as other information objects such as reports.

The ATSMHS uses the Inter-Personal Messaging (IPM) protocol P2 for communication between UAs. ICAO Doc 9880 Part II [5] specifies the relevant IPM Content Type profile.

In the Basic ATSMHS, each IPM message contains a single ia5-text or general-text body part.

[AMHS-AMU-A01] ATS Message User Agents shall comply with the requirements specified in section 3.1 of ICAO Doc 9880 Part II [5] for the support of the Basic ATSMHS, summarized as the following requirements:

- A UA profile based on AMH21 as specified in ISO/IEC ISP 12062-2;
- The requirements of Repertoire Group A, for messages including a body part whose type is an Extended Body Part Type of general-text-body-part type;
- Provisions related to traffic logging.

[AMHS-AMU-A02] It is recommended that standard ISO/IEC 10021 protocols P3 and/or P7 should be used for message submission and delivery.

Note: In the Basic ATSMHS, a UA can communicate with the MTS using P3, P7 or proprietary access protocols, as an implementation choice local to the AMHS MD. The above recommendation is intended to foster seamless operation and enable a smooth transition to the Extended ATSMHS.

[AMHS-AMU-A03] The maximum message-text length supported by the UA shall be a configurable parameter value.

[AMHS-AMU-A04] A UA shall be capable of accepting and processing a maximum received message-text length of at least 64 kByte and be capable of handling messages longer than the maximum length without system malfunction.

Note. It is a local implementation matter how to handle received messages longer than the maximum supported message length.

[AMHS-AMU-A05] If a user application is co-located with an MTA on a common platform, then the interface between the application's (logical) UA and the message transfer service shall provide equivalent functionality to the MT-Access abstract service as defined for the P3 access protocol specified in ISO/IEC 10021-6.

[AMHS-AMU-A06] If "forced" delivery to a UA is required (e.g. for reception of urgent, high priority messages) then either the P3 protocol or (in the case of MS) P7 with Alerts configured should be used.

[AMHS-AMU-A07] It should be possible for direct AMHS users to request confirmation of delivery and to receive delivery reports.

A.2.4 Message Store Requirements

The MS is Optional in the AMHS logical architecture. It is a local decision whether MS functionality is required. The local options of the MS that are appropriate to the MS user’s intended task need to be specified when procuring an ATS Message Server.

[AMHS-MST-A01] It is recommended that, when an MS is included in the ATS Message Server, standard ISO/IEC 10021 protocol P3 should be used between the MS and MTA for message submission and delivery.

Note: In the Basic ATSMHS, an MS can communicate with the MTS using P3 or proprietary access protocols, as an implementation choice local to the AMHS MD. The above recommendation is intended to foster seamless operation and enable a smooth transition to the Extended ATSMHS.

[AMHS-MST-A02] It is recommended that the standard ISO/IEC 10021 protocol P7 should be used between MS and UA for message retrieval and indirect submission.

Note: In the Basic ATSMHS, a UA can communicate with the MS using P7 or proprietary access protocols, as an implementation choice local to the AMHS MD. The above recommendation is intended to foster seamless operation and enable a smooth transition to the Extended ATSMHS.

[AMHS-MST-A04] MS implementations may support the Distribution List (DL) functional group.

Note: The DL Exempted Recipients class (DL+ER) is an Optional functional group in profiles AMH13 and AMH15. It is only needed if support of dl-exempted-recipients is required in the message submission envelope.

A.2.5 AFTN/AMHS Gateway Requirements

An AFTN/AMHS Gateway supporting the Basic ATSMHS includes an MTA and an Access Unit (the Message Transfer and Control Unit – MTCU), as specified in ICAO Doc 9880 Part II [5] chapter 4.

[AMHS-GWY-A01] Where interworking with AFTN end systems is required, a gateway between the AMHS and AFTN message services shall be implemented in conformance with ICAO Doc 9880 Part II [5] chapter 4.

[AMHS-GWY-A02] An AFTN/AMHS Gateway supporting the Basic ATSMHS shall implement all elements which are applicable to the Basic ATSMHS and which are marked as "M" in the "ATS Messaging Service" column of ICAO Doc 9880 Part II Table 4-3.

[AMHS-GWY-A03] The AFTN/AMHS Gateway shall support address conversion of O/R addresses belonging to a non-hierarchical addressing plan, as well as the MF-Addressing Schemes specified in ICAO Doc 9880 Part II [5] section 2.5.1.4.

[AMHS-GWY-A04] The AFTN/AMHS Gateway shall support address conversion and routing for all currently assigned ICAO eight-letter addressee indicators (AF-addresses).

ANNEX B – SPECIFICATION OF AMHS EXTENDED INTEROPERABILITY REQUIREMENTS

B.1 EXPLANATORY MATERIALS

This normative Annex is an integral part of this ASIA/PAC Specification. It specifies requirements for AMHS End Systems that support the Extended ATSMHS as defined in ICAO Doc 9880 Part II [5].

This Annex must be read in conjunction with the Main Body of this ASIA/PAC Specification, which provides definitions, document references and contextual information.

References given in square brackets are defined in section 6 of the Main Body. Reference is also made to Annex A of this ASIA/PAC Specification for the definition of the Basic ATSMHS details.

The Extended ATSMHS is functionally a superset of the Basic ATSMHS, and is backward compatible with it, in that the ability to downgrade to the Basic ATSMHS level of service is required. AMHS End Systems claiming compliance with the requirements in this Annex must also be compliant with the requirements in Annex A.

This Annex is structured such that requirements common to all AMHS End Systems supporting the Extended ATSMHS are specified in section B.2.1, followed by requirements specific to each AMHS End System type. Compliance is conditional upon the type of AMHS End System under consideration (e.g. section B.2.2 on ATS Message Server is not applicable when considering requirements for ATS Message User Agents).

B.2 REQUIREMENTS

B.2.1 Common Requirements

B.2.1.1 Standards Baseline

[AMHS-BAS-B01] AMHS End Systems shall comply with the standards identified in Annex A of this ASIA/PAC Specification unless stated otherwise.

[AMHS-BAS-B02] AMHS End Systems conforming to this Annex shall comply with the requirements specified in ICAO Doc 9880 Part II [5], including those requirements specific to the support of the Extended ATSMHS, unless explicitly stated otherwise in this Annex.

[AMHS-BAS-B03] In the event of conflicting requirements not explicitly identified, the specification in ICAO Doc 9880 Part II [5] shall take precedence.

Note: ICAO Doc 9880 Part II [5] paragraph 2.2.4.1.b) requires the storage of management information about ATS Message Servers and AFTN/AMHS Gateways in the ATN cross-domain management information base (XMIB). This is not required for conformance to this ASIA/PAC Specification.

B.2.1.2 General Requirements

[AMHS-GEN-B01] ATS Message Servers and ATS Message User Agents shall support the functional groups Basic, IHE, and FTBP.

Note: Migration to AMHS functional groups DIR and SEC may be foreseen at some time in the future, but is not currently required for compliance with this ASIA/PAC Specification.

[AMHS-GEN-B03] AMHS End Systems shall support the implementation of advanced, agreed and validated concepts of operation by providing managed access to the messaging system for new end-user applications via well-defined interfaces.

Note: The basic recommendation for the use of standardized interfaces wherever possible also applies to AMHS components supporting the Extended ATSMHS. However, it is noted that the Open Group APIs are not fully compliant with extended service requirements such as support for the Business Class (BC) functional group, so some customization may be necessary.

B.2.1.3 Naming and Addressing

There are no ASIA/PAC specific requirements for Naming and Addressing.

B.2.1.4 Performance Requirements

There are no additional performance requirements specified in this Annex. The performance requirements specified in Annex A are fully applicable to elements of the Extended ATSMHS. However, it should be noted that the use of binary attachments will tend to result in larger message sizes. Unless the number of messages with file transfer body parts is very small, there will be an impact on performance. Also, the use of security will increase the submission time and also the time to open a message.

B.2.2 ATS Message Server Requirements

B.2.2.1 General

An ATS Message Server supporting the Extended ATSMHS includes an MTA, a DUA and optionally one or more MSs, as specified in ICAO Doc 9880 Part II [5] sections 3.2.2 to 3.2.5.

B.2.2.2 P1 Message Transfer

[AMHS-AMS-B01] MTAs shall implement the P1 MTS transfer profile AMH11 as specified in Annex A of this ASIA/PAC Specification.

B.2.2.3 P3 Message Access

[AMHS-AMS-B03] MTAs supporting direct message submission and delivery should support P3 access.

B.2.3 ATS Message User Agent Requirements

B.2.3.1 General

An ATS Message User Agent supporting the Extended ATSMHS includes an IPM UA as specified in ICAO Doc 9880 Part II [5] sections 3.1.2 to 3.1.5.

The UA in the Extended ATSMHS supports the P3 protocol to access the MTA in an ATS Message Server and/or the P7 protocol to access the MS in an ATS Message Server, where available.

Note: In the Extended ATSMHS, each IPM message may contain a combination of ia5text, general text and file transfer body parts. Use of the Bilaterally Defined body part type is prohibited for sending, though it must be supported for reception for backwards compatibility – see ICAO Doc 9880 Part II [5] paragraph 3.1.4.2.1.2.

[AMHS-AMU-B01] An ATS Message User Agent supporting the Extended ATSMHS shall comply with the requirements specified in section 3.1 of ICAO Doc 9880 Part II [5] for the support of the Extended ATSMHS, summarized as the following requirements;

- A UA profile based on Profile AMH21;

- The requirements of Repertoire Group A, for messages including a body part whose type is an Extended Body Part Type of general-text-body-part type;

- Support of the IPM Business Class (BC) functional group;

- Support of the file-transfer body part;

- UA access profile based on Profiles AMH23 or AMH25 for P3 access to the MTS, or based on Profiles AMH24 or AMH26 for P7 access to the MS;

- The additional provisions relating to parameters generated at an ATS Message User Agent, as specified for the Extended ATSMHS;

- Provisions related to traffic logging.

B.2.3.2 IPM Content

[AMHS-AMU-B02] A UA in an ATS Message User Agent supporting the Extended ATSMHS shall conform to MHS Profile AMH21 as specified in Doc 9880 Part II [5].

[AMHS-AMU-B03] A UA in an ATS Message User Agent shall be prohibited from sending messages containing a Bilaterally Defined body part.

[AMHS-AMU-B05] The values of the precedence field in the per-recipient heading fields of a message shall be the same for all recipients, as this field corresponds to AFTN Priority.

B.2.3.3 P3 Access

[AMHS-AMU-B06] A UA supporting P3 access shall conform to the profile AMH12 and optionally profile AMH14 in ICAO Doc 9880 Part II [5].

[AMHS-AMU-B07] A UA supporting P3 access shall conform to the profile AMH23 and/or AMH25 in ICAO Doc 9880 Part II [5], section 3.1.4.3.1.

B.2.3.4 P7 Access

[AMHS-AMU-B10] A UA supporting P7 access shall conform to the profile AMH13 or AMH15 ICAO Doc 9880 Part II [9].

[AMHS-AMU-B11] A UA supporting P7 access shall conform to the profile AMH24 or AMH26 in ICAO Doc 9880 Part II [5], section 3.1.4.3.1.

B.2.4 Message Store Requirements

B.2.4.1 General

The MS is an optional functional object in the AMHS logical architecture. For an MS in an ATS Message Server supporting the Extended ATSMHS, the access profiles are prescribed in ICAO Doc 9880 Part II [5].

B.2.4.2 MS Access to MTA

[AMHS-MST-B01] An MS which supports P3 access in an ATS Message Server supporting the Extended ATSMHS shall conform to the profile AMH12 and optionally profile AMH14 in ICAO Doc 9880 Part II [5].

[AMHS-MST-B02] An MS which supports P3 access in an ATS Message Server supporting the Extended ATSMHS shall conform to Profiles AMH23 and/or AMH25 in ICAO Doc 9880 Part II [5].

B.2.4.3 P7 Access

[AMHS-MST-B06] An MS in an ATS Message Server supporting the Extended ATSMHS shall conform to the Profile AMH13 or AMH15 in ICAO Doc 9880 Part II [5].

[AMHS-MST-B07] An MS in an ATS Message Server supporting the Extended ATSMHS shall conform to the profile AMH24 or AMH26 in ICAO Doc 9880 Part II [5].

B.2.5 AFTN/AMHS Gateway Requirements

B.2.5.1 General

An AFTN/AMHS Gateway supporting the Extended ATSMHS includes an MTA and an Access Unit (the Message Transfer and Control Unit – MTCU), as specified in ICAO Doc 9880 Part II [5] chapter 4.

[AMHS-GWY-B02] It is recommended that AMC information in an AFTN/AMHS Gateway supporting the Extended ATSMHS should be used to retrieve information in support of address and content conversion.

Note: The retrieval of AMC information can be used by the MTCU to facilitate address conversion. The MTCU also requires further information on the level of service supported by the intended AMHS recipients.

The Minimum Technical and Operational Requirements for a Regional RAIM Prediction System

Basic Common Denominator - Noting the differences among different RAIM algorithms on-board different aircraft, a regional RAIM prediction system provided by a service provider, such as an ANSP, should provide a “basic common denominator” RAIM prediction service for “basic” GNSS receivers, such TSO-129 (Fault Detection) and TSO-145/146 (Fault Detection and Exclusion).

Prediction Period – A regional RAIM prediction system shall provide prediction for RAIM outage and number of GNSS-satellite availability for a 72 hour period using the latest available GPS NANU.

*Approach Operation*s - A regional RAIM prediction system shall support aircraft approach operations based on RNP APCH (with/without Baro-VNAV) navigation specification. The system shall calculate the predicted RAIM availability for a 72 hour period for specific Aerodromes. The algorithms shall address the RAIM requirements for GNSS receivers operating in Approach operations (±0.3NM). Both the Fault Detection (FD) and Fault Detection and Exclusion (FDE) algorithms shall be provided. The system shall calculate the predicted RAIM availability at the Aerodrome Reference Point (ARP) for baro (pressure altitude) aided and non-baro aided GNSS user equipment at 1 minute intervals or better.

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INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE

ASIA/PACIFIC REGIONAL PERFORMANCE-BASED NAVIGATION IMPLEMENTATION PLAN

DRAFT VERSION 3.0

July 2011

RECORD OF AMENDMENT

Version	Activity	Date
0	Adopted by APANPIRG/19 as Interim Edition	September 2008
0.1	RASMAG Proposal	December 2008
0.2	Amended/Finalized by PBN/TF/4	March 2009
0.3	Amended/Finalized by PBN/TF/5	July 2009
1.0	Adopted by APANPIRG/20	September 2009
2.0	Adopted by APANPIRG/21	September 2010
3.0	Adopted by APANPIRG/22	September 2011

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ASIA/PACIFIC REGIONAL PERFORMANCE-BASED NAVIGATION IMPLEMENTATION PLAN

1. Executive Summary

1.1 This Asia/Pacific Regional PBN Implementation Plan has been produced in line with Resolution A 36/23 adopted by ICAO Assembly in its 36th Session held in September 2007 and Conclusion 18/52 adopted by APANPIRG/18. The Regional PBN Plan addresses the strategic objectives for PBN implementation based on clearly established operational requirements, avoiding equipage of multiple on-board or ground based equipment, avoidance of multiple airworthiness and operational approvals and explains in detail contents relating to potential navigation applications. The Plan envisages the conduct of pre- and post-implementation safety assessments and continued availability of conventional air navigation procedures during transition. The Plan also discusses issues related to implementation which include traffic forecasts, aircraft fleet readiness, adequacy of ground-based CNS infrastructure etc. Implementation targets for various categories of airspace for the short term (2008 – 2012) and for the medium term (2013 – 2016) have been projected in tabular forms to facilitate easy reference. For the long term (2016 and beyond) it has been envisaged that GNSS will be the primary navigation infrastructure. It is also expected that precision approach capability using GNSS and its augmentation system will become available in the long term.

2. Explanation of Terms

2.1 The drafting and explanation of this document is based on the understanding of some particular terms and expressions that are described below:

2.1.1 **Asia/Pacific Regional PBN Implementation Plan.** A document adopted by APANPIRG, often referred to as the "Regional PBN Plan", offering appropriate guidance for air navigation service providers, airspace operators and users, regulating agencies, and international organizations on the evolution of navigation capabilities as one of the key systems supporting air traffic management, and which describes the RNAV and RNP navigation applications that should be implemented in the short, medium and long term in the APAC Region.

2.1.2 **Performance Based Navigation** Performance based navigation specifies RNAV and RNP system performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in an airspace.

2.1.3 **Performance requirements.** Performance requirements are defined in terms of accuracy, integrity, continuity, availability and functionality needed for the proposed operation in the context of a particular airspace concept. Performance requirements are identified in navigation specifications which also identify which navigation sensors and equipment may be used to meet the performance requirement.

3. Acronyms

3.1 The acronyms used in this document along with their expansions are given in the following list:

ABAS	Aircraft-Based Augmentation System
AIS	Aeronautical Information Services
APAC	Asia and Pacific
APANPIRG	Asia/Pacific Air Navigation Planning and Implementation Regional Group
APCH	Approach
APV	Approach Procedures with Vertical Guidance
ATC	Air Traffic Control

Baro VNAV	Barometric Vertical Navigation
CNS/ATM	Communication Navigation Surveillance/Air Traffic Management
CPDLC	Controller Pilot Data Link Communications
DME	Distance Measuring Equipment
EMA	En-route Monitoring Agency
FASID	Facilities and Services Implementation Document
FIR	Flight Information Region
FMS	Flight Management System
GBAS	Ground-Based Augmentation System
GNSS	Global Navigation Satellite System
GRAS	Ground-based Regional Augmentation System
IATA	International Air Transport Association
IFALPA	International Federation of Air Line Pilots' Associations
INS	Inertial Navigation System
IRU	Inertial Reference Unit
PANS	Procedures for Air Navigation Services
PBN	Performance Based Navigation
PIRG	Planning and Implementation Regional Group
RASMAG	Regional Airspace Safety Monitoring Advisory Group
RCP	Required Communication Performance
RNAV	Area Navigation
RNP	Required Navigation Performance
SARP	Standards and Recommended Practices
SBAS	Satellite-Based Augmentation System
SID	Standard Instrument Departure
STAR	Standard Instrument Arrival
TMA	Terminal Control Area
VOR	VHF Omni-directional Radio-range
WGS	World Geodetic System

4. Introduction

Need for the regional PBN Implementation Plan

4.1 The Thirty-sixth Session of the ICAO Assembly held in Montreal in September 2007 adopted a Resolution to resolve that States and PIRGs complete a regional PBN implementation plan by 2009.

4.2 Recognizing that the PBN concept is now established, States should ensure that all RNAV and RNP operations and procedures are in accordance with the PBN concept as detailed in State letter AN 11/45-07/22 and the ICAO Doc 9613: PBN Manual for ensuring a globally harmonized and coordinated transition of PBN.

4.3 In view of the need for detailed navigation planning, it is advisable to develop a Regional PBN Plan to provide proper guidance to air navigation service providers, airspace operators and users, regulating agencies, and international organizations~~,~~ on the evolution of navigation capabilities as one of the key systems supporting air traffic management, and which describes the RNAV and RNP navigation applications that should be implemented in the short and medium term in the APAC Region.

4.4 Furthermore, the Asia/Pacific Regional PBN Implementation Plan will contain the basic material serving as guidance for regional projects for the implementation of air navigation infrastructure, such as ABAS, SBAS, GBAS, GRAS, etc., as well as for the development of national implementation plans.

Roles of Navigation in supporting ATM operations

4.5 An "airspace concept" may be viewed as a general vision or master plan for a particular airspace. Based on particular principles, an airspace concept is geared towards specific objectives. Strategic objectives drive the general vision of the airspace concept. These objectives are usually identified by airspace users, air traffic management (ATM), airports as well as environmental and government policy. It is the function of the airspace concept and the concept of operations to respond to these requirements. The strategic objectives which most commonly drive airspace concept are safety, capacity, efficiency, access, and the environment.

4.6 Navigation is one of several enablers of an airspace concept. Communications, ATS Surveillance and ATM are also essential elements of an airspace concept.

4.7 The PBN–concept specifies RNAV and RNP system performance requirements in terms of accuracy, integrity, availability, continuity and functionality needed for the proposed operations in the context of a particular Airspace Concept, when supported by the appropriate navigation infrastructure. In that context, the PBN concept represents a shift from sensor-based to performance-based navigation. Performance requirements are identified in navigation specifications which also identify the choice of navigation sensors and equipment that may be used to meet the performance requirements. These navigation specifications are defined at a sufficient level of detail to facilitate global harmonization by providing specific implementation guidance for States and operators.

4.8 Under the PBN concept, the generic navigation requirements are defined based on operational requirements. Thus, users may evaluate the available options. To ensure synchronization of investment and interoperability of the airborne and ground systems, the selection of the solution should be in consultation with aviation stakeholders, including international and domestic airline operators, air navigation service providers, and regulators. The solution selected should also be the most cost-effective one.

4.9 The development of the PBN concept recognized that advanced aircraft RNAV systems are achieving an enhanced and predictable level of navigation performance accuracy which, together with an appropriate level of functionality, allows a more efficient use of available airspace to be realized. It also takes account of the fact that RNAV systems have developed over a 40-year period and as a result there were a large variety of differing implementations globally. Identifying navigation requirements rather than on the means of meeting the requirements will allow use of all RNAV systems meeting these requirements irrespective of the means by which these are met.

Benefits of Performance-Based Navigation

4.10 The main benefits derived from the implementation of PBN are:

a) Increased airspace safety through the implementation of continuous and stabilized descent procedures using vertical guidance;

b) Reduced aircraft flight time due to the implementation of optimal flight paths, with the resulting savings in fuel, noise reduction, and enhanced environmental protection;

c) Use of the RNAV and/or RNP capabilities that already exist in a significant percentage of the aircraft fleet flying in APAC airspace;

d) Improved airport and airspace arrival paths in all weather conditions, and the possibility of meeting critical obstacle clearance and environmental requirements through the application of optimized RNAV or RNP paths;

e) Implementation of more precise approach, departure, and arrival paths that will reduce dispersion and will foster smoother traffic flows;

f) Reduced delays in high-density airspaces and airports through the implementation of additional parallel routes and additional arrival and departure points in terminal areas;

g) Reduction of lateral and longitudinal separation between aircraft to accommodate more traffic;

h) Decrease ATC and pilot workload by utilizing RNAV/RNP procedures and airborne capability and reduce the needs for ATC-Pilot communications and radar vectoring;

i) Increase of predictability of the flight path.

Goals & Objectives of PBN Implementation

4.11 APANPIRG, in its Eighteenth meeting (September 2007), discussed various issues related to an early implementation of PBN in the region. To facilitate coordination between States, a PBN Task Force was formed under Conclusion 18/52 and tasked to develop a harmonized regional PBN implementation plan.

4.12 The Asia/Pacific Regional PBN Implementation Plan has the following strategic objectives:

a) To ensure that the implementation of the navigation item of the CNS/ATM system is based on clearly established operational requirements.

b) To avoid undue equipage of multiple on board equipment and/or ground-based systems.

c) To avoid the need for multiple airworthiness and operational approvals for intra- and inter-regional operations.

d) To explain in detail the contents of the Regional Air Navigation Plan, relating to potential navigation applications.

4.13 Furthermore, the Asia/Pacific Regional PBN Implementation Plan will provide a high-level strategy for the evolution of the navigation applications to be implemented in the APAC Region in the short term (2008-2012) and medium term (2013-2016). This strategy is based on the concepts of Area Navigation (RNAV) and Required Navigation Performance (RNP) in accordance with ICAO Doc. 9613: *Performance Based Navigation Manual*, and will be applied to aircraft operations involving instrument approaches, standard departure (SID) routes, standard arrival (STAR) routes, and ATS routes in oceanic and continental areas.

4.14 The Regional PBN Plan was developed by the APAC States together with the international organizations concerned (including IATA and IFALPA)~~,~~ and is intended to assist the main stakeholders of the aviation community plan a gradual transition to the RNAV and RNP concepts. The main stakeholders of the aviation community that benefit from this Regional Plan are:

- Airspace operators and users.
- Air navigation service providers.
- Regulating agencies.
- International organizations.

4.15 The Regional PBN Plan is intended to assist the main stakeholders of the aviation community plan the future transition and their investment strategies. For example, airlines and operators can use this Plan to derive future equipage and additional navigation capability investments; air navigation service providers can plan a gradual transition for the evolving ground infrastructure. Regulating agencies will be able to anticipate and plan for the criteria that will be needed in the future.

4.16 Recognizing the safety benefits of PBN, the thirty-sixth session of the ICAO Assembly held in Montreal, September 2007 adopted a Resolution to resolve that States and PIRGs prepare ~~a~~ PBN implementation plans by 2009 to achieve:

a) Implementation of RNAV and RNP operations (where required) for en route and terminal areas according to established timelines and intermediate milestones; and

b) Implementation of APV (Baro-VNAV and/or augmented GNSS) for all instrument runway ends, either as the primary approach or as a back-up for precision approaches by 2016 with intermediate milestones as follows: 30 per cent by 2010, 70 per cent by 2014.

The ICAO Assembly also urges that States include in their PBN implementation plan provisions for implementation of APV to all runway ends serving aircraft with a maximum certificated take-off mass of 5700 kg or more, according to established timelines and intermediate milestones.

Planning Principles

4.17 Planning for the implementation of PBN in the APAC Region shall be based on the following principles:

a) Pre- and post-implementation safety assessments will be conducted in accordance with ICAO provisions to ensure the application and maintenance of the established target levels of safety.

b) Continued application of conventional air navigation procedures during the transition period, to guarantee the operations by users that are not RNAV and/or RNP equipped.

c) The first regional PBN implementation plan should address the short term (2008-2012) and medium term (2013-2016) and take into account long term global planning issues.

d) Target date for preparation of the first regional PBN implementation plan is APANPIRG/19 (September 2007).

5. PBN Operational Requirements & Implementation Strategy

5.1 Introduction of PBN should be consistent with the Global Air Navigation Plan. Moreover, PBN implementation shall be in full compliance with ICAO SARPs and PANS and support relevant ICAO Global Plan Initiatives.

5.2 The ICAO Council accepted the second amendment to the Global Air Navigation Plan for the CNS/ATM System in November 2006. The approved plan has been renamed as Global Air Navigation Plan (Doc 9750). The relevant Global Plan Initiatives including implementation of performance based navigation (PBN) and navigation system have been included in the Global Plan. 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.

5.3 The consolidated *Navigation Strategy for the Asia/Pacific Region was* reviewed and updated by the Thirteenth meeting of CNS/MET Sub Group of APANPIRG in July 2009. The updated strategy was reviewed and adopted by APANPIRG in its Twentieth meeting held in September 2009 under Conclusion 20/46.

Route Operations

5.4 As the routes structure and en-route operation are extensive and complicated in APAC - region, it is difficult to restructure and include the whole airspace in a single implementation plan for en-route operations.

5.5 Considering the traffic characteristics and CNS/ATM capability, en-route operations can be classified as Oceanic, Remote continental, and Continental en-route.

5.6 In principle, each classification of en-route operation (paragraph 5.5 above) should adopt, but not be limited to, a single RNAV or RNP navigation specification. This implementation strategy should be applied by implementing States in coordination with airspace users.

5.7 APANPIRG established the PBN Task Force to develop a PBN implementation plan for the Asia/Pacific Region and to address related regional PBN implementation issues. Accordingly, States are encouraged to work cooperatively bilaterally, multilaterally and with the PBN Task Force to ensure regional and sub-regional harmonization of en-route PBN implementation.

5.8 In areas where operational benefits can be achieved and appropriate CNS/ATM capability exists or can be provided for a more accurate navigation specification than that specified in this plan, States are encouraged to introduce the more accurate navigation specification on the basis of coordination with stakeholders and affected States.

5.9 Similarly, in circumstances where affected States are agreeable to completing an implementation in advance of the timelines specified in this plan, early implementation is encouraged on the basis of coordination between affected States and airspace users.

TMA Operations

5.10 TMA operations have their own characteristics, taking into account the applicable separation minima between aircraft and between aircraft and obstacles. TMA operations also involve–the diversity of aircraft, including low-performance aircraft flying in the lower airspace and conducting arrival and departure procedures on the same path or close to the paths of high-performance aircraft.

5.11 In this sense and as called for under APANPIRG Conclusion 18/53, States shall develop their own national plans for the implementation of PBN in sovereign TMAs. Such national plans should be based on the Asia/Pacific Regional PBN Implementation Plan, seek the harmonization of the application of PBN and avoid the need for multiple operational approvals for intra- and inter-regional operations. Applicable aircraft separation criteria should also be considered.

Instrument Approaches

5.12 States are encouraged to introduce PBN approaches that provide Vertical Guidance to enhance safety. Conventional approach procedures and conventional navigation aids should be maintained to support non-equipped aircraft during the transitional period.

5.13 During early implementation of PBN, IFR Approaches based on PBN should be designed to accommodate a mixed-equipage (PBN and non-PBN) environment. ATC workload should be taken into account while developing approach procedures. One possible way to accomplish this is to co-locate the Initial Approach Waypoint for both PBN and conventional approaches

6. Current Status & Forecast

APAC traffic forecast

6.1 Traffic forecasts have a special role to play in the planning and implementation processes; they represent the demand for future ATM. Global Air Navigation Plan (Doc 9750) requires that the Planning and Implementation Regional Groups (PIRGs) base their work on well developed traffic density forecasts. Guidance on the preparation of traffic forecasts is provided in *Manual on Air Traffic Forecasting* (Doc 8991). At the Asia/Pacific regional level, the traffic forecasting activities were started with the formation of ICAO Pacific Area Traffic Forecasting Group formed in 1991. The scope of the group was subsequently broadened to include Intra-Asia/Pacific traffic also and the group was renamed as Asia/Pacific Area Traffic Forecasting Group (APA TFG).

6.2 Report of the Fourteenth meeting of Asia/Pacific Area Traffic Forecasting Group (APA TFG/14) has been published as Doc 9915. Report includes medium term forecasts of air traffic in the Transpacific area and for selected Transpacific and Asia/Pacific city pair markets through 2012. Report also contains a long term forecast with a horizon to the year 2025 and the short term forecast for the period 2008 – 2010 and intermediate forecasts for each of the years 2015 and 2020. Forecasts are provided for total passenger traffic and aircraft movements and in the case of the aggregate transpacific market also for peak hour movements on selected groups for the year 2012.

6.3 The February 2008 forecast prepared by IATA–for APAC traffic in respect of passenger, cargo, aircraft movements and new aircraft deliveries in the Regions is also provided in the Appendix B to this plan as reference.

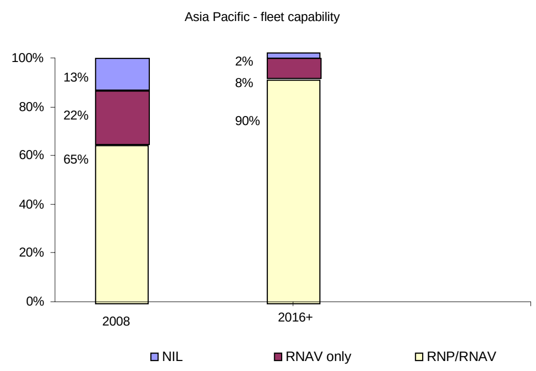
Aircraft fleet readiness status

6.4 2007 was a record year for Asia/Pacific airlines with 418 new aircraft deliveries and more than 1,000 new orders. The overall number of deliveries to Asia/Pacific based airlines in 2008 is expected to total 430 aircraft.

6.5 All major commercial aircraft manufacturers since the 1980's have included RNAV capabilities. The commercial aircraft currently produced incorporate an RNP capability.

6.6 One significant issue for PBN implementation today is directly related to the multitude of FMS installations and varying degrees of capabilities associated with the current fleet of RNAV aircraft. Specifically, there are numerous FMS systems installed in today's fleets, all with varying capabilities.

6.7 The diagram below displays a high level analysis based on fleet numbers from Ascend Online Fleets database March 2008 and RNAV/RNP classification by IATA.



CNS Infrastructure

Navigation infrastructure

Global Navigation Satellite System (GNSS)

6.8 Global Navigation Satellite System (GNSS) is a satellite-based navigation system utilizing satellite signals, such as Global Positioning System (GPS), for providing accurate and reliable position, navigation, and time services to airspace users. In 1996, the International Civil Aviation Organization (ICAO) endorsed the development and use of GNSS as a primary source of future navigation for civil aviation. ICAO noted the increased flight safety, route flexibility and operational efficiencies that could be realized from the move to space-based navigation.

6.9 GNSS supports both RNAV and RNP operations. Through the use of appropriate GNSS augmentations, GNSS navigation provides sufficient accuracy, integrity, availability and continuity to support en-route, terminal area, and approach operations. Approval of RNP operations with appropriate certified avionics provides on-board performance monitoring and alerting capability enhancing the integrity of aircraft navigation.

6.10 GNSS augmentations include Aircraft-Based Augmentation System (ABAS), Satellite-Based Augmentation System (SBAS), Ground-Based Augmentation System (GBAS), and Ground-based Regional Augmentation System (GRAS).

Other PBN navigation infrastructure

6.11 Other navigation infrastructure includes INS, VOR/DME, DME/DME, and DME/DME/IRU. These navigation infrastructures may satisfy the requirements of RNAV navigation specifications, but not those of RNP.

6.12 INS may be used to support PBN en-route operations with RNAV 10 and RNAV 5 navigation specifications.

6.13 VOR/DME may be used to support PBN en-route and STAR operations based on the RNAV 5 navigation specification.

6.14 Uses of DME/DME and DME/DME/IRU may support PBN en-route and terminal area operations based on RNAV 5, RNAV 2 or RNAV 1 navigation specifications. Validation of DME/DME coverage area and appropriate DME/DME geometry should be conducted to identify possible DME/DME gaps, including identification of critical DMEs, and to ensure proper DME/DME service coverage.

Surveillance infrastructure

6.15 For RNAV operations, States should ensure that sufficient surveillance coverage is provided to assure the safety of the operations. For RNP operations, surveillance coverage may not be required. Details on the surveillance requirements for PBN implementation can be found in the ICAO PBN Manual and ICAO PANS-ATM (Doc 4444), and information on the current existing surveillance infrastructure in APAC can be found in ICAO FASID tables.

Communication infrastructure

6.16 Implementation of RNAV/RNP routes includes communication requirements. Details on the communication requirements for PBN implementation can be found in ICAO PANS-ATM (Doc 4444), ICAO RCP Manual (Doc 9869), and ICAO Annex 10. Information on the current existing communication infrastructure in APAC can also be found in ICAO FASID tables.

7. Implementation Plan for Performance Based Navigation

ATM Operational Requirements

7.1 The Global ATM Operational Concept (Doc 9854) makes it necessary to adopt an airspace concept able to provide an operational scenario that includes route networks, minimum separation standards, assessment of obstacle clearance, and a CNS infrastructure that satisfies specific strategic objectives, including safety, access, capacity, efficiency, and environment.

7.2 In this regard, the following programmes will be developed:

a) traffic and cost benefit analyses
b) necessary updates on automation
c) operational simulations in different scenarios
d) ATC personnel training
e) Flight plan processing
f) Flight procedure design training to include PBN concepts and ARINC-424 coding standard
g) Enhanced electronic data and processes to ensure appropriate level of AIS data accuracy, integrity and timeliness
h) WGS-84 implementation in accordance with ICAO Annex 15
i) iuniform classification of adjacent and regional airspaces, where practicable
j) RNAV/RNP applications for SIDs and STARs
k) Coordinated RNAV/RNP routes implementation
l) RNP approach with vertical guidance

Short Term Implementation Plan

Route Operations

7.3 During the planning phase of any implementation of PBN routes, States should gather inputs from all aviation stakeholders to obtain operational needs and requirements. These needs and requirements should then be used to derive airspace concepts and to select appropriate PBN navigation specification.

7.4 In this phase, the application of RNAV 10 and RNP 4 navigation specifications is expected for Oceanic and Remote continental routes. Prior to implementation of RNP 4, States should consider air traffic demands, ATC workload, surveillance and communication capabilities and fleet readiness statistics, and consult all stakeholders.

7.5 For Continental routes, the application of RNAV 5 and RNAV 2 navigation specifications is expected. In the continental en-route areas of operation, States may choose to implement RNAV 2 routes to enhance efficiency of airspace usage and support closer route spacing, noting that appropriate communication and surveillance coverage must be provided. The RNAV 2 navigation specification can also be used in airspace~~,~~ where sufficient CNS capability is provided and there are operational benefits.

TMA Operations

7.6 In selected TMAs, the application of RNAV 1 in a radar environment can be supported though the use of GNSS or ground navigation infrastructure, such as DME/DME and DME/DME/IRU. In this phase, mixed operations (equipped and non-equipped) will be permitted.

7.7 In a non-radar environment and/or in an environment without adequate ground navigation infrastructure, the SID/STAR application of Basic-RNP1 is expected in selected TMAs with exclusive application of GNSS. In this phase, mixed operations (equipped and non-equipped) will be permitted.

Instrument Approaches

7.8 The application of RNP APCH with Baro-VNAV procedures is expected to be implemented in the maximum possible number of airports, commencing primarily with international airports. To facilitate transitional period, conventional approach procedures and conventional navigation aids should be maintained for non-equipped aircraft.

7.9 States should promote the use of APV operations (Baro-VNAV or augmented GNSS) to enhance safety and accessibility of RNP approaches.

7.10 The application of RNP AR APCH procedures should be considered in selected airports, where obvious operational benefits can be obtained due to the existence of significant obstacles.

Summary table & Implementation targets

<table>
<tr><th colspan="3">Short Term (2008-2012)*</th></tr>
<tr><th>Airspace</th><th>Preferred Nav. Specifications</th><th>Acceptable Nav. Specifications</th></tr>
<tr><td>Route – Oceanic</td><td>RNP 4</td><td>RNAV 10</td></tr>
<tr><td>Route – Remote continental</td><td>RNP 4</td><td>RNAV 10</td></tr>
<tr><td>Route – Continental en-route</td><td colspan="2">RNAV 2, RNAV 5</td></tr>
<tr><td>TMA – Arrival</td><td>RNAV 1 in radar environment and with adequate navigation infrastructure.

Basic-RNP 1 in non-radar environment</td><td></td></tr>
<tr><td>TMA – Departure</td><td>RNAV 1 in radar environment and with adequate navigation infrastructure.

Basic-RNP 1 in non-radar environment</td><td></td></tr>
<tr><td>Approach</td><td>RNP APCH with Baro-VNAV in most possible airports

RNP AR APCH in airport where there are obvious operational benefits.</td><td></td></tr>
<tr><td colspan="3">Implementation Targets
RNP APCH (with Baro-VNAV) in 30% of instrument runways by 2010 and 50% by 2012 and priority should be given to airports with operational benefits
RNAV 1 SID/STAR for 50% of international airports by 2010 and 75% by 2012 and priority should be given to airports with RNP Approach
Re-defining existing RNAV/RNP routes into PBN navigation specification by 2012
Implementation of additional RNAV/RNP routes</td></tr>
</table>

*** Note:** Early completion of an implementation is encouraged within the timeframe on the basis of coordination between affected States and airspace users.

Medium Term Implementation Plan

Route Operations

7.11 Noting the current development of route spacing standards for RNAV 1, RNAV 2, RNP 2, in this phase, it is expected that the implementations of all existing RNAV/RNP routes are consistent with PBN standards. States are encouraged~~,~~ to harmonize their RNAV/RNP routes based on consistent PBN navigation specifications and separation standards. Implementations of additional RNAV/RNP routes are also encouraged.

7.12 With the utilization of ADS and CPDLC, the application of RNP routes in the Oceanic and Remote continental airspace in the APAC Region is expected. This will permit the use of smaller lateral and longitudinal separation, such as 30 NM based on the RNP 4 navigation specification. States should also consider the fleet readiness status during their planning.

7.13 Noting the current development of RNP 2 navigation specification, in this phase, the application of RNP 2 is expected for the continental en-route airspace with high air traffic density. Depending on the sufficiency of DME/DME coverage or GNSS availability, States may consider the use of RNAV 2 navigation specification.

7.14 In this phase, the establishment of a backup system in case of GNSS failure or the development of contingency procedures will be necessary.

TMA Operations

7.15 Noting the current development of Advanced RNP 1 navigation specification, in this phase, it is expected that the application of RNAV 1 or RNP 1 will be expanded in selected TMAs. The application of RNAV 1/RNP 1 will also depend on DME/DME infrastructure, GNSS availability and aircraft navigation capability. In TMAs of high air traffic complexity and movement, the use of RNAV 1 or RNP 1 equipments will be mandatory. In TMAs of less air traffic complexity, mixed operations will be permitted (equipped or non-equipped).

Instrument Approaches

7.16 In this phase, the extended application of RNP APCH with Baro-VNAV or APV in most airports is expected. These applications may also serve as a back-up to precision approaches and provide vertical guided approaches for the runways without precision approach capability.

7.17 The extended application of RNP AR Approaches is expected for airports where there are operational benefits.

7.18 The introduction of application of landing capability using GNSS and its augmentations is expected to guarantee a smooth transition toward high-performance approach and landing capability.

Summary table & Implementation targets

Medium Term (2013-2016)*		
Airspace	**Preferred Nav. Specification**	**Acceptable Nav. Specification**
Route – Oceanic	RNP 2**, RNP 4	RNAV 10
Route – Remote continental	RNP 2	RNAV 2, RNP 4, RNAV 10
Route – Continental en-route	RNAV 1, RNP 2	RNAV 2, RNAV 5
TMA – Arrival	Expand RNAV 1 or RNP 1 application Mandate RNAV 1 or RNP 1 approval for aircraft operating in higher air traffic density TMAs	
TMA – Departure	Expand RNAV 1 or RNP 1 application Mandate RNAV 1 or RNP 1 approval for aircraft operating in higher air traffic density TMAs	
Approach	Expansion of RNP APCH (with Baro-VNAV) and APV Expansion of RNP AR APCH where there are operational benefits Introduction of landing capability using GNSS and its augmentations	
Implementation Targets • RNP APCH with Baro-VNAV or APV in 100% of instrument runways by 2016 • RNAV 1 or RNP 1 SID/STAR for 100% of international airports by 2016 • RNAV 1 or RNP 1 SID/STAR for 70% of busy domestic airports where there are operational benefits • Implementation of additional RNAV/RNP routes		

* **Note 1:** In circumstances where affected States are agreeable to completing an implementation in advance of the timeline, early implementation is encouraged on the basis of coordination between affected States and airspace users.

** **Note 2:** Related CNS requirements and operational procedures for RNP 2 application in Oceanic Airspace are yet to be determined.

*** **Note 3:** When establishing the implementation targets in accordance with Assembly Resolution A36/23, the States should first conduct an analysis of the instrument RWY eligibility for APV approach. This analysis should include the feasibility of the APV at a particular location, the presence of regular commercial operations and the current or projected user fleet capability for APV. Locations where APV approach is either not feasible or where the regular operators cannot realize the benefit of APV within the set implementation timeline, need not be included. Where APV is not implemented, States should consider implementation of RNP APCH with LNAV minima instead of APV to provide the safety benefits of straight-in approach procedures.

Long Term Implementation Strategies (2016 and beyond)

7.19 In this phase, GNSS is expected to be a primary navigation infrastructure for PBN implementation. States should work co-operatively on a multinational basis to implement GNSS in order to facilitate seamless and inter-operable systems and undertake coordinated research and development programmes on GNSS implementation and operation.

7.20 Moreover, during this phase, States are encouraged to consider segregating traffic according to navigation capability and granting preferred routes to aircraft with better navigation performance.

7.21 With the expectation that precision approach capability using GNSS and its augmentation systems will become available, States are encouraged to explore the use of such capability where there are operational and financial benefits.

8. Transitional Strategies

8.1 During transition to PBN, sufficient ground infrastructure for conventional navigation systems must remain available to serve non-equipped flights. Before existing ground infrastructure is considered for removal, users should be given reasonable transition time to allow them to equip appropriately to attain equivalent PBN-based navigation performance. States should approach removal of existing ground infrastructure with caution to ensure that safety is not compromised. Performance of safety assessments and consultation with users through regional air navigation planning processes will be necessary.

8.2 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 towards PBN.

8.3 States should cooperate on a multinational basis to implement PBN in order to facilitate seamless and inter-operable systems and undertake coordinated research and development programmes on PBN implementation and operation.

8.4 States are encouraged to consider segregating traffic according to navigation capability and granting preferred routes to aircraft with better navigation performance**,** taking due consideration of the needs of State aircraft.

8.5 States should encourage operators and other airspace users to equip with PBN-capable avionics. This can be achieved through early introductions of RNP approaches, preferably those with vertical guidance.

8.6 ICAO Asia-Pacific Regional Office should provide leadership supporting implementation and transition towards PBN.

9. Safety Assessment & Monitoring Requirements

Need for a safety assessment

9.1 To ensure that the introduction of PBN applications within the Asia/Pacific Region is undertaken in a safe manner, in accordance with relevant ICAO provisions implementation shall only take place following conduct of a safety assessment by the implementing State or group of States that demonstrates that an acceptable level of safety will be met. This assessment may also need to demonstrate that residual levels of risk associated with specific PBN implementations are acceptable. Additionally, after implementation ongoing periodic safety reviews shall be undertaken by the implementing State or group of States, where required, in order to establish that operations continue to meet acceptable levels of safety.

En-route safety assessment and monitoring

9.2 When considering en-route PBN implementations, the ICAO *Procedures for Air Navigation Services – Air Traffic Management* (PANS-ATM, Doc 4444, Chapter 5, Section 5.4) contains procedures and RNAV procedural separation minima for use in the separation of aircraft in the en-route phase. In some cases, these separation minima require specific RNP capabilities and are based on collision risk modelling which determines communications and surveillance requirements. However, this modelling does not include all operational and technical aspects and is dependent upon parameter values that may vary depending on the particular airspace where the separation minimum will be applied. Therefore, prior to implementation, a system verification of sufficient duration and integrity must be performed to assess such parameters and conditions including weather deviations or other contingency events for the airspace concerned and to demonstrate that operational and technical requirements will be met.

9.3 APANPIRG has established the Regional Airspace Safety Monitoring Advisory Group (RASMAG) to facilitate the airspace safety monitoring aspects for implementations of reduced separation minima and CNS/ATM applications within the Asia and Pacific Regions. RASMAG has adopted the term En-route Monitoring Agency (EMA) to describe an organization providing airspace safety assessment, monitoring and implementation services for international airspace in the Asia/Pacific region to assist the implementation and operation of reduced horizontal (lateral and longitudinal) separation minima. To ensure regional harmonization of en-route safety assessment requirements and methodologies, implementing States are encouraged to work cooperatively with RASMAG who will provide guidance and technical assistance to States to support their en-route PBN implementations.

Undertaking a safety assessment

9.4 The implementing State or group of States shall ensure that a safety assessment and, where required, ongoing monitoring of PBN implementations are conducted. The implementing State or group of States may have the capability to undertake such activities or, in the case of en-route implementations, may seek assistance from an En-route Monitoring Agency. The latter course of action is preferred as an EMA can establish the necessary monitoring and data collection activity in an effective manner for the international airspaces in which the EMA holds responsibility.

9.5 In undertaking a safety assessment to enable en-route implementation of PBN, a State authority or EMA shall:

1) Establish and maintain a database of PBN approvals;
2) Pre-implementation - conduct safety and readiness assessments and, for international implementations, report results to RASMAG;
3) Post-implementation - maintain awareness of data link performance and monitor aircraft horizontal-plane navigation performance and the occurrence of large navigation errors (lateral and longitudinal), implement remedial actions as necessary and, for international implementations, report results to RASMAG;
4) Monitor operator compliance with State approval requirements after PBN implementation;
5) Initiate necessary remedial actions in any instances where PBN requirements are not met.

9.6 Detailed information relating to the international airspace jurisdiction, roles and responsibilities of regional EMAs is contained in the *Asia/Pacific En-route Monitoring Agency Handbook*, which is available from the ICAO Asia/Pacific Regional Office.

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Appendix A – CHANGES TO THE ASIA/PACIFIC REGIONAL PBN IMPLEMENTATION PLAN

Whenever a need is identified for a change to this document, the Request for Change (RFC) Form (see below) should be completed and submitted to the ICAO Asia and Pacific Regional Office. The Regional Office will collate RFCs for consideration by the Performance Based Navigation Task Force (CNS/MET Sub-group of APANPIRG).

When an amendment has been agreed by a meeting of the Performance Based Navigation Task Force then a new version of the PBN Regional Plan will be prepared, with the changes marked by an "|" in the margin, and an endnote indicating the relevant RFC, so a reader can see the origin of the change. If the change is in a table cell, the outside edges of the table will be highlighted; e.g.:

Final approval for publication of an amendment to the PBN Regional Plan will be the responsibility of APANPIRG.

PBN Regional Plan REQUEST FOR CHANGE FORM

RFC Nr:	

Please use this form when requesting a change to any part of this PBN Regional Plan. This form may be photocopied as required, emailed, faxed or e-mailed to ICAO Asia and Pacific Regional Office +66 (2) 537-8199 or icao_apac@bangkok.icao.int

1. SUBJECT:			
2. REASON FOR CHANGE:			
3. DESCRIPTION OF PROPOSAL: [expand / attach additional pages if necessary]			
4. REFERENCE(S):			
5. PERSON INITIATING:		**DATE:**	
ORGANISATION:			
TEL/FA/X/E-MAIL:			

6. CONSULTATION		**RESPONSE DUE BY DATE:**		
	Organization	**Name**	**Agree/Disagree**	**Date**
7. ACTION REQUIRE :				
8. PBN REGIONAL PLAN EDITOR			**DATE REC'D :**	
9. FEEDBACK PASSED			**DATE :**	

AMENDMENT RECORD

Amendment Number	Date	Amended by	Comments

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Appendix B – IATA Traffic Forecast

"By 2010 Asia will be the largest single market for aviation" - IATA 27th Feb 2008. Globally predicted passenger traffic will rise by 4.9 per cent per year between 2007 and 2026, almost trebling in two decades as jet planes got bigger and more people flew on them. Meanwhile airfreight will rise by 5.8 per cent annually in the same period.The greatest demand will come from the Asia-Pacific region, where airlines will take delivery of 31 per cent of new planes in the next 20 years, compared with 24 per cent for Europe and 27 per cent for North America.

Passenger
Asia Pacific airlines saw a marginal drop in demand growth from 6.2 per cent in December 2007 to 5.7 per cent in January 2008. Currently, airlines in the region benefited from increased competitiveness due to the strong Euro and the booming economies of both India and China.

Cargo
Steady year-on-year airfreight growth of 4.5 per cent was recorded in January 2008. In the larger freight markets there is continued strength. Asia Pacific airlines saw demand increase 6.5 per cent, up from 6 per cent in December 2007, boosted by the booming economies in China and India.

For the period 2002-2020 aircraft movements are expected to increase at an annual growth rate of 5.4 per cent, to reach almost 294 thousand aircraft movements by the year 2020. Average annual growth rates of 6.5, 5.7 and 5.2 per cent are forecast for the periods 2005 - 2010, 2010-2015 and 2015 - 2020, respectively.

TRANSPACIFIC PASSENGER FORECAST			
Average Annual Percentage Growth Rates			
	Low	Medium	High
2005-2010	5.3	6.5	7.8
2010-2015	4.5	5.7	7.0
2015-2020	4.0	5.2	6.5
2002-2020	4.1	5.4	6.7

The Intra-Asia/Pacific passenger aircraft movements are expected to increase at an average annual growth rate of 4.6 per cent to the year 2020. The growth rates for the intermediate periods of 2005-2010, 2010- 2015 and 2015-2020 are 5.0, 4.3 and 4.2 per cent, respectively.

INTRA ASIA /PACIFIC AIRCRAFT MOVEMENT FORECAST			
Average Annual Percentage Growth Rates			
	Low	Medium	High
2005-2010	3.6	5.0	5.5
2010-2015	3.1	4.3	5.2
2015-2020	3.1	4.2	5.2
2002-2020	3.3	4.6	5.6

New Aircraft Deliveries by Region

Record new aircraft orders were placed by the airline industry in 2005 – 2007. The large numbers of new orders represent strong confidence in the future prospects of the global airline industry. In its latest forecast of aviation growth, European aircraft maker Airbus said the world's fleet of large passenger jets (of more than 100 seats) would double in the next 20 years to nearly 33,000. The greatest demand will come from the Asia-Pacific region, where airlines will take delivery of 31 per cent of new planes in the next 20 years, compared with 24 per cent for Europe and 27 per cent for North America.

New Aircraft Deliveries by Region	2006	2007	2008	2009	2010	2011	2012+
	Existing						
Africa	665	26	15	20	16	13	28
Asia Pacific	3,578	329	428	407	344	267	440
Europe	5,301	292	348	364	251	153	297
Latin America/Caribbean	1,031	93	91	45	66	43	65
Middle East	626	41	57	44	36	27	164
North America	6,987	240	293	309	222	163	412
Total	18,188	1,026	1,237	1,208	944	679	1,551
Increase in Global aircraft fleet (%)	4.2	4.9	4.6	4.9	3.4	2.4	2.4

Appendix C - Reference documentation for developing operational and airworthiness approval

General Guidelines for Obtaining Airworthiness and Operational Approvals for PBN Navigation Specifications, Version 1.0, **International Air Transport Association**,
August 2008. (URL -
http://www2.icao.int/en/pbn/ICAO%20Documentation/State%20and%20International%20Organization%20Publications/IATA%20Guidelines%20for%20PBN%20Operational%20Approval.pdf**)**

States should consider using the COSCAP Operational Approval Handbook [insert link to Internet copy] as a reference until ICAO Operational Approval guidance material is published.

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Appendix D – Practical Example of tangible benefits

Practical examples of tangible benefits derived from the implementation of PBN are:

- Increased airspace safety through the implementation of continuous and stabilized descent procedures using vertical guidance;
- Provision of runway-aligned final approach path which may not be possible from conventional navigation
- Reduced aircraft flight time due to the implementation of optimal flight paths, with the resulting savings in fuel, noise reduction, and enhanced environmental protection;
- Improved airport and airspace arrival paths in all weather conditions, and the possibility of meeting critical obstacle clearance and environmental requirements through the application of optimized RNAV or RNP paths;
- Implementation of more precise approach, departure, and arrival paths that will reduce dispersion and will foster smoother traffic flows;
- Reduced delays in high-density airspaces and airports through the implementation of additional parallel routes and additional arrival and departure points in terminal areas;
- Reduction of lateral and longitudinal separation between aircraft to accommodate more traffic;
- Decrease ATC and pilot workload by utilizing RNAV/RNP procedures and airborne capability and reduce the needs for ATC-Pilot communications and radar vectoring;
- Increase of predictability of the flight path.
- Reduction of maintenance and flight inspection costs associated with conventional navigation aids

Insert here real examples of specific measurable benefits resulting from States PBN implementation (Australia, India, Maldives and Thailand volunteered to provide this information by 1 August 2011 prior to APANPIRG/22)

Appendix E: Basic Planning Elements (BPEs) Table

Basic Plan Elements	Regional Plan References
1. Policy and Implementation Planning Formation of a key working group Standards & Requirements in accordance with ICAO Communication with stakeholders	4.0
2. Assessment of CNS infrastructure	6.11-6.16
3. Assessment for PBN fleet readiness Based on actual operator traffic	6.4-6.7
4. Selection of appropriate PBN navigation specification	7.3-7.18
5. Strategies for en-route implementation Key traffic flows and city pairs identified Domestic International Harmonization in en-route, across FIRs	5.4-5.9
6. Strategies for terminal area implementation, including timeline Specify terminal areas selected for implementation by 2010	5.10- 5.11
7. Strategies for Instrument approach implementation, including timeline Specify procedures selected for implementation by 2010 APV (Baron-VNAV and/or augmented GNSS) Designate RNP APRCH (LNAV or LNAV/VNAV) Designate RNP AR APCH (with operational justification)	4.16(b) / 5.12-5.13 / 7.8-7.10 / 7.16- 7.18
8. Transition strategy Include decommissioning plan	4.17(b) / 8.0
9. Safety Assessment Pre- and post- implementation safety assessments conducted in accordance with ICAO provisions Seek guidance and technical assistance from RASMAG Periodic safety reviews undertaken by the State or group of States where required	4.17(a) / 9.0
10. Description of the tangible benefits Benefits to operations derived from PBN implementation	4.10 / Appendix D
11. Regulatory Framework and Process for Operational Approval	Appendix C

REVISED NAVIGATION STRATEGY FOR THE ASIA/PACIFIC REGION

Considering:

a) the material contained in the Performance Based Navigation Manual (Doc 9613) for enroute, approach, landing and departures operations;

b) operators ~~will~~are equipped ~~aircraft~~ to support PBN operations;

c) GNSS ~~will be~~ is the ~~predominant~~ navigation sensor for RNP;

d) APV operations may be conducted with either BARO-VNAV or augmented GNSS;

e) Augmented GNSS ~~will~~ to support Category I operations by end ~~2009~~ 2012 and Category II and III operations by 2015;

f) in the Asia/Pacific Region, ILS is capable of meeting the majority of requirements for precision approach and landing;

g) MLS CAT III is operational;

h) 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.

Strategy

a) transit to PBN operations as follows :-

i) RNP10/RNP4/RNP2 for Oceanic and Remote Continental routes;
ii) RNAV5/RNAV2/RNP2/RNP0.3 for Continental En-route;
iii) RNAV1, RNAV2 and ~~Basic~~ RNP1 based arrivals and departure;
iv) APV **;
v) Precision approaches at selected runways.

with respective end states as follows:
vi) RNP4/RNP2 for Oceanic and Remote Continental routes;
vii) RNP1/RNP2/RNP0.3 for Continental En-route;
viii) RNP1 and RNP0.3 based arrivals and departure;
ix) APV**;
x) Precision approaches at selected runways.

Note: Ideally, end-state should follow the above process but may be achieved directly without transitting through the immediate phases (i.e. (i) to (v)), if considered safe to do so.

b) retain ILS as an ICAO standard system for as long as it is operationally acceptable & economically beneficial;

c) implement GNSS with augmentation as required for APV and precision approach operations where operationally required and economically beneficial;

d) implement the use of APV operation in accordance with ICAO's requirement;

e) protect all the Aeronautical Radio Navigation Service (ARNS) frequencies; and

f) ensure civil-military interoperability.

** APV includes BARO-VNAV, RNP, RNP-AR, APV(SBAS) ~~1 & 2~~

UPDATED ADS-B SUBJECT/TASKS LIST

Serial No.	His No.	Subject/Tasks List	Associated with Strategic Objective	Associated GPI	Deliverables	Target Date	Status and Action to be taken and led by
1	3	Each member 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	4/2011	Closed
2	14	Guidance material on how to build safety case for delivery of separation services.	A.Safety	GPI01/05/06/09/14/16/17/21/22	Guidance material for implementation	Apr-11	Completed
3	17	Guidance on legal liability issues for ADS-B data sharing.	A.Safety	GPI01/05/06/09/14/16/17/21/22	Guidance material for implementation	Aug-12	U.S.A.
4	18	Develop and implement regional collaboration project for ADS-B Out operational use including data sharing in SEA and report on implementation progress.	D. Efficiency	GPI01/05/06/09/14/16/17/21/22	Sub-regional ADS-B collaboration project has been developed.	Jul-08/ Apr-11	SEA WG - On going
5	19	Develop and implement regional collaboration project for ADS-B out operational use including data sharing in South Pacific and report on implementation progress.	D. Efficiency	GPI01/05/06/09/14/16/17/21/22	Develop and implement sub-regional ADS-B collaboration project.	Apr-09/ Dec-11	South Pacific States On-going
6	21	Study application of ADS-B and multilat for precision runway monitoring.	D. Efficiency	GPI01/05/06/09/14/16/17/21/22	Guidance material for implementation	Apr-11	All Members On-going
7	22	Perform data collection and data analysis of ADS-B messages to examine GPS performance in different geographic areas.	D. Efficiency	GPI01/05/06/09/14/16/17/21/22	Report of data collected and analyzed - continuous	Apr-11	All Members On-going
8	23	Develop and implement regional collaboration project for ADS-B out operational use including data sharing in Bay of Bengal area and report on implementation progress.	D. Efficiency	GPI01/05/06/09/14/16/17/21/22	Develop and implement sub-regional ADS-B collaboration project.	Apr-09/ Dec-11	Bay of Bengal States

Serial No.	His No.	Subject/Tasks List	Associated with Strategic Objective	Associated GPI	Deliverables	Target Date	Status and Action to be taken and led by
9	25	Provide feedback to the proposed amendment and template for data sharing based on experience gained by Indonesia and Singapore.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Comments	April-2011	Completed
10	26	Prepare a paper on the experience of using the ADS-B data sharing template and make any recommendations for change of the data sharing template.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Comments	April-2011	Completed Singapore & Indonesia
11	27	Clarify relation between DO260B and 3NM separation in TMA.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Prepare a WP	April-2011	Completed
12	28	Renaming SEA ADS/B WG and relation between WG and TF.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Comments	April-2011	All Members Completed
13	29	Review the forward fit requirement for SA Aware compliance by June 2012.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	To develop a strategy to resolve this issue	April-2011	IATA & Australia
14	30	To exam existing air-ground communication and surveillance capability in the boarder area between China and Myanmar and identify the need and possibility for sharing ADS-B data from potential ADS-B ground station at Lashio.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Report status and position	April-2011	China & Myanmar On-going
15	31	To exam possibility of sharing ADS-B data from potential ADS-B ground station from Coo Co and Pathein.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Report status and possibility	April-2011	Myanmar & India
16	32	ATS operational letter of agreements between neighboring FIRs among South China Sea States for radar-like surveillance service	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Report progress	April-12	China, Hong Kong China, Viet Nam and Singapore

Serial No.	His No.	Subject/Tasks List	Associated with Strategic Objective	Associated GPI	Deliverables	Target Date	Status and Action to be taken and led by
17	33	Review of FPL Amendment to update AIGD and its effective date.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Update the AIGD	April-2012	Australia and Secretariat
18	34	Identify new data sharing projects in the eastern part of South China Sea.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Prepare a working paper	April-2011	Singapore
19	35	Identify new data sharing projects in Bay of Bengal.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Prepare a working paper	April-2011	Australia On-going
20	36	States to advise when their ground stations can be upgraded to receive ADS-B DO260B compliant ADS-B data.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22		April/May12	All Members
21	37	Guidance material addresig military concerns regarding sharing ADS-B data	A. Safety	GPI01/05/06/09/ 14/16/17/21/22	Prepare a working paper	April-12	Australia
22	38	Bring attention of States concerned to the risk that ADS-B data without integrity (such as NUC=0) should not be used to support procedural control	A. Safety	GPI01/05/06/09/ 14/16/17/21/22	Letter to States	October-11	Regional Office
23	39	Comparing the changes brought by DO260B and identifying any potential impacts on ATC systsms.	A. Safety	GPI01/05/06/09/ 14/16/17/21/22	Prepare a working paper	April-12	Hong Kong China & Singapore

INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE

DRAFT

GUIDANCE MATERIAL ON

BUILDING A SAFETY CASE FOR

DELIVERY OF AN ADS-B SEPARATION SERVICE

Version 1.0

May 2011

CONTENTS

GUIDANCE MATERIAL ON BUILDING A SAFETY CASE FOR DELIVERY OF AN ADS-B SEPARATION SERVICE

REFERENCES

The guidance material herein uses information in the three reference documents below:

1. ICAO Doc 9859 AN/474 Safety Management Manual (SMM), Second Edition 2009 – in particular Chapter 4 'Hazards', and Chapter 5 'Safety Risks'

2. ICAO Circular 326 AN/188 'Assessment of ADS-B and Multilateration Surveillance to Support Air Traffic Services and Guidelines for Implementation'

3. RTCA DO-303/EUROCAE ED-126 December 13, 2006 'Safety, Performance and Interoperability Requirements Document for the Non-Radar Airspace Application'

Much of the information needed for the preparation of a Design Safety Case for an ADS-B surveillance service can be derived from the above reference documentation. The aspects that need to be separately covered by a proponent are those arising from any differences in the specific airspace for the surveillance system, and the system engineering of the surveillance services if they differ from the reference systems.

INTRODUCTION

Basic guidance on the building of a Safety Case for delivery of an ADS-B separation service is provided in this document. It relies on referencing existing guidance material in the publications listed above, as well as some existing Safety Cases covering early ADS-B services.

A number of discrete 'steps' in the building of a Safety Case are described to progress to a completed document.

The first steps cover the generic requirements for the preparation of a Safety Case for any airways system, including any surveillance systems used for separation by ATC. The primary reference is Chapters 4 and 5 of ICAO Doc 9859.

The remaining steps cover the elements of a Safety Case specific to a new ADS-B surveillance service. The basic references are ICAO Circular 326 and RTCA DO-303/Eurocae ED-126. These documents contain a significant amount of information on hazard identification and risk assessment of an ADS-B service (as well as a MULTILAT service.) The final steps are guidance to the actual content headings of a Safety Case for an ADS-B service.

Definitions

Accuracy: A measure of the difference between the aircraft position reported by the surveillance system, as compared to the true position

ALARP: As Low as Reasonably Practicable (in risk mitigation)

Availability The probability that a system will be able to perform its intended function when required for use.

Continuity The probability of a system to perform its required function without unscheduled interruption, assuming the system is available when the procedure is initiated (Circ 326)

Failure: Inability of the system to perform its intended service or function

Fault: Degradation in the performance of a system

Hazard: A condition or set of conditions of a system, or an object, with the potential to cause injury to personnel, damage to equipment or structures, loss of material, or reduction of ability to perform a prescribed function.

Hazard identification: The process of recognising that a hazard exists and defining its characteristics

Integrity: The ability of a system to provide timely warnings to users when the system should not be used for navigation (and, in the case of ADS-B for surveillance).

Maintainability: The ability of a system to be retained in, or restored to service

NRA: Non-Radar Airspace

Operational Requirement: The stated purpose of the (surveillance) system

Reliability: The probability that, during a certain period of time, a system performs its prescribed functions (usually expressed in MTBF)

Risk: The probability of occurrence, together with the severity of the consequence(s), of a hazardous event

Risk assessment: The process of determining the risk involved in the occurrence of a hazardous event, and the tolerability of that risk.

Risk management: The systematic application of management policies, procedures and practices to the tasks of identifying hazards and assessing and controlling risks.

Safety: The state in which the possibility of harm to persons or of property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and safety risk management. (Doc 9859)

Safety Case: A document which provides substantial evidence that the system to which it pertains meets its safety objectives

PART A: GENERIC GUIDANCE FOR SAFETY CASE PREPARATION

1 What is a Safety Case?

1.1 One of the primary purposes of a Safety Management System is to predict what accidents or incidents may occur, how they may happen, and how they may be prevented. The processes for safety assurance may differ in details; however they all prescribe the systematic undertaking of safety risk assessment and the presentation of evidence that the particular system is safe.

One way of presenting such evidence is by preparing a Safety Case. A Safety Case is an explicit documentation of a safety critical system, its corresponding safety objectives, and the associated safety risk assessment and risk management of the system, at appropriate milestones in the life of the system.

2 Generic contents of a Safety Case

2.1 A Safety Case is a documented record of the steps or processes undertaken by the system proponent to ensure that the system has been designed, tested and implemented as safely as reasonably practicable. Its basic component is a structured, comprehensive statement of the hazards and the corresponding safety risks of the occurrence of the hazards surrounding the provision of an operational service. This should include the significance of the hazards in terms of their likelihood of occurrence and potential effects on aviation safety, and the means whereby they are to be managed. The essential features of a Safety Case are that it should:

a) fully describe the surveillance system including the operational role and functions which it covers (i.e. the configuration and the boundaries of the system);
b) define or reference the performance standards and specifications of the system;
c) establish the safety objectives and the safety requirements for the system;
d) identify the hazards and the operational consequences of the hazards. Identification of hazards and consequences must ensure that all possible failure and fault modes have been identified under all normal and abnormal modes of operation;
e) assess the associated risks (in terms of frequency of occurrence and severity) of each identified operational consequence;
f) categorize each of the risks within a recognised risk tolerability classification scheme;
g) establish the controls necessary to ensure the risks are tolerable.

3 Safety planning

3.1 It is expected that safety will be built into any new surveillance system from its early inception and that the management of safety related activities will be undertaken in a planned manner over the lifecycle of the system.

3.2 The safety plan may be a discrete element of a project management plan, if applicable, or it may stand-alone. The Safety Plan is an important basic document that sets out the safety objectives and requirements and the actions and processes to be followed in the development of the system.

3.3 The safety plan should provide the basis for the development of the several parts of the Safety Case at defined milestones as the development, design and implementation of the surveillance system progresses to commissioning and normal day-to-day operation.

4 A Safety Case may have several discrete parts over the system lifecycle

4.1 ATC surveillance systems have a lifecycle consisting of several distinct phases. The safety hazards and associated risks may differ in type and degree in each phase, and their identification and control treatment will be more appropriately undertaken at a particular phase in the lifecycle. Accordingly, Safety Cases need to be developed to separately consider the safety situation in each of the lifecycle phases. This may require several parts of the Safety Case, with each part building on the previous part as the system is developed.

4.2 The distinct phases of a surveillance system's life which may be covered by a Safety Case, are normally:

a) **the operational requirements definition phase**, when the role and broad functionality of the new system is determined. This phase should identify the safety objectives of the system and its applicable system safety requirements, (these may be based on ICAO SARPS, the State's regulatory requirements, and the service provider's internal safety standards);
b) **the design and procurement phase**, when the system is designed and developed to meet the specified operational and/or engineering requirements. In this phase, the system configuration and operation is defined, incorporating the safety objectives and requirements within the evolving design. A full hazard and risk assessment is usually undertaken at this time;
c) **the implementation phase,** when the system is subject to procedural and/or engineering readiness testing against the design specifications, followed by operational trials, such as ghosting or mimicking. At this phase, the risk assessment is tested and validated by actual trials and testing of the installed system, and specific safety related operational, engineering and/or management procedures are developed to obviate or control the identified risks; and
d) **the routine operations phase,** when the safety of the system continues to be monitored and improved as any hazards are identified as they arise, and the risks are mitigated during actual operations.

4.3 The Safety Case should describe the historical and current safety status of the system or service as it develops throughout its entire lifecycle.

5 STEP 1 – State the purpose and scope of the safety case

5.1 The purpose and scope of the Safety Case should be clearly stated in its introductory paragraphs, and should include:

a) A statement of the purpose and role of the surveillance system under consideration, i.e. its Operational Requirement.

b) A description of the system and its location; its configuration including the sub-system elements; the system boundaries; the elements of the system which have been considered within the scope of the document, i.e., whether it covers equipment, procedures, airspace, personnel, etc.; and the interfaces with other external systems.

c) A statement of the assumptions upon which the Safety Case is based. This should include the defined or known levels of safety, or integrity, of each of the interfacing or support systems/services, and those other services externally provided by third parties, such as those provided by telecommunications service providers, electrical power service providers, etc.

5.2 The relevant lifecycle phase of the system, covered by the particular part/s of the Safety Case should also be defined.

6 STEP 2 – Develop and document the safety objectives and system safety requirements

6.1 The overall safety objectives and related system safety and safety related performance requirements supporting the objectives for the system should be defined as far as possible, particularly at the design stage. Safety objectives and system safety/performance can be derived by reference to the Operational Requirement and the type of service involved – for example an enroute surveillance service may have a lower level of criticality of availability and continuity than a terminal surveillance service. The safety requirements of a particular service may be established by assessing the effect of possible functional failure or fault modes as the source of safety hazards and the associated effect on the operation of the system.

6.2 The fault modes analysis should cover conceivable faults or eventualities affecting system performance including the possibility of human errors, common mode failures, simultaneous occurrences of more than one fault, and external eventualities which cause or result in the loss of, or affect the integrity of, external data, services, security, power supply, or environmental conditions.

6.3 The assessment of the safety objectives may then result in an iterative process of revision and further development of the system design, the adoption of modified operational procedures, or the establishment of contingency arrangements. For this reason, as far as possible the safety objectives should be expressed in a form that is clear and unambiguous so that they can be tested against, and the compliance of the system determined.

6.4 The selection of an appropriate way of expressing the safety objectives is important. Traditional measures include the specification of ***availability, continuity, accuracy, maintainability, recoverability,*** *etc.*, which have some interdependence. In the case of surveillance systems, specifying only availability, without also specifying a limit on the rate of occurrence of failures and faults, and the recoverability of the system following failure, could be insufficient to adequately define the safety requirements. For instance, a very infrequent occurrence of a fairly long down-time may be less hazardous than more frequent failures with shorter down-times, particularly for an ADS-B service in NRA where reversion to procedural separation is the contingency for system failure.

6.5 Quantitative statements of safety objectives and system performance requirements should be used where possible, however, in many areas (e.g.; where people and procedures are involved) it may not be feasible to define quantitative values. For these, qualitative values can be established. Where possible, these should be equated to or assigned corresponding quantitative values.

For a surveillance system, it is obviously important for safety that the voice or data communications service between pilot and ATC has a level of availability and continuity at least equalling same levels of performance as that assigned to the surveillance system itself. Obviously the two systems should be designed so that no single point of failure can result in both systems simultaneously failing at remote stations where single power source may only be available. Bearer links back to the ATC Centre will normally need to be duplicated on separate bearer circuits in order to achieve the reliability required for surveillance services.

6.6 In the development of the Australian ADS-B surveillance service in low density enroute airspace, the following basic safety and performance requirement for both the ADS-B service and the related voice communication service were established:

Table 1 – Basic Performance Parameters for ADS-B ground system (aircraft component not included)

SERVICE	SERVICE CATEGORY	GROUND SYSTEM OPERATIONAL AVAILABILITY	GROUND SYSTEM RELIABILITY per sector. MTBF (95%confidence level)
Enroute surveillance and voice comms (low density airspace)	Essential	.999	5000 hours

Source: Airservices Australia Ops Requirements Doc v2.0

7 STEP 3 – Develop a Safety Risk management methodology

7.1 An appropriate, recognised methodology for safety risk management, i.e. for hazard identification; risk assessment; risk management, control, and mitigation, of a surveillance system, is required. The methodology may vary depending upon the type and safety implications of the proposed surveillance system, and the use of different methods, or combinations thereof, may be appropriate for the different elements and lifecycle phases included in the safety case.

7.2 Chapters 3 and 4 of the ICAO SMM are recommended as an appropriate methodology for States to adopt. Persons preparing Safety Cases are encouraged to familiarise themselves with the concepts in those two Chapters. The following Steps 4 – 8 inclusive are based on and derived from those Chapters.

8 STEP 4 – Process for Hazard Identification and Analysis

8.1 Surveillance systems for aircraft separation services provide significant safety enhancement compared with procedural systems. However, there are safety consequences that predominantly arise during abnormal conditions or in fault or failure situations. Potential risks arise if related systems for air ground communication fail, or aircraft navigation or transponder avionics lose integrity or fail. Lesser impacts on safety might occur where the integrity of a system is degraded or lost but where there are alternative back-up systems, or contingency arrangements, that can be reverted to in order to maintain separation.

8.2 The process for hazard identification and analysis is set out in section 4.5 of the ICAO SMM, from which some of the information in this section is extracted and summarised.
It is essentially a 3 step process:

a) First: Identify the generic hazard (also known as top level hazard, or TLH). Generic hazard is used as a term that intends to provide focus and perspective on a safety issue, while also helping to simplify the tracking and classification of many individual hazards flowing from the generic hazard.
b) Second: Break down the generic hazard into specific hazards components of the generic hazard. Each specific hazard will likely have a different and unique set of causal factors, thus making each specific hazard different and unique in nature.
c) Third: Link specific hazards to potentially specific operational consequences, i.e. specific events or outcomes of the occurrence of the hazard.
d) Fourth: Document the hazards and its consequence.

8.3 Techniques for hazard identification and analysis for a new surveillance system may include:

a) the use of data or experience with similar systems/changes undertaken by overseas or other
b) respected providers of ATC surveillance services;
c) quantitative modelling based on sufficient data, a validated model of the change, and analyzed assumptions; e.g. RAM modelling.
d) the application and documentation of expert knowledge, experience and objective judgement by specialist staff;
e) trial implementation of a proposed change in an “off-line” system, or under a pre-existing surveillance service, and with sufficient backup facility to revert to the existing system before the change, if risks cannot be mitigated;
f) event tree analysis (ETA);
g) failure modes and effects analysis (FMEA);
h) human factors analysis (HFA);
i) hazard identification workshop with expert personnel (HAZID).

9 STEP 5 – Establish the Safety Risk of each Hazard

9.1 The references for this process is section 5.4 and 5.5 of the ICAO SMM, and Tables 30 and 31 of RTCA DO-303/Eurocae ED-126.

9.2 For each of the identified operational consequences of the identified hazards, the safety risk should be established by assessing the probability of occurrence, and the severity of the consequence or outcome.

9.3 Safety risk probability is defined in the SMM as the likelihood that an unsafe event or condition might occur. Safety risk severity is defined as the possible consequences of an unsafe event or condition.

9.4 Particular attention should be given to hazards that have operational consequences of common mode failure. For example, for an ADS-B surveillance service, failure or drop-out or short term loss of integrity of the GNSS may lead to total or partial loss of ATC surveillance and aircraft navigation. The risk control avenues open to a service provider may identify that a safety requirement is to ensure a means of backup to provide continuity of navigation and surveillance during the loss of GNSS, particularly for a terminal area service. Alternatively procedural mitigation may be implemented. Service providers should identify the most appropriate means or combination of risk controls based on local infrastructure and operational circumstances.

9.5 The following tables have been extracted from the SMM as the criteria for the risk assessment process.

Table 2: Safety Risk Probability Table (source ICAO SMM)

Probability	Meaning	Value
Frequent	Likely to occur many times	5
Occasional	Likely to occur sometimes	4
Remote	Unlikely to occur, but possible	3
Improbable	Very unlikely to occur	2
Extremely improbable	Almost inconceivable that the event will occur	1

Table 3: Safety Risk Severity Table (source ICAO SMM)

Severity of Occurrence	Meaning	Value
Catastrophic	Equipment destroyed Multiple deaths	A
Hazardous		B
Major	A significant reduction in safety margins, physical distress or a workload	C
Minor	Nuisance Operating limitations Use of emergency procedures Minor incident	D
Negligible	Little consequences	E

10 STEP 6 – Establish the Safety Risk Assessment Criteria

10.1 In order to ensure that the range of possible safety risks are appropriately classified and controlled, it is necessary for service providers to establish standard, stand-alone, criteria for safety risk assessment and classification. Such a safety risk classification scheme provides a structure for deriving the safety requirements for any airways system, as well as the criteria for risk control decisions. Typically, such schemes provide a standard relationship between the probability of occurrence of each risk and the categorised severity of the risk in terms of its potential impact on safety.

10.2 A Safety Case document must include or reference the risk assessment criteria (also termed a Risk Tolerability Classification scheme) adopted by the service provider for system safety management.

10.3 The following two Tables (Table 4 and Table 5) have been extracted from the ICAO SMM for Safety Risk Assessment criteria and Safety Risk Tolerability criteria:

Table 4: Safety Risk Assessment Matrix (source ICAO SMM)

Risk Probability	Risk Severity				
	Catastrophic A	**Hazardous B**	**Major C**	**Minor D**	**Negligible E**
Frequent 5	5A	5B	5C	5D	5E
Occasional 4	4A	4B	4C	4D	4E
Remote 3	3A	3B	3C	3D	3E
Improbable 2		2B	2C	2D	2E
Extremely Improbable 1	1A	1B	1C	1D	1E

Table 5: Safety Risk Tolerability Matrix (source ICAO SMM)

Suggested criteria	Assessment risk index	Suggested criteria
INTOLERABLE	5A, 5B,5C, 4A, 4B, 3A	Unacceptable
TOLERABLE/MITIGATE	5D, 5E, 4C, 4D, 4E, 3B, 3C, 3D, 2A, 2B, 2C	Acceptable based on risk mitigation. May require management decision
ACCEPTABLE	3E, 2D, 2E, 1A, 1B, 1C, 1D, 1E	Acceptable

10.4 A further reference, specifically for a surveillance service is shown in RTCA DO-303/EUROCAE ED-126. Table 30 of that document presents a qualitative Hazard Classification Matrix derived from ED-78A/DO-264 with 5 grades of risk severity. However, the Risk Classification Scheme (RCS) actually used in the Operational Safety Analysis presented in RTCA DO-303/EUROCAE ED-126 at Table 31 is derived from Table 30 and is based on 5 grades of Safety Targets with the Risk Classification per flight hour of each expressed quantitatively. The scheme is repeated in Table 6 below for reference:

Table 6: DO-303 OSA - Risk Classification Scheme for ADS-B Surveillance Service

Safety Targets	Risk per flight-hour	Risk per flight
ST1 Accident	**1e-08**	**1e-08**
ST2 Serious Incident	**1e-05**	**1e-05**
ST3 Major Incident	**1e-04**	**1e-04**
ST4 Significant Incident	**1e-02**	**1e-02**
ST5 No immediate effect on safety	**Not rated**	**Not rated**

11 STEP 7 – Process for Risk Control and Mitigation

11.1 A risk control process to eliminate, control or mitigate all risks categorised as intolerable or unacceptable, at least to a tolerable or acceptable level, must also be defined. Risk controls may vary considerably, and employ any one, or a combination of, the following:

a) system redesign, modification or replacement;
b) process or procedures redesign, particularly procedures by operational personnel;
c) reliability improvement schemes;
d) personnel education and/or training;
e) various management controls on personnel, operational procedures and equipment; and
f) regulatory controls; including aircraft equipage mandates, limitations on entry to airspace by unequipped aircraft; equipage requirements in accordance with ICAO SARPs, etc.

11.2 Any identified risks which cannot be controlled to a tolerable level shall be explicitly included in a section of the Safety Case which includes a full discussion on all relevant aspects of the risk. The rationale for any decision to proceed with the development or operation of the system while the risk prevails is to be stated and justified.

11.3 **Precedence of Risk Controls.** In the application of the above or other risk control processes, a safety precedence sequence should be adopted and applied. For instance, control of identified hazards should normally be sought first through improved system design or equipment changes, followed then by specific operational procedures or training. For some risks, only one type of mitigation process will be feasible, others may need several means of risk control to bring the overall risk into tolerability. Whichever means of control is implemented the control process should demonstrate how the risks are being brought within the acceptable or tolerable areas of the criteria.

12 STEP 8 – Document and track the Hazards and their Risks

12.1 A standard method of documenting and tracking Hazards and Risks should be established.

12.2 Figure 4.2 of Chapter 4 of the ICAO SMM indicates the process involved in hazard/risk documentation.

12.3 The proformae used for the purpose of documenting/tracking Hazards relevant to ADS-B service as used by two States are shown in ICAO Circular 326 at Appendices G1/G2 (Australia) and Appendix G3 (USA).

13 STEP 9 – Safety Case coverage over the lifecycle of the surveillance system

13.1 As previously discussed, Safety Cases should be developed in separate parts to define the safety situation of the system over the discrete stages of its lifecycle. A four part Safety Case has been adopted by some service providers to define the safety situation at the Operational Requirements Definition stage, at the completion of the Design and Procurement phase, at the Implementation stage, and for the routine Operational phase.

13.2 The contents of the Safety Case will differ for each part. For some systems, it may be appropriate to have more or fewer parts of the Safety Case. For all parts, the level of description and detail included should be sufficient to provide a reasonably informed reader with an understanding of the safety situation, without the need to refer extensively to supporting references. A decision on the number of Parts should be made at an early stage of a surveillance project.

13.3 A guide to the coverage of each part of a four part Safety Case is included in Attachment A ‘Safety Case Coverage for a Four Part Safety Case’.

14 STEP 10 – Authority for issue and change of the Safety Case

14.1 Safety Cases should be placed under a documentation control process. The Safety Case should be authorised by competent authority designated by the service provider. An authority or authorities covering System Requirements, System Design, System Operation, and System Maintenance should be appointed, and the issue of the parts of the Safety Case should be made under the authorization of one or more of these designated bodies, as appropriate to the content of each part.

PART B: SPECIFIC ELEMENTS FOR INCLUSION IN SAFETY CASE COVERING ADS-B BASED SURVEILLANCE SYSTEMS

Primary references:

ICAO Circular 326, in particular:

- **Chapter 2:** ATC Surveillance
- **Chapter 3:** Assessment of ADS-B and MLAT surveillance
- **Chapter 4:** State Implementation Roadmap
- **Appendix A:** General Description of the Reference Radar
- **Appendix B:** Technical Comparison between MSSR, ADS-B and MLAT
- **Appendix C:** Key ADS-B Performance Requirements to Support the Claim that ADS-B Surveillance "Is As Good As the Reference SSR"
- **Appendix G1:** HAZID and Mitigation (Australia)
- **Appendix G3:** Hazard Analysis Report (US Capstone Program)

RTCA DO-303/EUROCAE ED-126 December 13, 2006 Safety, Performance and Interoperability Requirements Document for the ADS-B Non-Radar Airspace Application

Secondary reference:

ICAO Doc 9689 AN/953 Manual on Airspace Planning, Methodology for the Determination of Separation Minima, First Edition 1998

Introduction

This Part itemises the topics that should specifically be included in a Design and Implementation Safety Case for the introduction of an ADS-B based surveillance system. The information herein is derived from two sources; ICAO Circular 326 and the actual Design Safety Case that was produced by the Australian ANSP to gain the approval of the aviation regulator for the commissioning of the Upper Airspace ADS-B surveillance system. That Safety Case was essentially based on a comparative assessment showing that ADS-B was as good as or better than a Monopulse SSR system when used for the same surveillance purposes in the same airspace by ATC. This comparative assessment approach has been documented by the ICAO SASP in Circular 326 as an appropriate means of assessing the safety of an ADS-B separation service in low complexity airspace.

1 STEP 11 – State Implementation Roadmap

1.1 For this STEP, readers should first acquaint themselves with Chapters 3 and 4 of ICAO Circular 326.

1.2 In Chapter 3 of ICAO Circular 326, the ICAO SASP describes the assessment it undertook of the use of ADS-B to support ATS. The assessment methodology compared ADS-B to a Reference SSR which the SASP defined in terms of its technical performance. The assessment demonstrated that ADS-B surveillance is better or at least no worse than the

Reference SSR, and therefore no less safe than Radar. The SASP concluded that, if a number of ADS-B performance requirements relating to the integrity and accuracy of the received ADS-B transmissions from aircraft and the overall latency and update rates of the system are met, then ADS-B can be used as a means of supporting the provision of a 5NM separation (also 2.5NM and 3NM) minima similar to that used with radar.

1.3 However, in making that conclusion, the SASP noted that its assessment was undertaken based on global assumptions and was for low complexity airspace and for the defined reference radar. In its Conclusions to Chapter 3, for reasons it explains in that Chapter, it noted that there remains the requirement for a region or State to undertake a State or local assessment that demonstrates the intended safety level will be met using ADS-B surveillance. To this end, a ‘State implementation roadmap’ was provided for the guidance of States.

1.4 Circular 326 provides the references and technical evidence to show that ADS-B is as good as or better than an MSSR when used for a 3NM or 5NM separation service by ATC. It is therefore unnecessary to demonstrate that in a Safety Case covering a State or local surveillance service. A State can make reference to that finding in Circular 326 rather than prove that in a Safety Case. However, it should be noted that the Circular clearly points out that the analysis by the SASP makes assumptions on a generic airspace situation which may not be totally relevant to the airspace situation in any particular State and that State and/or local level assessments should be undertaken where there is any difference between the Sate’s conditions and those in the assumptions made in the Circular, for example, in complex airspace. (Refer to Sections 4.12 and 4.14 of Circular 326.) Further, there always remains the requirement to undertake State or local level hazard identification and risk analysis of all hazards. For that purpose, the further value of Circular 326 as guidance material for ADS-B Safety Case preparation is that it provides a Compendium of Hazards and Mitigation Measures which has been extracted from several site-specific ADS-B Safety Cases of ADS-B trials and implementation undertaken in two States (USA and Australia). Further there are those identified by EUROCAE in the Annexes to ED-126. Those hazard compendiums will be of value as a reference to those States embarking on safety assessment of their own ADS-B programs.

1.5 The State Implementation Roadmap in Circular 326 comprises four distinct processes. These are:

a) Process A - Definition of Airspace Concept
b) Process B - Identification of ADS-B Performance Requirements
c) Process C – Safety Assessment
d) Process D – Preparation for Implementation

Those Processes imply that a four part Safety Case may best be adopted for those phases of system development. General guidance on the undertaking of all four Processes is given in Chapter 4 of Circular 326. It is recommended that authors of Safety Case documents for ADS-B surveillance should familiarize themselves with the Processes.

1.6 **ADS-B System Design - Performance standards**. In Appendix C to Circular 326 the ICAO SASP identifies the key ADS-B performance requirements for an ADS-B system to enable use of a 3NM or 5NM separation minimum in the provision of ATC. ADS-B 3NM and 5 NM separation services could be delivered when ADS-B data quality indicators meet the requirements in that Appendix. The Safety Case should therefore include the minimum values of quality indicators (in terms of NUC; NIC and NAC) of an aircraft ADS-B transmission before aircraft targets are displayed on ATC screens.

2 STEP 12 – Safety Case for ADS-B NRA

2.1 **RTCA DO-303/EUROCAE ED-126**. Extensive guidance material to assist in preparation of a Design Safety Case on the ADS-B NRA Application is contained in RTCA DO-303/EUROCAE ED-126. That document is a virtual Safety Case and the publication can be used as a reference alongside ICAO Circular 326. The complete document is relevant although the **Operational Safety Assessment** at Annex C has most relevance. Annex C contains the following Steps:

a) Hazard Classification Matrix as per DO-264/ED-78A (Table 30)
b) Safety Targets and Risk Classification Scheme (Table 31)
c) Operational Hazards Identification by Expert Analysis (Table 33)
d) Allocation of Safety Objectives (the maximum frequency or probability at which an operational hazard can be tolerated to occur) and the Safety Requirements for Operational Hazard mitigation.

3 STEP 13 – Safety Case Contents

3.1 **Contents of the Safety Case**. Guidance material on the **contents** (i.e. the topic headings, with a brief description of each topic that may be included under each heading) for inclusion in an ADS-B Design Implementation Safety Case is at Attachment B . This topic listing has been derived by reference to the Safety Case for the ADS-B Upper Airspace Program (UAP) prepared in Australia by the ANSP. (That particular Safety Case was the basis of the regulatory approval by CASA of the now implemented ADS-B UAP of Airservices Australia.)

ATTACHMENT A

Safety Case Coverage for a Four Part Safety Case

The following is a guide to the structure of a four part Safety Case over the life of an airways system.

Safety Case Part 1 - Operational Requirements Phase
A Safety Case Part 1 contains the Safety Objectives and the corresponding Safety Requirements for the proposed system, and will normally be the initial document provided to advise the proposed project's existence and its safety significance. The Safety Case at this stage should be an evaluation of the proposed system, perhaps most appropriately carried out by means of a Preliminary System Safety Assessment (PSSA), supplemented as necessary by overseas or previous experience, and in-house expertise and knowledge of deficiencies in existing systems which the new system is to replace.

Safety Case Part 2 - Design and Procurement Phase
Part 2 of the Safety Case is essentially to assure that the design of the system supports and provides for the safety requirements. Arguments to support the design rationale and the proposed technology of the system, and to verify and validate that such satisfies the safety requirements will be provided. The human factors aspects of the design, and the safety implications of the design of the procedures, and the ability of personnel to safely operate to the design procedures, should also be considered. Here, a full hazard and risk evaluation of the detailed design, including hardware, software, man/machine interface, human factors, equipment and administrative interfaces and external factors, should be undertaken.

Safety Case Part 3 – Implementation Phase
Part 3 of the Safety Case will provide an analysis of the safety situation following its installation and integration. The functional testing to be carried out for installation and pre-commissioning evaluation of the safety situation is detailed in this part. A testing regime aimed at validating the risk assessment made in Part 2 of the Safety Case, and identifying safety hazards not previously identified at Part 2 which arise during testing and integration and related activities, should be defined , with the strategy for assessing and managing these hazards and the safety issues which arise from such testing also specified.

Safety Case Part 4 - Normal Operations Phase
Part 4 of the Safety Case will provide the evidence that the system is safe in operational service. It will address all relevant operational and management issues, and will take account of the safety findings from the preceding three parts of the Safety Case. This part of the Safety Case is maintained as a living document for the life of the system, to define and document any further hazards, identified at post-commissioning or during routine operations, and the risk control actions taken to maintain compliance with safety objectives, in the light of actual day-to-day knowledge and experience with the system.

Note in respect to all Parts
It is important that all parts of the Safety Case be retained and maintained as necessary over the life of the system, reflecting the safety situation for any approved modifications or changes to the system.

ATTACHMENT B

Sample Headings and Content for ADS-B Design and Implementation Safety Case

No.	Heading	Brief Description of Content
1	Title	State the Title of the Safety Case. E.G. ADS-B Upper Airspace Program – Implementation Phase Safety Case
2	Purpose/Background/Operational Requirement	State the background to the development of the system. State the previous trials leading up to the implementation of the surveillance system. State the operational requirement of the system; the scope of the system and the scope of the safety case.
3	Scope	Define the scope of the system covered by the Safety Case. Operational staff impact. Technical staff impact. Changes to voice comms system. System coverage, engineering and operational standards adopted. Include coverage and location of ground station infrastructure, ground station design, bearer link network design, changes to ATM facilities at Area Centres. System transition management. Relativity to other programs. Existing system upgrade requirements. Development of new ATC procedures. Regulatory approval requirements/plans.
4	System Overview and Description	Overall system description/diagram. Ground Stations locations. Site Monitor. Terrestrial and satellite bearer links to ATC Centres. ATC System Processors. ATC Display. Remote Control and Monitoring System. RAIM prediction system. Power supply system(s). Provide schematic diagram of overall system including third party provided services and data-links
5	VHF Communication System	Overall voice comms system description/performance standards/overview/ bearers/third party provided services.
6	New ATC Procedures and Staff Training plan	Define existing separation standards and the intended new separation standard(s). Define ATC staff training required for ‘radar-like service’.
7	Logistics support	Define all aspects of the ILS plan including hardware and software maintenance, spares support plan,
8	Safety Requirements	Establish the safety standards and requirements in terms of system performance parameters (RAM).
9	Assumptions, Constraints and Dependencies	Comparison with radar for 5NM separation service. Proposed aircraft operational accuracy (NAC) and integrity (HPL) standards. State dependencies with related projects (voice, data bearers, aircraft equipage requirements, ATC system upgrades, etc)
10	Responsibilities	Establish the relevant staff responsibilities for the project implementation and safety management. Include all specialist and management personnel and responsibilities
11	Consultation and Communication	State the external consultation undertaken with stakeholders including any issues in relation to safety considerations. Provide references to documentation of

No.	Heading	Brief Description of Content
		consultation outcomes.
12	Design Process	Define the design process undertaken in system development. Define the design test plan/procedures and the outcome of design reviews.
13	Design Safety Risk Management	Describe the processes undertaken for Safety Risk Management at the design phase. Include reference to design HAZID and HAZLOG reviews undertaken. Establish the current status of all hazards identified in the design phase
14	Design Limitations and Shortcomings	Itemize all design phase deficiencies remaining (major and minor) and their safety status and impact
15	Implementation Process	Establish engineering transition plan. Establish operational transition plan. Establish contingency plan for reversion to existing system.
16	Status of Safety Controls and Safety Requirements	State the status of all safety controls and requirements. All outstanding Hazards and all safety requirements not satisfied to be subject to individual documentation
17	Engineering Support and Engineering System Maintenance	Describe the means of future engineering support – internally and externally to the organisation as applicable. Provide references to documented system maintenance procedures.
18	Criteria for Maintenance Technician certification	Establish the technician competency requirements for system monitoring, operation and maintenance.
19	Safety Performance Monitoring	Describe or reference the process for monitoring and management of safety performance after implementation of the system.
20	ATC Staff Training and Education Plan	Establish the ATC staff training plan and comprehensive training package.
21	Pilot Information Package	Provide reference to the Pilot Information and the dissemination of the package.
22	SystemTransition Plan	
23	RAM End-to-End System Analysis	Undertake Reliability, Availability, Maintainability analysis of the end-to-end system. (Use manufacturer provided RAM data or field data if available.) Compare results with established design standards/requirements.
24	System Test Procedure	Describe generally and provide reference to the detailed System Test Plan.
25	System Test Results	State the outcome of the system tests undertaken
26	**Define the System Safety Risk Management plan**	**Provide documentation of the safety risk management plan**
27	**Define Risk Management Process used for the Safety Case**	**Risk Management Process to be defined or referenced. Include process for Hazard Identification, Risk Assessment, Risk Classification, and Risk Control processes.**
28	**HAZID**	**Provide the record of all HAZID activities undertaken**
29	**Status of Hazards (HAZLOG)**	**Provide documentation of the status of all Hazards.**
30	**List all Hazards not controlled to tolerable level**	**List all Hazards not controlled to tolerable level, the reasons and justification.**

No.	Heading	Brief Description of Content
31	Post implementation review plan	Establish the plan, timing and procedures for post implementation review of the performance and safety of the system.
32	Related documentation	Include listing of references to all related or referenced documents

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EDITION 2

SAMPLE LETTER OF AGREEMENT
ON AUTOMATIC DEPENDENT SURVEILLANCE BROADCAST (ADS-B)
COLLABORATION BETWEEN
[PARTY 1]
AND
[PARTY 2]

This Agreement is made on the [ ] day of [ ] 2011

BETWEEN

The [Party 1] of [Address], hereinafter referred to as "[.]",

And

The [Party 2] of [Address], hereinafter referred to as "[.]";

(each individually referred to as a "Party" and collectively as the "Parties").

WHEREAS

(A) Automatic Dependent Surveillance – Broadcast ("ADS-B") is a new surveillance technology that will enhance safety and efficiency of air traffic services provision, complementing the role of radars used by air navigation service providers currently;

(B) The Asia Pacific Air Navigation Planning and Implementation Regional Group ("APANPIRG"), recognising the benefits of ADS-B, has established the ADS-B Implementation Task Force under the auspices of the International Civil Aviation Organisation to progressively implement ADS-B in the Asia-Pacific region;

(C) It is the expressed desire of airlines, through representation by the International Air Transport Association, to reap operational benefits arising from the use of ADS-B surveillance by air navigation service providers in the separation of air traffic;

(D) In line with the global thrust towards seamless air traffic services including over oceanic airspaces, the Civil Air Navigation Services Organisation has voiced support for collaboration between air navigation services providers on sharing of ADS-B surveillance data and VHF communications facilities and services, in order to reap the full capabilities of advanced technology in the most cost-effective manner;

(E) The Parties are desirous of collaboration to enhance air traffic services in the South East Asia region by mutual sharing of the ADS-B surveillance data and to facilitate direct controller-pilot communications by availing communication facilities to each other (hereinafter referred to as "ADS-B Collaboration");

(F) The Parties have agreed to enter into this Agreement to govern their rights and obligations, to regulate their relationship with each other as Provider and User (defined below) of the ADS-B data and to reap the full potential of ADS-B for the benefit of airlines.

IT IS HEREBY AGREED as follows:

ARTICLE 1 – Definitions and Interpretations

1.1 For the purpose of this Agreement, the following definitions shall apply:

(a) “ADS-B” or “ADS-B OUT” means a function on an aircraft or vehicle that periodically broadcasts its state vector (position and velocity) and other information derived from on-board systems in a format suitable for ADS-B IN capable receivers.

(b) “ADS-B IN” means a function that receives surveillance data from ADS-B OUT data sources.

(c) "ADS-B data" means information regarding aircraft position, altitude and status received from aircraft or other information generated from the ADS-B Ground Stations that receive the information from the aircraft.

(d) “ADS-B Ground Station” means a duplicated ADS-B ground station comprising receivers and communications interfaces.

(e) “ADS-B Filtering System” means the system to process the ADS-B data from the ADS-B ground stations or from other ADS-B sources before the data are sent to the Users. It includes the data fusion equipment, filtering equipment and routers.

(f) Air Traffic Services (“ATS”) includes flight information service, alerting service, air traffic advisory service, air traffic control (“ATC”) service (area control service, approach control service and aerodrome control service).

(g) All Purpose Structured Eurocontrol Radar Information Exchange (“Asterix”) means Eurocontrol standard format for data message exchange.

(h) “Direct Controller-Pilot Communication” (“DCPC”) means VHF communications, or other approved communication media in future, which is the required means for communications in order to achieve radar-like separation.

(i) “Private Circuit” means dedicated communication links between equipment sites, including those between the Provider’s and the User’s premises.

(j) “Provider” means the respective party providing the ADS-B data, DCPC facilities or other services required for ADS-B Collaboration as stated in **Annex A.**

(k) “Premises” of each Party means the building or land belonging to the Party, or to the Party who has possession and control over the building or land, as the case may be.

(l) “User” means the respective party receiving the ADS-B data, using DCPC facilities or other services required for ADS-B Collaboration as stated in **Annex A**.

(m) Very High Frequency (“VHF”) means the radio frequency band from 30MHz to 300MHz.

(n) “VHF Station” means a duplicated VHF ground station comprising transmitters, receivers and communications interfaces.

1.2 Unless the context or the provisions of this Agreement otherwise require:

(a) words importing the singular number include the plural number, and vice versa;

(b) references to the neuter gender include the masculine and feminine genders, and vice versa;

(c) words denoting one gender include all other genders;

(d) references to Articles and Annexes are references to Articles and Annexes of this Agreement; and

(e) the headings to the Articles hereof shall not be deemed to be a part thereof nor shall they be taken in consideration in the interpretation or construction of this Agreement.

ARTICLE 2 – Objective of the Agreement

2.1 The objective of this Agreement is to improve safety and operational efficiency in the Parties’ respective provision of air traffic services for civil air traffic flow in the Parties’ respective flight information regions by providing and enhancing ADS-B coverage, ADS-B data availability and DCPC facilities in these regions and where applicable, the areas including and up to 150 nautical miles from the boundaries of these flight information regions.

2.2 To achieve the objective specified in **Article 2.1**, the Parties shall provide their respective ADS-B data, DCPC facilities and other services required for ADS-B Collaboration in accordance with **Annex A** and according to the Implementation Schedule in **Annex B** and the Technical Scope of Works in **Annex C**.

2.3 The ADS-B data is to be provided for the technical and operational purposes specified in **Article 7.1**, including but not limited to:

(a) ATC situational awareness;
(b) ATC safety nets;
(c) Support of procedural separation procedures; and
(d) Updating flight plans

ARTICLE 3 – Provision of Equipment and Private Circuits

3.1 The Provider and the User shall be responsible for the provision, installation and commissioning of all equipment and private circuits required for the provision of ADS-B data, DCPC facilities and other services required for ADS-B Collaboration under this Agreement at their respective premises, unless otherwise stated in **Annex C**.

3.2 The technical requirement of the required equipment and private circuits are stated in **Annex C**.

3.3 The Provider and the User shall collaborate to test the above-mentioned equipment and private circuits to support ADS-B Collaboration before operational use.

ARTICLE 4 – Operations and Maintenance

4.1 The Provider and the User shall perform the routine maintenance, repair and replacement services of the equipment and the private circuits installed for the provision of ADS-B data, DCPC facilities and other services required for ADS-B Collaboration under this Agreement at their respective premises, unless otherwise stated in **Annex C**. The required standards of such maintenance, repair and replacement services shall be applied by the respective parties performing such services in a manner to keep the equipment and the private circuits in good working condition and fit for its purposes.

4.2 Where reasonably practicable, the Provider shall give the User a minimum of [.] days' notice in respect of any planned periodic break and a minimum of [.] hours' notice for any other planned non-periodic breaks in service.

4.3 The Provider shall report immediately or at the earliest opportunity any failure in the provision of the ADS-B data, DCPC facilities and other services required for ADS-B Collaboration, or any abnormality in the ADS-B data, DCPC facilities and other services required for ADS-B Collaboration, to the User's technical supervisor centre, as listed in **Annex C**.

4.4 The User shall monitor the ADS-B data, DCPC facilities and other services required for ADS-B Collaboration from the Provider and report immediately or at the earliest opportunity any failure in the reception or any abnormality of the ADS-B data, DCPC facilities or other services required for ADS-B Collaboration, to the Provider's technical supervisor centre, as listed in **Annex C**.

4.5 The User will engage a maintenance agent for the routine maintenance, repair and replacement services of the DCPC facilities and other services required for provision of DCPC facilities.

ARTICLE 5 – Modifications

5.1 From time to time, the equipment, private circuits and facilities provided by the Parties may need to be modified to meet new requirements., in such situations, the Provider and the User shall be responsible, upon agreement being reached pursuant to this Article, to implement such modifications on the equipment and private circuits provided by them respectively, within the agreed timeframe. The apportionment of the modification costs is specified in **Annex D**.

5.2 Any proposal for such modification shall allow at least [.] or any agreed period between agreement of the modification and the date that the modification is proposed to become effective.

5.3 The Provider and the User shall collaborate to test the equipment, private circuits and facilities affected by such modification before operational use.

5.4 No modification to a Party's equipment, private circuits or facilities shall be effected without the express agreement in writing of the other Party if the modification will require the latter to also modify any of its equipment, private circuits or facilities.

ARTICLE 6 – Cost

6.1 The cost apportionment for the use of ADS-B data, DCPC facilities and other services required for ADS-B Collaboration including maintenance costs is specified in **Annex D**.

ARTICLE 7 – Limitations on Use and Communication of ADS-B Data

7.1 The User shall use the ADS-B data provided to ensure the safe, efficient and regular provision of civil air traffic services and activities in support of his civil air traffic services and for investigation or technical demonstration, evaluation, and test purposes. The User shall not, at all times, use such data for any other purpose, nor communicate to any party not specified in this Agreement in any manner or form whatsoever any data supplied pursuant to this Agreement, without the prior written consent of the Provider.

ARTICLE 8 – Liability

8.1 [To be mutually agreed between the Parties]

ARTICLE 9 – Force Majeure

9.1 A Provider shall not be in breach of this Agreement if any failure to perform its duties or to provide the ADS-B data, DCPC facilities and other services required under the

ADS-B Collaboration, arises from or is caused by any event or circumstance which is beyond its control and which constitutes force majeure. Such Provider shall promptly inform the User and take all reasonable steps (under the circumstances) to minimise the disruption and to resume normal operations as quickly as possible.

ARTICLE 10– Settlement of Disputes

10.1 [To be mutually agreed between the Parties]

ARTICLE 11 – Final Provisions

11.1 It is understood that nothing in this Agreement shall prejudice or detract from the primary obligation of the Parties whether under domestic law or applicable international law, to ensure the safe, efficient and regular provision of civil air traffic services for the areas within their respective areas of responsibility.

ARTICLE 12 – Duration

12.1 This Agreement shall enter into force on ___________ for a contract period of **[.]** years.

12.2 This Agreement shall automatically be extended for a further contract period of [.] years upon expiry of each contract period unless either Party has givenwritten notice to the other of its intention to terminate at least [.] months before the date of expiry of each contract period.

12.3 in the event the provision of any ADS-B data as specified in **Annex A** hereof is to be permanently withdrawn from service, the Provider shall give the User not less than [.] year notice in writing in advance thereof.

ARTICLE 13 – Entire Agreement

13.1 This Agreement (including the Annexes hereto) constitutes the entire agreement between the Parties in relation to its subject matter and supercedes all prior or contemporaneous agreements and understandings whether oral or written with respect to that subject matter.

ARTICLE 14 – Amendment

14.1 This Agreement shall not be amended, modified or supplemented by the Parties in any manner, except by an instrument in writing signed on behalf of each of the Parties by a duly authorized officer or representative.

ARTICLE 15 – Rights of Third Parties

15.1 For the avoidance of doubt, the Parties agree and acknowledge that no person who is not a party to this Agreement may enforce any term of this Agreement in his own right, in particular and to the extent legally possible, the Parties specifically exclude the application of any law in [State of party1], [State of party2] or elsewhere which provides that any third party has the right to enforce this Agreement.

In witness whereof, the parties having been duly authorized, have entered into this Agreement on the day and year first above written.

Signed for and on behalf of
[Party 1]

Signed for and on behalf of
[Party 2]

[Name and title of authorised signatory]

[Name and title of authorised signatory]

ANNEX A

PROVIDERS AND USERS OF ADS-B AND DCPC FACILITIES

1 In this Agreement, the Providers and Users are as specified below:

(a) [Facility 1]

Provider: [.]
User: [.]

(b) [Facility 2]

Provider: [.]
User: [.]

(c) [Facility 3]

Provider: [.]
User: [.]

2 Each Provider authorizes the User to communicate the Provider's ADS-B data to the maintenance agents appointed by the User for the purposes of maintenance and management of ADS-B equipment.

ANNEX B

IMPLEMENTATION SCHEDULE

[To include time line for various facilities]

ANNEX C

TECHNICAL SCOPE OF WORKS

1 Equipment, Facilities And Services To Be Provided By Each Party

1.1 ADS-B Stations

[Description of equipment to be provided by each party]

1.2 ADS-B Filtering System

[Description of equipment to be provided by each party]

1.3 DCPC Facilities (VHF Radio Voice Communication Station)

[Description of equipment to be provided by each party]

1.4 Private Circuits between States

[Description of equipment to be provided by each party]

2 ADS-B Data Sharing Interface Specification

2.1 Data Elements

2.1.1 ADS-B messages will comprise the data elements defined in Eurocontrol Asterix Category 21 version 0.23.

2.1.2 ADS-B Data received from each aircraft will be transmitted from each ADS-B station to the User(s) at an update rate of 1second.

2.1.3 The Asterix Category 21 version 0.23 standard allows packaging of multiple ADS-B records into a single data block, or alternatively to place a single ADS-B record per data block. Record packaging should be performed to the extent possible to minimise communication bandwidth requirements without delaying transmission of any given record.

2.1.4 The ADS-B stations and routers / processors shall not alter the contents of the data elements.

2.2 Message Description

2.2.1 The message format will be in accordance with Asterix Cat 21 version 0.23.

2.3 Communication Protocol

2.3.1 The network layer is to be implemented using the Internet Protocol (IP). The network shall support Internet Group Management Protocol (IGMP) level 0, 1 and 2 as defined in RFC3300.

Note: IGMP level 1 supports transmission of Multicast datagrams, level 2 supports transmission and reception of multicast datagrams, while level 0 corresponds to IP unicast.

2.3.2 For Asterix messages, the Network Layer will use the IP for the delivery of packets. An addressing scheme, as agreed, shall be used. Multicast shall be used.

2.4 Physical Aspects

2.4.1 The communication media will be VSAT data-link communications links and submarine cables. The bandwidth of the media shall be as follows:

[Description of communication media]

3 DCPC Facilities– VHF Radio Voice Communication interface

3.1 Communication Protocol

[Description of communication protocol]

3.2 Physical Aspects

[Description of communication media]

4 Maintenance

4.1 [Description of maintenance requirement]

5 Functional Performance Requirement

5.1 General Performance Requirements

5.1.1 The ADS-B data and DCPC facilities together with the systems and equipment that provide such data and DCPC will meet and comply with the relevant international standards and best practices for applying radar-like separation using ADS-B, or radar if such standards have not been defined for ADS-B.

5.2 Specific Performance Requirements

5.2.1 Unless otherwise stated, the ADS-B stations, ADS-B routers and DCPC facilities will be duplicated with no common point of failure.

5.2.2 The following standard will be met:

Aircraft Updates	1 second update rate
Network Latency	95%: < 2 seconds of ground-station output (from ADS-B ground station to input of the User)
Reliability 1	2 autonomous ground-stations including antennae, each providing data with no common point of failure
Reliability 2 - MTBF	Each ground-station including antenna to have MTBF >10,000 hrs
Reliability – Communications Infrastructure	Completely duplicated, no common point of failure
Reliability – Total ADS-B Service	Total Service MTBF > 50,000 hrs
Availability – Total ADS-B Service	Total Service Availability > 0.999
Integrity – Ground Station	Ground Station shall be checked by Site monitor and monitored by RCMS
Integrity – Data Communications & Processing	All systems up to ATM system, errors < 1 x 10E-6

5.2.3 The following standard for DCPC facilities will be met:

Type	System Monthly Availability Minimum Requirement
VHF Base Stations (Per Frequency)	[State required availability]

5.3 Filtering and Message Modification

5.3.1 The ADS-B data from aircraft is collected and formed into Asterix messages in accordance with the technical specification of the ground station. The content of the Asterix messages should not be removed or modified unless technically required.

6 Location and Contact Number of the Technical Supervisor Centres of Each Party

6.1 All routine co-ordination and fault reporting of the equipment, facilities or services provided by a Party will be addressed to the following technical supervisor centre at the Party's premises:

(a) Technical Supervisor Centre at [Party 1]'s premises:

[Contact details]

(b) Technical Supervisor Centre at [Party 2]'s premises:

[Contact details]

ANNEX D

COST

1 General

1.1 The costs to be borne by the Parties will be on a mutually-agreed basis between the Parties.

1.2 The costs will include equipment costs, installation and testing costs, maintenance and operating costs, private circuit or equipment lease costs, cost of performance reporting, administration costs and costs of relevant taxes including but not limited to goods and services tax and costs of relevant services including but not limited to consultancy services.

2 Costs for Provision of equipment, facilities and services

2.1 Unless otherwise specified in this Annex, each Party will pay for his own costs including all the capital and recurrent costs of the equipment, private circuits, facilities and associated services provided by him as specified in **Annex C**.

2.2 Costs of [Facility 1]

[Description on how cost of Facility 1 will be shared]

2.3 Costs of [Facility 2]

[Description on how cost of Facility 2 will be shared]

2.4 Costs of [Facility 3]

[Description on how cost of Facility 3 will be shared]

3 Technical and operational support costs

3.1 [Description on how technical and operational support costs will be shared]

4 Termination costs

4.1 [Description on how cost due to termination will be shared]

5 Modification costs

5.1 Unless otherwise agreed between the Parties, in the event of modification pursuance to **Article 5** of this Agreement, each Party will bear the modification costs of the equipment, private circuits, facilities and associated services provided by him as specified in **Annex C**.

6 Facilities Fees

6.1 [Description on fees for facilities, if any]

ANNEX E

CORRESPONDENCE

1. The correspondence between the Parties shall be posted and faxed or emailed to the addresses and attention it to the person indicated below:

   To [Party 1]:
   [Contact details]

   To [Party 2]:
   [Contact details]

2 Any Party may from time to time, by written notice to the other Party, designate a different person, facsimile or email to whom the correspondences, notices or communications must be attention to.

AMENDMENT TO AIGD

5.9.2 ADS-B Flight Planning Requirements (Before transition to new DOC4444 format in 2012)

Until the new ICAO flight plan, which incorporates ADSB designators, is in use in 2012, the following shall apply:

5.9.2.1 Flight Notification
A remark shall be entered in section 18 of the fight plan to indicate that
the flight is capable of transmitting ADS-B messages via the Mode S Extended
Squitter data link. The format of the remark should be:
RMK/ADSB

Note: Only flights with ADS-C capability should use the surveillance equipment indicator"D"and only flights with CPDLC capability should use the equipment indicator "J".

5.9.2.2 Aircraft Address (24 Bit Code)
Where required, the aircraft address (in hexadecimal format) may be recorded in
section 18 of the ICAO flight plan as per the following example:
CODE/7C432B
States should note that use of hexadecimal code may be prone to human error and is
less flexible in regard to airframe changes for a notified flight.

5.9.3 ADS-B Flight Planning Requirements (After transition to new DOC4444 format in 2012)
After transition to the new flight plan format in 2012, the following shall apply:
5.9.3.1 Flight Notification
An appropriate ADS-B designator shall be entered in section 10 of the flight plan to indicate that
the flight is capable of transmitting ADS-B messages.

For information, these include:
B1 ADS-B with dedicated 1090 MHz ADS-B "out" capability
B2 ADS-B with dedicated 1090 MHz ADS-B "out" and "in" capability
U1 ADS-B "out" capability using UAT
U2 ADS-B "out" and "in" capability using UAT
V1 ADS-B "out" capability using VDL Mode 4
V2 ADS-B "out" and "in" capability using VDL Mode 4

5.9.3.2 Aircraft Address (24 Bit Code)
Where required, the aircraft address (in hexadecimal format) may be recorded in section 18 of the ICAO flight plan as per the following example:
CODE/7C432B
States should note that use of hexadecimal code may be prone to human error and is
less flexible in regard to airframe changes for a notified flight.

5.9.3.3 SSR Mode S

When an aircraft is equipped with a mode S transponder, that transmits ADS-B messages, an appropriate Mode S designator should also be entered in field 10; i.e.: either

- E Transponder — Mode S, including aircraft identification, pressure-altitude and extended squitter (ADS-B) capability, or

- L Transponder — Mode S, including aircraft identification, pressure-altitude, extended squitter (ADS-B) and enhanced surveillance capability.

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ADDITION TO AIGD SECTION 9

SECTION 9 : RELIABILITY & AVAILABILITY CONSIDERATIONS

Reliability and Availability of ADS-B systems should normally be equivalent or better than the reliability and availability of radar systems.

9.1 Reliability

9.1.1 Reliability is a measure of how often a system fails and is usually measured as Mean Time Between Failure (MTBF) expressed in hours. Continuity is a measure equivalent to reliability, but expressed as the probability of system failure over a defined period. In the context of this document,, failure means inability to deliver ADS-B data to the ATC centre. Ie: Failure of the ADS-B system rather than an equipment or component failure.

9.1.2 Poor system MTBF has a safety impact because typically it causes unexpected transition from one operating mode to another. For example, aircraft within surveillance coverage that are safely separated by a surveillance standard distance (say, 5 NM) are unexpectedly no longer separated by a procedural standard distance (say 15 mins), due to an unplanned surveillance outage.

9.1.3 In general, reliability is determined by design (see para 9.3 B below)

9.2 Availability

9.2.1 Availability is a measure of how often the system is available for operational use. It is usually expressed as a percentage of the time that the system is available.

9.2.2 Poor availability usually results in loss of economic benefit because efficiencies are not available when the ATC system is operating in a degraded mode (eg using procedural control instead of say 5 NM separation).

9.2.3 Planned outages are often included as outages because the efficiencies provided to the Industry are lost, no matter what the cause of the outage. However, some organisations do not include planned outages because it is assumed that planned outages only occur when the facility is not required.

9.2.4 Availability is calculated as

Availability (Ao) = MTBF/(MTBF+MDT)

where MTBF= Mean Time Between SYSTEM Failure
MDT = Mean Down Time for the SYSTEM

The MDT includes Mean Time To Repair (MTTR), Turn Around Time (TAT) for spares, and Mean Logistic Delay Time (MLDT)
NB: This relates to the failure of the system to provide a service, rather than the time between individual equipment failures. Some organisations use Mean Time Between Outage (MTBO) rather than MTBF.

9.2.5 Availability is directly a function of how quickly the SYSTEM can be repaired. Ie: directly a function of MDT. Thus availability is highly dependent on the ability & speed of the support organisation to get the system back on-line.

9.3 Recommendations for high reliability/availability ADS-B systems

A : **System design** can keep system failure rate low with long MTBF. Typical techniques are

- to duplicate each element and minimise single points of failure. Automatic changeover or parallel operation of both channels keeps system failure rates low. Ie: the system keeps operating despite individual failures. Examples are :
    - Separate communication channels between ADS-B ground station and ATC centre preferably using different technologies or service providers eg one terrestrial and one satellite
- Consideration of Human factors in design can reduce the number of system failures due to human error. Eg inadvertent switch off, incorrect software load, incorrect maintenance operation.
- Take great care with earthing, cable runs and lightning protection to minimise the risks of system damage
- Take great care to protect against water ingress to cables and systems
- Establish a system baseline that documents the achieved performance of the site that can be later be used as a reference. This can shorten troubleshooting in future.
- System design can also improve the MDT by quickly identifying problems and alerting maintenance staff. Eg Built in equipment test (BITE) can significantly contribute to lowering MDT.

B: **Logistics strategy** aims to keep MDT very low. Typical strategies are :

- Establish availability and reliability objectives that are agreed organisation wide. In particular agree System response times (SRT) for faults and system failure to ensure that MDT is achieved. An agreed SRT can help organisations to decide on the required logistics strategy including number, location and skills of staff to support the system.
- Having appropriate maintenance support contracts in place so that faulty modules are repaired within contractually defined times – preferably with contractual

incentives/penalties for compliance. Such support contracts are best negotiated as part of the acquisition contract when competition between vendors is at play to keep costs down. Sometimes it is appropriate to demand that the support contractor also keep a certain level of buffer stock of spares “in country”.

It is strongly recommended that maintenance support is purchased under the same contract as the acquisition contract.

- Establish baseline preventative maintenance regimes including procedures and performance inspections in conjunction with manufacturer recommendations for all subsystems
- Use remote control & monitoring systems to identify faulty modules before travel to site. This can avoid multiple trips to site and reduce the repair time
- Have handbooks, procedures, tools available at the site or a nearby depot so that travel time does not adversely affect down time
- Have adequate spares and test equipment ready at a maintenance depot near the site or at the site itself. Vendors can be required to perform analysis of the number of spares required to achieve low probability of spare “stock out”
- Have appropriate plans to cope with system and component obsolescence. It is possible to contractually require suppliers to regularly report on the ability to support the system and supply components.
- Have ongoing training programs and competency testing to ensure that staff are able to perform the required role

The detailed set of operational and technical arrangements in place and actions required to maintain a system through the lifecycle are often documented in a Integrated Logistics Support Plan.

C: **Configuration Management** aims to ensure that the configuration of the ground stations is maintained with integrity. Erroneous configuration can cause unnecessary outages. Normally configuration management is achieved by :

- Having clear organizational & individual responsibilities and accountabilities for system configuration.
- Having clear procedures in place which define who has authority to change configuration and records of the changes made including, inter alia
  - The nature of the change including the reason
  - Impact of the change & safety assessment
  - An appropriate transition or cutover plan
  - Who approved the change
  - When the change was authorized and when the change was implemented

- Having appropriate test and analysis capabilities to confirm that new configurations are acceptable before operational deployment.
- Having appropriate methods to deploy the approved configuration (Logistics of configuration distribution). Suggested methods;
    - Approved configuration published on intranet web pages
    - Approved configuration distributed on approved media

D: <u>Training & Competency plans</u> aim to ensure that staff have the skills to safety repairs Normally this is achieved by :

- Conduct of appropriate Training Needs Analysis (TNA) to identify the gap between trainee skill/knowledge and the required skill/knowledge.
- Development and delivery of appropriate training to maintainers
- Competency based testing of trainees
- Ongoing refresher training to ensure that skills are maintained even when fault rates are low

E: <u>Data collection & Review</u> :

Regular and scheduled review should be undertaken to determine whether reliability/availability objectives are being met. These reviews need to consider :

- Reports of actual achieved availability & reliability
- Data regarding system failures including "down time" needs to be captured and analysed so the ANSP actually knows what is being (or not being) achieved.
- Any failure trends that need to be assessed. This requires data capture of the root cause of failures
- Any environmental impacts on system performance, such coverage obstructions such as trees, planned building developments, corrosion, RFI etc. Changes in infrastructure may also be relevant including airconditioning (temperature/humidity etc) and power system changes.
- System problem reports especially those that relate to software deficiencies (design)
- System and component obsolescence
- Staff skills and need for refresher training

PROPOSED MODIFICATION TO REGION PROCEDURES – ADS-B

1.1 ADS-B technology is increasingly being adopted by Asia Pacific States. Asia Pacific adopted 1090 Extended squitter technology.

1.2 Reliance on ADS-B transmissions can be expected to increase over the coming years.

1.3 Transitional schemes that require maintenance of lists of approved and/or incorrectly operating aircraft are cumbersome, costly and error prone. List based systems cannot be practically used with ADS-B air-air applications. ADS-B air-air applications are already installed on some aircraft.

1.4 Currently a number of aircraft are transmitting ADS-B data which is misleading or non compliant with the ICAO standards expressed in Annex 10. Examples include:

- Aircraft broadcasting incorrect message formats;
- Aircraft broadcasting inertial positional data and occasionally indicating in the messages that this data has high integrity when it does not;
- Using GPS sources that do not generate correct integrity data, whilst indicating in the messages that the data has high integrity'
- Transmitting ADS-B data with changing (and incorrect) Flight Identity; and
- Transmitting ADS-B data with incorrect Flight Identity continuously

1.5 If the benefits of ADS-B are to flow to the aviation Industry, misleading and non compliant ADS-B transmissions should be stopped. There can be little justification for transmission of misleading data because it generates a potential safety risk if that data is used.

1.6 One state (Australia) promulgated regulations in 2007 that prohibited misleading and non compliant ADS-B transmissions. The regulation

9B.2 ADS-B transmitting equipment carried by an aircraft for operational use in Australia must comply with an approved equipment configuration.

9B.3 If ADS-B transmitting equipment carried by an aircraft does not comply with an approved equipment configuration, it must be deactivated before flight in Australia.

1.7 This regulation became effective in 2007 and applies to all Australian airspace at all flight levels. However, these regulations only apply in the territorial airspace of that state.

1.8 In late 2009 CASA clarified some aspects of the regulations as follows:

9B.6 If an aircraft carries ADS-B transmitting equipment which does not comply with an approved equipment configuration, the aircraft must not fly in Australian territory unless the equipment is:

(a) deactivated; or

(b) set to transmit only a value of zero for the NUCp or NIC.

Note It is considered equivalent to deactivation if NUCp or NIC is set to continually transmit only a value of zero.

Alternative approved equipment configuration — standard for aircraft manufactured on or after 28 June 2012

7 For an aircraft manufactured on or after 28 June 2012, an equipment configuration is approved if:

(a) it has been certified by EASA as meeting the standards of EASA AMC 20-24; and

(b) the aircraft flight manual attests to the certification; and

(c) the GNSS receiver or system complies with the requirements of clause 3 in Part B.

Alternative approved equipment configuration — standard for aircraft manufactured before 28 June 2012

8 For an aircraft manufactured before 28 June 2012, an equipment configuration is approved if:

(a) it has been certified by EASA as meeting the standards of EASA AMC 20-24; and

(b) the aircraft flight manual attests to the certification; and

(c) the GNSS receiver or system complies with the requirements of clause 4 in Part B.

2. ICAO APANPIRG POSITION ON MISLEADING DATA

2.1 The 21st meeting of the Asia/Pacific Air Navigation Planning And Implementation Regional Group (APANPIRG) adopted the following Conclusion:

Conclusion 21/42 – Rule on Misleading ADS-B Transmissions

That, States where ADS-B may be used, even voluntarily, promulgate rule for ADS-B Avionics Equipage Requirements consider publishing additional provisions for misleading ADS-B transmission as follows:

After <insert earliest date that ADS-B may be used for any relevant operational purpose> if an aircraft carries ADS-B transmitting equipment which does not comply with

a) EASA AMC 20-24, or
b) the equipment configuration standards in Appendix XI of Civil Aviation Order 20.18 of the Civil Aviation Safety Authority of Australia.

the aircraft must not fly unless the equipment is:

(a) deactivated; or
(b) set to transmit only a value of zero for the NUCp or NIC.

Note:
1. It is considered equivalent to deactivation if NUCp or NIC is set to continually transmit only a value of zero.

2. Regulators should take appropriate action to ensure that such regulations are complied with.

3. ATC systems should discard ADS-B data when NUC or NIC=0

3. PROPOSAL

3.1 It is proposed that APANPIRG initiate changes to the ICAO Regional Supplementary Procedures Doc7030 to require aircraft operators to disable 1090 ES ADS-B transmissions are that misleading or non compliant.

3.2 Proposed wording is attached at Appendix A. This proposal simply extends the APANPIRG 21 decision into international airspace to ensure that safety of air-air and air-ground operations are maintained.

APPENDIX A: Proposed change to Doc 7030

5.5 AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST (ADS-B)

5.1. *If an aircraft operates within an FIR and*

(A) carries 1090 extended squitter ADS-B transmitting equipment which does ***not*** *comply with*

a) EASA AMC 20-24, or
b) the equipment configuration standards in Appendix XI of Civil Aviation Order 20.18 of the Civil Aviation Safety Authority of Australia or
c) FAA Rulemaking <exact reference to be included after publication later in 2011>
d)EASA Certification Specification Airborne Communications Navigation and Surveillance (CS-ACNS) *<exact reference to be included after publication later in 2011>*

Or

(B) if the aircraft ADS-B transmitting equipment becomes unserviceable resulting in the aircraft transmitting misleading information,

Then

the aircraft must not fly unless the equipment is:

(a) deactivated; or
(b) transmits only a value of zero for the NUCp or NIC.

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ATTACHMENT

MAIN POINTS ADDRESSED BY THE UPDATES TO THE ICAO POSITION FOR THE INTERNATIONAL TELECOMMUNICATION UNION (ITU) WORLD RADIOCOMMUNICATION CONFERENCE (2012) (WRC-12)

The updated ICAO Position reflects new developments, resulting from ICAO and ITU studies and are as follows:

a) a further clarification of the spectrum requirement for unmanned aircraft systems (UAS), expressing clearly that in order for ICAO to be in a position to accommodate UAS in civil airspace and to develop SARPs, spectrum for UAS communications systems must be given the necessary status and sufficient protection from harmful interference through an appropriate allocation as an aeronautical safety service, similar to other spectrum used to support the safe operation of aircraft (WRC-12 Agenda Item 1.3 refers);

b) ITU-R studies have been successfully concluded in support of the new allocations made to the aeronautical mobile (route) service (AM(R)S) at WRC-07 and a potential new allocation for aeronautical surface applications at airports (WRC-12 Agenda Item 1.4 refers);

c) studies confirm that long-term aeronautical mobile-satellite (route) service (AMS(R)S) spectrum requirements up to the year 2025 can be accommodated within existing frequency bands available for this service. Provisions, however, are needed in the ITU Radio Regulations to improve transparency in the coordination process (WRC-12 Agenda Item 1.7 refers);

d) the aerospace industry has indicated that they are currently not considering the frequency band 37 - 38 GHz to support a wireless network within aircraft to provide or enhance intra-aircraft safety communications. The aerospace industry, however, has indicated the need to support a future agenda item to consider frequency spectrum requirements for this type of application (WRC-12 Agenda Items 1.12 and 8.2 refer); and

e) ITU-R studies identified a number of candidate frequency bands for expansion of the mobile satellite service (MSS). This includes three potential allocations in bands used by aeronautical radionavigation systems. If new services are to be introduced in these bands, operation of aeronautical safety systems must be protected (WRC-12 Agenda Item 1.25 refers).

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CONSIDERATION OF WRC-12 AGENDA ITEMS AND CURRENT AREAS OF CONCERN TO AVIATION

WRC-12 Agenda Item	Comments
1.1	No comment
1.2	Still unclear how this AI will be addressed – requires close monitoring
1.3*	See ICAO Position. For the satellite component, several methods could be combined. However, methods A2 and A3 are not supported.
1.4*	See ICAO Position. Methods A, B and C2 are supported.
1.5	There is a need to monitor this AI as any changes to the RR provisions and not just allocations may impact civil aviation
1.6	No comment
1.7*	See ICAO Position. Method B is preferred. A combination of methods B and D may also be an option. Methods A and C are not supported.
1.8	No comment
1.9	No comment
1.10	No comment
1.11	No comment
1.12	No currently known future aeronautical system foreseen in this band. Support Method B (PFD limits)
1.13	No comment
1.14	Bands currently being proposed are outside of those used for ARNS and AM(R)S, but further monitoring is required.
1.15	Bands currently being proposed are outside of those used for AM(R)S but further monitoring is required
1.16	No comment
1.17	No comment
1.18	No comment
1.19	None of the methods proposed are in accordance with the ICAO Position. Of the methods proposed for CRS, Method B2 comes closest.
1.20	No comment
1.21	ICAO Position is to protect existing ARNS. Methods A, B and C, proposing new allocation in the band include a WRC Resolution to protect existing ARNS services. Preferred method may depend on outcome of AI1.3/1.25. Method D is also supported.
1.22	Support Methods C and D, while protecting bands used for Aeronautical Safety Services
1.23	Method C is supported. Methods A and B pending confirmation of use by NDB in these bands.
1.24	No comment
1.25*	Support no change to existing aeronautical allocations. Methods A1, E1 and F1 can be supported.
2	Need to monitor
4	Need to monitor. Possible deletion of Res 419 (Aeronautical Security) is not opposed.
8.2	Support the introduction of a new AI, to consider the introduction of WAIC.

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DRAFT

HANDBOOK ON RADIO FREQUENCY SPECTRUM REQUIREMENTS FOR CIVIL AVIATION

PART II _ Frequency assignment planning criteria for aeronautical radio communication and navigation systems

Chapter 1 General methodology for compatibility analysis of aeronautical radio systems

1.1 Introduction

1.1.1 This chapter describes a general methodology, which can be used in interference analysis for different radio systems. The general methodology is mainly based on ITU-R Recommendation SM.337-4 which is logically combining currently available models and parameters of both desired and undesired systems, e.g. signal power and spectral distribution, receiver selectivity, antenna patterns, propagation attenuation etc. Recommendation ITU-R SM.337-6 provides the procedures for calculating distance and frequency separation for an acceptable (agreed) interference level.

1.1.2 The following primary factors, which quantify the interactive effects between interfering transmitters and victim receivers for various combinations of frequency or distance separation, are:

- the frequency dependent rejection (FDR) which is a measure of the rejection produced by a receiver selectivity curve on an unwanted transmitter emission, and

- frequency / distance (FD) which is a measure of the minimum distance separation that is required between a victim receiver and an interfering transmitter as a function of difference between their tuned frequencies.

1.1.3 The frequency/distance rules are an important part of the frequency management process in most radio services. In channelized services, these rules take the following form:

- co-channel or co-frequency transmitters must be separated by at least d_0 (NM),
- first adjacent frequency transmitters (separated by one channel or the applicable frequency separation (e.g. 25 kHz)) must be separated by at least d_1 (NM),
- second adjacent frequency transmitters (separated by two channels or two times the applicable frequency separation (e.g. 2 times 25 kHz)) must be at least d_2 (NM) away and so on.

1.1.4 For the purpose of frequency assignment planning appropriate frequency / distance rules should be applied when similar or dissimilar systems occupy the same (or adjacent) frequency band.

FD and FDR can provide solutions to co- and adjacent frequency sharing and adjacent band interference problems by providing estimates of minimum required frequency and geographic separation between interfering transmitters and victim receivers which are required for an adequate receiver performance.

Note: Throughout this document, capital letters are used to denote logarithmic values (dB) of the corresponding quantities designated with lower-case type, e.g. $P_D = 10 \log p_D$. P_D *is the input power to the transmitting antenna (dB) relative to 1 W when* p_D *is the input power (W).*

1.2 Methodology

The electromagnetic compatibility of radio equipment should be calculated by the following method:

- Step 1: determine the desired signal level at the victim receiver front end;
- Step 2: determine the resulting level of interference at the victim receiver's front end;
- Step 3: determine the interactive effects among wanted signals, interference and receiver characteristics for various frequency or distance separations;
- Step 4: determine the appropriate ITU-R propagation model to be used; and
- Step 5: determine, from these data, a relationship between the frequency separation and distance separation that the interference is considered tolerable.

1.3 Procedure

The compatibility analysis between an undesired transmitter and a victim receiver can be performed as follows (see Figure 1-1):

***Step 1*: a. Generic method:**

Determine the desired signal level P_D (dBW) at the desired (victim) receiver front end.

$$P_D = P_{Tx\_D} + G_{Tx\_D}(\varphi) - L_{Tx\_D\_FL} + G_{Rx}(\theta_D) - L_{Rx\_FL} - L_{POL\_Rx\_D} - L_b(d_D) \quad (1)$$

where:

P_D : desired signal level P_D (dBW) at the victim receiver front end

P_{Tx_D} : output power of the desired transmitter (dBW)

$G_{Tx\_D}(\varphi)$: gain of the desired transmitting antenna in direction of victim receiver with respect to an isotropic antenna (dBi)

$L_{TX\_D\_FL}$: feeder link losses between output of the desired transmitter and the input of the desired transmitting antenna (dB)

$G_{Rx}(\theta_D)$: gain of the receiving antenna in direction of desired transmitter with respect to an isotropic antenna (dBi)

L_{RX_FL} : feeder link losses between output of the receiving antenna and the input receiver (dB)

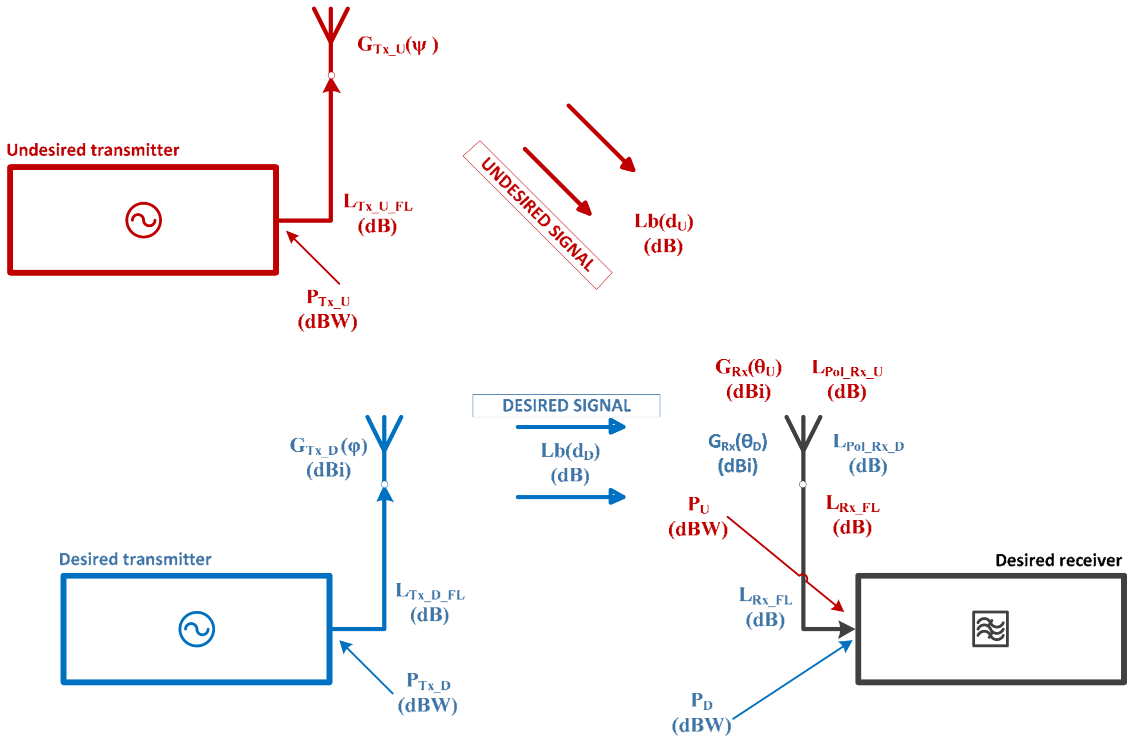
$L_{POL\_Rx\_D}$: loss due to polarization mismatch of receiving antenna with respect to desired transmitted signal (dB)

$L_b(d_D)$: basic transmission loss for a separation distance d_D between desired transmitter and receiver (dB) (see Recommendation ITU-R P.341)

φ: angle between boresight of desired transmitting antenna in the direction of the desired receiving antenna

θ_D angle between boresight of the desired receiving antenna in the direction of the desired transmitting antenna

This formula calculates the level of the desired signal at the (desired) receiver input based on the characteristics of the (desired) transmitter.



$$P_D = P_{Tx\_D} - L_{Tx\_D\_FL} + G_{Tx\_D}(\varphi) + G_{Rx}(\theta_D) - L_{Rx\_FL} - L_{POL\_Rx\_D} - L_b(d_D)$$

$$P_U = P_{Tx\_U} - L_{Tx\_U\_FL} + G_{Tx\_U}(\psi) + G_{Rx}(\theta_U) - L_{Rx\_FL} - L_{POL\_Rx\_U} - L_b(d_U) + FDR(\Delta f)$$

Figure 1 – 1 Elements of desired and undesired signal

b. Method when the minimum signal strength of the desired signal has been specified:

As an alternative approach the desired signal power level P_D (dBW) at the victim receiver front end can be determined based on the minimum required field strength at the receiver antenna (signal in space) within the service volume. In most cases, Annex 10 contains SARPs for radiocommunication and radionavigation systems where the minimum fieldstrength at the antenna (signal in space) is determined in the format of e = xx µV/m or as a power flux density of S = yy dBW/m^2. The field strength in µV/m can be converted into dB(W/m^2) as follows:

xx (µV/m) = $\frac{\mathbf{xx^2.10^{-12}}}{\mathbf{120.\pi}}$ or **S = E – 145.8** where S = dB(W/m^2) and E = dB (µV/m).

The power of the desired signal at the input of the receiver can be calculated as follows (see also Figure 1-2):

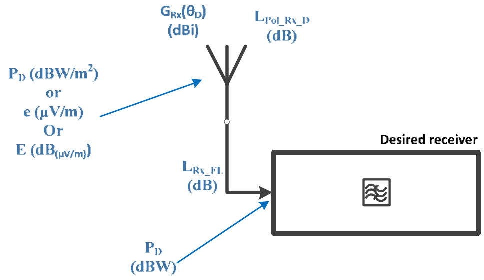


Figure 1 – 2 Calculation of P_D at receiver input

$$P_D = E - 20 \cdot \log f - 107.2 + G_{Rx}(\theta_D) - L_{Rx\_FL} - L_{POL\_Rx\_D} \qquad (1a)$$

where:

P_D :	desired signal level P_D (dBW) at the victim receiver front end
E :	minimum required electric field strength at the edge of the service area (dB(µV/m))
f:	frequency (MHz)
$GRx(\theta_D)$:	gain of the receiving antenna in direction of desired transmitter with respect to an isotropic antenna (dBi)
L_{RX_FL} :	feeder link losses between output of the receiving antenna and the receiver input (dB)
$L_{POL\_Rx\_D}$:	loss due to polarization mismatch of receiving antenna with respect to desired transmitted signal (dB)
θ_D	angle between boresight of receiving antenna and desired transmitting antenna

Note: *When assuming the minimum field strength throughout the service volume than this approach is slightly more conservative since it does not take into account actual field strength values.*

In aeronautical frequency assignment planning, typical (worst case) values are:

$G_{Rx}(\theta_D)$	= 0 dB
L_{Rx_FL}	= -3 dB
$L_{POL\_Rx\_D}$	= 0 dB

And turns formula (1a) into $P_D = E - 20 \cdot \log f - 110.2$

Step 2: Calculate the resulting level of interference at the victim receiver's front end using the formula:

$$P_U = P_{Tx\_U} - L_{Tx\_U\_FL} + G_{Tx\_U}(\psi) + G_{Rx}(\theta_U) - L_{Rx\_FL} - L_{POL\_Rx\_U} - L_b(d_U) + FDR(\Delta f) \quad (2)$$

where:

P_U :	undesired signal level PU (dBW) at the victim receiver front end
P_{Tx_U} :	output power of the undesired transmitter (dBW)
$L_{TX\_U\_FL}$:	feeder link losses between output of the undesired transmitter and the input of the undesired transmitting antenna (dB)
$G_{Tx\_U}(\psi)$:	gain of the undesired transmitting antenna in direction of victim receiver with respect to an isotropic antenna (dBi)
$GRx(\theta_U)$:	gain of the receiving antenna in direction of undesired transmitter with respect to an isotropic antenna (dBi)
L_{RX_FL} :	feeder link losses between output of the receiving antenna and the input of the receiver (dB)
$L_{POL\_Rx\_U}$:	loss due to polarization mismatch of receiving antenna with respect to undesired transmitted signal (dB)
$L_b(d_U)$:	basic transmission loss for a separation distance d_U between the undesired transmitter and the receiver (dB) (see Recommendation ITU-R P.341)
$FDR(\Delta f)$:	frequency dependent rejection for a frequency separation Δf as expressed by equation (3)
ψ :	angle between boresight of undesired transmitting antenna in the direction of the receiving antenna
θ_U	angle between boresight of receiving antenna in the direction of the undesired transmitting antenna

FDR is the rejection provided by a receiver to a transmitted signal as a result of the limited bandwidth of the receiver with respect to the transmitted signal and the detuning between the receiver and the transmitter.

$$FDR(\Delta f) = 10 \cdot \log \frac{\int_0^\infty p(f)\mathrm{d}f}{\int_0^\infty p(f) \cdot h(f)\mathrm{d}f} \quad \text{dB} \qquad (3)$$

where:

$p(f)$:	power spectral density of the interfering signal (W/Hz); and
$h(f)$:	normalized frequency response of the receiver.

$$\Delta f = f_{Rx} - f_{Tx\_U} \qquad (4)$$

where:

fRx :	receiver tuned frequency; and
fTx_U :	interferer tuned frequency.

The FDR can be divided into two terms, the on-tune rejection (OTR) and the off-frequency rejection (OFR). The OTR is the rejection provided by a receiver selectivity characteristic to a co-tuned transmitter as a result of a transmitted signal exceeding the receiver bandwidth. The OFR is an additional rejection that results from off-tuning between interferer and receiver.

The FDR can also be described in the format of the receiver out-of-band immunity performance.

Note: FDR, OTR and OFR are considered as losses and defined below in a manner to ensure positive values.

$$fdr(\Delta f) = otr \cdot ofr(\Delta f) \tag{5}$$

And in logarithmic values:

$$FDR(\Delta f) = OTR + OFR(\Delta f) \quad \text{dB} \tag{6}$$

where:

$$OTR = 10 \cdot \log \frac{\int_0^\infty p(f)\,\mathrm{d}f}{\int_0^\infty p(f) \cdot h(f + \Delta f)\ \mathrm{d}f} \quad \text{dB} \tag{7}$$

$$OFR(\Delta f) = 10 \cdot \log \frac{\int_0^\infty p(f) \cdot h(f + \Delta f)\,\mathrm{d}f}{\int_0^\infty p(f) \cdot h(f)\,\mathrm{d}f} \quad \text{dB} \tag{8}$$

The on-tune rejection also called the *bandwidth correction factor* can often be approximated by:

$$OTR \approx K \cdot \log\left(\frac{B_T}{B_R}\right) \qquad B_R \le B_T \tag{9}$$

where:

B_R : interfered receiver 3 dB bandwidth (Hz)
B_T : interferer transmitter 3 dB bandwidth (Hz)
K = 10 for non-coherent signals
= 20 for pulse signals.

Note: OTR = 0 if $B_R > B_T$

Step 3: The interference will be considered tolerable if the following inequality is satisfied:

$$P_D - P_U \ge \alpha + ASF \tag{10}$$

where:

P_D : desired signal level P_D (dBW) at the victim receiver front end
P_U : undesired signal level P_U (dBW) at the victim receiver front end

α protection ratio (dB)

ASF aviation safety factor (dB) (see Part I of this Handbook (9.2.22). General material is in Recommendation ITU-R SM.1535 on “*The protection of safety services from unwanted emissions*”

In some cases it is required to calculate the interference-to-noise ratio (I/N) at the IF output or demodulation input of the victim receiver. The interference will be considered tolerable if the following inequality is satisfied:

$$\frac{I}{N} \leq \left(\frac{I}{N}\right)_{req} + ASF \quad (11)$$

where:

I/N : calculated interference-to-noise ration at the victim receiver input referred to the IF bandwidth (dB)

$(I/N)_{req}$: required interference-to-noise ration at the victim receiver input referred to the IF bandwidth (dB)

ASF aviation safety factor (dB)

The noise at the receiver input referred to the IF bandwidth is given by:

$$N = 10 \cdot \log k \cdot T_0 + 10 \cdot \log B_{IF} + NF \quad (12)$$

where:

N: receiver noise power (dBm)

k: Boltzmann’s constant

T_0 absolute temperature (K)

B_{IF} receiver’s intermediate frequency bandwidth (Hz)

NF receiver noise figure (dB)

The I/N ratio is then given by:

$$\frac{I}{N} = P_U - 10 \cdot \log k \cdot T_0 + 10 \cdot \log B_{IF} + NF \quad (13)$$

Step 4: Determine the appropriate ITU-R propagation model to be used

See paragraph 1.3 for propagation models.

Step 5: Determine a relationship between the frequency separation and distance separation that the interference is considered tolerable

Substitute P_D and P_U of steps 1 and 2 above into equation (10) to derive or numerically compute a relationship between the frequency separation Δf and the distance separation d_U such that the interference is considered tolerable.

1.3 Propagation Model

1.3.1 Free – Space Propagation Model

The propagation loss that would occur if the antennas were replaced by isotropic antennas located in a perfectly dielectric, homogeneous, isotropic and unlimited environment, the distance between the antennas being retained (see Recommendation ITU-R P.525).

$$L_{bf} = 20 \cdot \log\left(\frac{4 \cdot \pi \cdot d}{\lambda}\right) \tag{14}$$

where:

- L_{bf} : free-space basic transmission loss (dB)
- d : distance
- λ : wavelength

where d and λ are expressed in the same unit.

Equation (14) can also be written using the frequency instead of the wavelength.

$$L_{bf} = 32.4 + 20 \cdot \log f + 20 \cdot \log d \tag{15}$$

where:

- f : frequency (MHz)
- d : distance (km).

or

$$L_{bf} = 37.8 + 20 \cdot \log f + 20 \cdot \log d \tag{16}$$

where:

- f : frequency (MHz)
- d : distance (NM)

1.3.2 Propagation of radio waves in the atmosphere

The propagation of radio waves, typical VHF and UHF frequencies, is subject to a number of conditions, compare to the free space propagation. These conditions include:

a. Refraction – refraction of radio waves in the atmosphere along the Earth's surface bend slightly towards the Earth. The effect is that radio waves can propagate beyond the horizon with no other (significant) loss than the free space loss. This phenomenon is corrected in radio propagation by using a 4/3 Earth radius. The radio horizon (radio path until it reaches the radio horizon) is calculated using a 4/3 Earth.
b. Ducting – Unusual weather conditions (or other phenomena such as sand storms) can bend the radio waves more than normal and VHF or UHF radio frequencies can be received without significant attenuation over longer distances. In aeronautical frequency assignment planning this phenomenon is not normally taken into account.

The standard propagation model calculates the propagation loss along the radio path as follows:

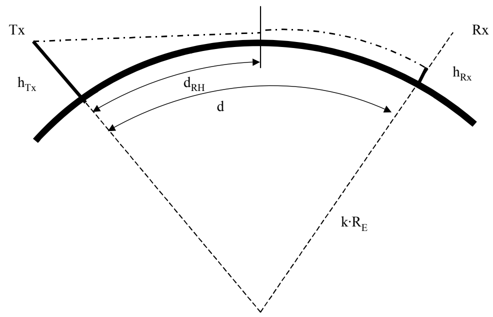


Figure 1 - 3

Radio signals from transmitter Tx in Figure 3 propagate until the radio horizon over the distance d_{RH} under free space propagation conditions. Beyond the radio horizon the radio signals are attenuated with a constant factor *a*, which is depending on the actual frequency as follows

a. in the band 108 – 137 MHz *a* is 0.5 dB/NM
b. in the band 960 – 1215 MHz *a* is 1.6 dB/NM
c. in the band 5030 – 5091 MHz *a* is 2.7 dB/NM

Note: The constant attenuation factor *a* was derived from ITU-R Recommendation P.528 for 125 MHz, 1200 MHz and 5100 MHz for 50 % of the time. These curves are reproduced in Appendix A and are based on the IF 77 electromagnetic wave propagation model. The IF-77 model was developed by the Institute for Telecommunication Sciences and the FAA (US). A Windows version of this model is contained in the ICAO frequency assignment planning program **Search Frequency** and can be used for assessing more precise signal parameters. Normally, for radio paths up to the radio horizon, aeronautical frequency assignment planning is based on free space propagation. Applying the IF-77 model may result in a more accurate prediction of the actual radio wave propagation characteristics.

The distance to the radio horizon can be calculated with the formula:

$$d_{RH} = 1.23\sqrt{h_{Tx}} \text{ where} \qquad (17)$$

d_{RH} is the distance of the station to the radio horizon (NM)
h_{Tx} is the height of the station above the Earth's surface

In Figure 1 – 3 the factor ($d – d_{RH}$) is the distance of the receiver beyond the radio horizon from the transmitter Tx.

If d ≤ d_{RH} the basic transmission (or propagation) loss between the transmitter Tx and the receiver Rx is

37.8 + 20.log d + 20.log f   (re. (16))

In this case, the receiver is within direct line of (radio) sight of the transmitter.

If d > d_{RH}, the basic transmission loss between the transmitter Tx and the receiver Rx is

37.8 + 20.logd_{RH} + 20 log f + (d-d_{RH}).a (re. (17)

In this case, the receiver is beyond the radio horizon of the transmitter. The distance dRH is calculated with formula (17). (d is in NM)

1.3.3 Aeronautical Standard Propagation Model

Aeronautical standard propagation model (ASPM) is derived from the ITU-R Recommendation P.528. For distances up to the radio horizon, free space propagation is assumed. Beyond the radio horizon, a constant attenuation factor *a*, which depends on the frequency band under consideration, is used.

The distance to the radio horizon can be calculated using the following formula:

$$d_{RH} = \sqrt{2 \cdot k \cdot R_E} \cdot \left(\sqrt{h_{Tx}} + \sqrt{h_{Rx}}\right) \qquad (18)$$

where:

d_{RH} :	distance to the radio horizon
k :	effective Earth radius factor
R_E	Earth radius
h_{TX}	height of transmitting antenna above Earth's surface
h_{RX}	height of receiving antenna above Earth's surface

If heights h_{TX} and h_{RX} are expressed in feet (ft) and the distance d in Nautical Miles (NM), the Earth radius R_E = 6360 km and if the atmospheric conditions are assumed to be normal (effective Earth radius factor k = 4/3) the following practical formula can be used:

$$d_{RH} = 1.23 \cdot \left(\sqrt{h_{Tx}} + \sqrt{h_{Rx}}\right) \qquad (19)$$

where:

d_{RH} :	distance to the radio horizon (NM)
h_{TX}	height of transmitting antenna above Earth's surface (ft)
h_{RX}	height of receiving antenna above Earth's surface (ft)

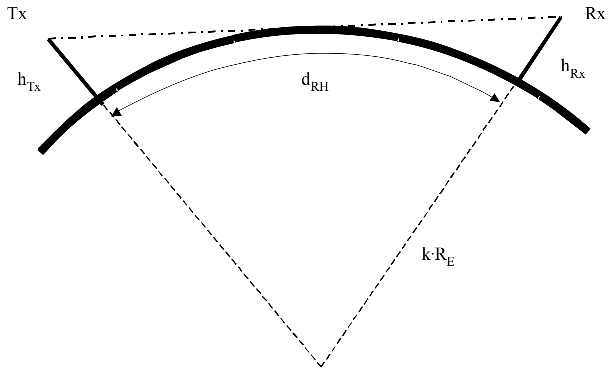


Figure 1 – 4

The situation as depicted in Figure 1 – 4 is typical applied in frequency assignment planning for air-ground communication systems (e.g. operating in the VHF band 112 – 137 MHz. In this situation, the minimum separation distance is between two aircraft each operating within their respective designated operational coverage (DOC) (see also Chapter 2).

1.3.4 Separation distance ratio

In particular for air-ground voice communication systems, the minimum separation distance can be expressed in terms of a distance ratio. This is the ratio of the distance from the (desired ground based) transmitter to the desired (victim) aircraft receiver to the distance of the nearest interfering transmitter (another aircraft).

Formula (1) calculates the desired signal level at the receiver input as follows:

$$P_D = P_{Tx\_D} + G_{Tx\_D}(\varphi) - L_{Tx\_D\_FL} + G_{Rx}(\theta_D) - L_{Rx\_FL} - L_{POL\_Rx\_D} - L_b(d_D)$$

and formula (2) calculates the undesired (interfering) signal level at the receiver input:

$$P_U = P_{Tx\_U} - L_{Tx\_U\_FL} + G_{Tx\_U}(\psi) + G_{Rx}(\theta_U) - L_{Rx\_FL} - L_{POL\_Rx\_U} - L_b(d_U) + FDR(\Delta f)$$

D/U ratio is 20 dB

The D/U ratio for voice communication systems $P_D - P_U$ = 20 dB ((re (10) and as specified in Annex 10).

Assuming that $P_{Tx\_D} = P_{Tx-U}$; $L_{Tx\_D\_FL} = L_{Tx\_U\_FL}$; $G_{Tx\_D}(\Psi) = G_{Tx\_U}(\Psi)$; $L_{Pol\_Rx\_U} = 0$ and FDR (Δf) = 0

(the desired and undesired transmitter have the same power output; the same cable losses and the same antenna gain, they have the same antenna gain in the direction of the desired (victim) receiver, have the same polarization and operate on the same frequency) $P_D - P_U$ can be re-written using the formulas (1) and (2) as:

$P_D - P_U$ =(- $L_b(d_D)$) – (-$L_b(d_U)$) = 20 dB.

$L_b(d_D)$ is the distance from the (desired) aircraft to the (desired) ground transmitter and $L_b(d_U)$ is the distance from the (desired) aircraft to the (undesired or interfering) aircraft.

Under free space propagation conditions, using formula 16 gives:

$L_b(d_U) - L_b(d_D) = 37.8 + 20 \cdot \log f + 20 \cdot \log d_U - (37.8 + 20 \cdot \log f + 20 \cdot \log d_D) = 20$

or

$20 \cdot \log d_U - 20 \cdot \log d_D = 20 \quad >> 20 \cdot \log \frac{d_U}{d_D} = 20 \quad >> \log \frac{d_U}{d_D} = 1 \quad >> \frac{d_U}{d_D} = \mathbf{10}$

D/U ratio is 14 dB

If the D/U ratio for voice communication systems $P_D - P_U$ = 14 dB (as specified in Annex 10 and used in congested areas) the separation distance ratio can be calculated as follows:

$P_D - P_U$ = =(- $L_b(d_D)$) – (-$L_b(d_U)$) = 14 dB.

$L_b(d_U) - L_b(d_D) = 37.8 + 20 \cdot \log f + 20 \cdot \log d_U$ -$(37.8 + 20 \cdot \log f + 20 \cdot \log d_D)$ =14

or

$20 \cdot \log d_U - 20 \cdot \log d_D = 14 \quad >> 20 \cdot \log \frac{d_U}{d_D} = 14 \quad >> \log \frac{d_U}{d_D} = 0.7 \quad >> \frac{d_U}{d_D} = \mathbf{5}$

In many cases, applying the separation distance 1 : 10 leads to separation distances which are (far) beyond the radio horizon.

1.3.4.1 The effect of the radio horizon

The effect of the radio horizon is demonstrated in the following example. (Re Figure 1 – 5)

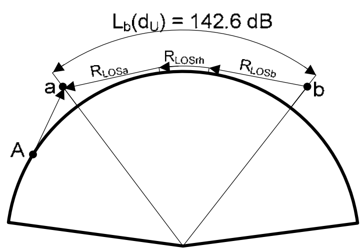


Figure 1 – 5 Separation distances (aircraft are not within line of sight)

In order to protect (aircraft) station **a** from interference from (aircraft) station **b** (with the same characteristics as in 1.3.4.1), $L_b(d_U)$ needs to be 142.6 dB

When aircraft station a is at an altitude of FL 250 (25000 ft) and aircraft b is at an altitude of FL 450 (45000 ft) the minimum separation between the two aircraft can be calculated as follows:

For station **a** the distance to the radio horizon (R_{LOSa}) is 194 NM

For station **b** the distance to the radio horizon (R_{LOSb}) is 261 NM

$L_b(d_U)$ = $37.8 + 20.\log(f) + 20.\log(R_{LOSa} + R_{LOSb}) + 0.5.d_{rh}$ (dB)

$= 79.7 + 455 + 0.5\ d_{rh} = 142.6$ $\qquad d_{rh} = 19.5$ NM

The total minimum distance required between the two aircraft stations **a** and **b** is **474.5 NM.**

In aeronautical frequency assignment planning, the distance d_{rh} is normally not taken into consideration; protection is sufficient when the two aircraft are separated by the sum of their distances to the radio horizon. The probability that two aircraft at the same time are at the maximum altitude and the maximum range of the closest point of the designated operational coverage can be ignored. Although 20 dB may be used in frequency assignment planning in Regions where frequency congestion is not severe or is not anticipated to become severe, Annex 10 stipulates that a desired to undesired protection ratio of 14 dB is sufficient to protect air/ground communication systems from harmful interference.(Re. Annex 10, Volume 5, paragraph 4.1.5.1)

The minimum separation distance between two ground stations “A” and “B”, which have a designated operational range of R_A and R_B respectively becomes:

$$\mathbf{R_A + R_{LOSa} + R_{LOSb} + R_B} \qquad (20)$$

This separation distance protects two aircraft, operating on the same frequency and which are at the same time at the closest point and the maximum altitude of their respective designated operational coverage areas. These criteria are implemented in the ICAO frequency assignment planning program “**Search Frequency”** and are in conformity with the provisions in Annex 10, Volume 5.

When applying the 20 dB D/U protection ratio, the method for calculating the minimum separation distance described in this paragraph results (in almost all cases) in a minimum separation distance which is less than the separation distance calculated with the 1 :10 distance ratio; therefore using the 1 : 10 separation distance ratio method is not recommended or practical.

1.3.4.2 In (congested) areas cases where the 14 dB D/U ratio is applied, the separation distance ratio 5 as shown in paragraph 1.3.4 can be used.

In some cases (depending on the size of the designated operational coverage), applying a 1 : 5 distance ratio may result in smaller minimum separation distances compared to using the line-of-sight criterion.

Using formula (20) (line-of-sight criterion) calculates a minimum separation distance *between the closest point at the edge of the designated operational coverage for each service* of:

$\mathbf{D_{sep} = R_{LOSa} + R_{LOSb} = 1.23\sqrt{H_a} + 1.23\sqrt{H_b}}$

(H_a and H_b are the maximum altitude of the different designated operational coverage areas).

Using the 1 : 5 distance ratio will give a minimum separation distance *between the closest point at the edge of the designated operational coverage for each service* of

$\mathbf{D_{sep} = 5R_A}$ **or** $\mathbf{5R_B}$, whichever of these two is the largest distance (R_A and R_B are the ranges of the different designated operational coverage areas).

Note 1: the line-of-sight criterion should be applied where this provides a smaller minimum separation distance compared to the 1 : 5 separation distance ratio method.

The 1 : 5 separation distance criterion assumes that both the (desired) ground transmitter and the (undesired) aircraft transmitter have the same e.i.r.p. Typical value for aircraft e.i.r.p. is 43 dBm or 12.5 W (with a 25 W transmitter, 0 dB antenna gain and 3 dB cable losses). When the ground station e.i.r.p. is less than 12.5 W, the 14 dB protection ratio is not provided. In case the interfering ground station is within line-of-sight of the (desired) aircraft station and has an e.i.r.p greater than 12.5 W, the 14 dB protection ratio is not provided. Therefore, the 1 : 5 distance ratio should be used with caution.

Example calculations:

(i) a. Application of the line-of-sight criterion gives a minimum separation distance between two designated operational coverage areas for a TWR service (25 NM / 4000ft) of 156 NM (the radio horizon for 4000 ft is 78 NM).

b. Application of the 1 : 5 distance ratio gives a minimum separation between the two designated operational coverage areas of a TWR service of 5*25 NM or 125 NM.

In this case, the 1 : 5 separation distance criterion could be applied.

(ii) a. For two APP/U services (250 NM/45000 ft), using the line of sight criterion, the minimum separation distance between the designated operational coverage areas is 520 NM (the radio horizon for 45000 ft is 260 NM)

b. Application of the 1:5 distance ratio would give a minimum separation distance 0f 5*250 NM or 1250 NM.

In this case, the line-of-sight criterion should be applied.

Application of the 5:1 distance ratio gives only marginal relief in frequency assignment planning.

*Note: The ICAO frequency assignment planning program **SEARCH FREQUENCY** has implemented the frequency assignment planning criteria based on the line-of-sight (radio horizon) criterion (D/U ratio is 20dB.)*

*The program **SEARCH FREQUENCY** also includes the regional frequency assignment planning criteria as these are currently used in the AFI, APAC, CAR, MID and SAM Regions. Until such time that the Regional frequency assignment planning criteria have been updated and in line with the planning criteria are per Annex 10, the current regional frequency assignment planning criteria should be used.*

Implementation of the 14 dB D/U ratio with the 1 : 5 distance ratio is applied in the EUR Region.

Chapter 2

Aeronautical VHF radio air-ground radio communication systems operating in the band 117.975 – 137 MHz

2.1 Introduction

2.1.1 The frequency band 108 – 137 MHz is allocated by the International Telecommunication Union (ITU) to the Aeronautical Mobile (Route) Service (AM(R)S) and used for air-ground voice as well as air-ground and air-air data link communications. The ITU has published details concerning the allocation of radio frequency spectrum for all radio services in its Radio Regulations and relevant Resolutions and Recommendations to the Radio Regulations. Technical material on the use of this band is contained in ITU-R Recommendations and Reports. Part I of this Handbook includes details pertinent to this allocation as agreed within the ITU. The use of the band 102 – 137 MHz by aviation for air/ground communication systems (aeronautical mobile (R) service) is in full accordance with the provisions of the ITU, as contained in the ITU Radio Regulations. This chapter contains technical and operational material pertaining to the assignment and use of frequencies in the band 117.975 – 137 MHz.

Note: The allocation to the aeronautical mobile (R) service in the band 108 – 117.975 is subject to the conditions as contained in ITU Resolution 413 (WRC-07).

2.1.2 ICAO documents relevant to frequency assignment planning include:

- *Annex 10 Volume III (Communication systems),*
  - Part I (Digital data communication systems) – Chapter 6 – *VHF air-ground digital link*
  - Part II (Voice communication systems) – Chapter 2 – *Aeronautical Mobile Service*

- *Annex 10 Volume V,* Chapter 4 – *Utilization of frequencies above 30 MHz* and Attachment A – *Considerations affecting the deployment of VHF communication frequencies*
  Note: This material is reproduced in Appendix B

- *ICAO Regional Air Navigation Plans and relevant ICAO Regional Air Navigation Agreements.*

2.2 Interference model

2.2.1 General

2.2.1.1 An aircraft can be subject to interference caused by transmissions from other (nearby) aircraft and from ground stations. These transmissions can be generated on the desired frequency (co-frequency) or on frequencies adjacent to the desired frequency (adjacent frequency). Communications between aircraft and ground stations, operating on the same frequency within the same designated operational coverage of a particular frequency is not considered as harmful interference as indeed all relevant aircraft and ground stations are expected to use the communication services provided on this frequency (all transmissions from aircraft and ground station(s) within either area A or area B in Figure 2-1). Other co-frequency communications (from outside the designated operational coverage of the desired station / service, e.g. transmissions from within area B in Figure 2-1 may interfere with communications within area A in Figure 2-1 and vice versa) may cause interference which may be harmful. Similarly, the use of frequencies adjacent to the frequency in use may cause harmful interference.

2.2.2 Interference model used in aeronautical frequency assignment planning for air/ground VHF communication systems.

2.2.2.1 The model used for establishing co-frequency separation distances in aeronautical frequency assignment planning for systems used for both air-ground and ground-air communications is shown in Figure 2 – 1. When the (protection) distance between aircraft **a** and aircraft **b** is equal or greater than the sum of the radio horizon (line-of-sight) of each aircraft, the aircraft stations are mutually protected from interference from each other (see also paragraph 1.3.4).
Note: The calculation of minimum separation distances is described in paragraph 2.7.

When the minimum protection distance has been established between the closest points of the respective designated operational coverage (DOC) areas, all aircraft (and the ground station) operating within the DOC area "A" are protected from harmful interference from all aircraft (and the ground station) operating within DOC area "B" as these are operating well beyond the radio horizon of each other.

This method also protects aircraft if the e.i.r.p of the ground stations is different because the ground station is normally situated well beyond the radio horizon if the minimum separation distance between aircraft stations is met. Paragraph 2 – 7 describes in detail the different interference mechanisms that need to be considered in frequency assignment planning to protect frequency assignments from co-frequency interference (paragraph 2.7.3) and adjacent frequency interference (paragraph 2.7.4).

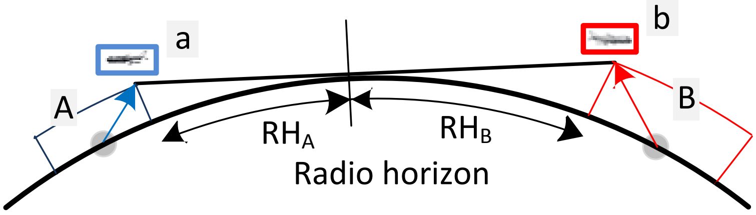


Figure 2 – 1 Model for establishing separation distances

In VHF air/ground communication frequency assignment planning, the following three interference models, based on the model in Figure 2 – 1 apply:

a. Both the desired and the undesired transmitting / receiving stations involve aircraft stations communicating with a ground station (see paragraph 2.7.3.1)
b. The desired ground station is transmitting (broadcasting) from the ground and the desired aircraft station is being interfered by another aircraft communicating with (transmitting) another ground station (see paragraph 2.7.3.2)

c. The desired ground station is transmitting (broadcasting) from the ground and the desired aircraft station is being interfered by a undesired transmitting (broadcasting) ground station (see paragraph 2.7.3.3)

2.3 Protection requirements for air/ground voice communication systems operating in the band 117.975 – 137 MHz.

2.3.1 Provisions concerning the deployment of VHF frequencies and the avoidance of harmful interference are contained in Annex 10, Volume V, Chapter 4 (4.1.5) and are reproduced in Appendix B for information and reference.

2.3.2 In summary, Annex 10 Volume V stipulates in paragraph 4.1.5.1 that:

a. The D/U protection ratio between the desired (wanted) and the undesired (interfering) signal shall be 14 dB. (This provision is to be implemented on the bases of a regional air navigation agreement)

b. The D/U protection ratio may be 20 dB in areas where frequency congestion is not severe

c. These protection ratios are to be achieved at the limit of the designated operational coverage (DOC) which automatically protects all aircraft within the DOC.

The requirement for a D/U ratio of 14 dB has been implemented through a regional agreement in Europe and is used in North America. Other Regions apply the 20 dB protection ratio (which is equivalent to the radio line-of sight criterion as described in paragraph 2.2.1).

2.3.3 Protection of signals in space.

2.3.3.1 Annex 10 has established minimum field strength levels (signal in space) for the various air/ground communication systems that can operate in the frequency band 112 – 137 MHz. These field strength levels, together with other relevant data such as typical values for ground and airborne transmitter power, are reproduced in Tables 2 – 1a and 2 – 1b. Protection of aeronautical VHF air/ground communication systems is based on the principle that these minimum field strength levels are not subject to harmful interference if the interfering (undesired) signal is either more than 14 dB (re. paragraph 2.3.2 a) or more than 20 dB (re. paragraph 2.3.2. b) below the specified minimum field strength (of the desired signal).

Protection is achieved by securing that the potential interferer is located at a distance that will allow for the interfering signal to sufficiently below the minimum field strength (see paragraph 1.3.3 which describes the line-of-sight method or paragraph 1.3.4 which describers the separation distance ratio method). The line-of-sight method is used in all ICAO Regions, except Europe and [parts of[North America, where a combination of the two methods is being used.

Table 2 – 1a also contains typical values for ground and airborne transmitter power that can be used in interference assessment.

Parameter	DSB-AM	DSB-AM	VDL-M2	VDL-M2	VDL-M3	VDL-M3	VDL-M4	VDL-M4
TRANSMITTER	Airborne	Ground	Airborne	Ground	Airborne	Ground	Airborne	Ground

Output power transmitter (typical ground station output power is 25 or 50 W (44 or 47 dBm)	44 dBm (25 W)	50 dBm (100 W)	42 dBm (16 W)	44 dBm (25 W)	44 dBm (25 W)	44 dBm (25 W)	42 dBm (15 W)	45 dBm (32 W)
Feeder loss (assumed)	-3 dB	-3 dB	-3 dB	-3 dB	-3 dB	-3 dB	-3 dB	-3 dB
Antenna gain (assumed)	0 dB	2 dB	0 dB	2 dB	0 dB	2 dB	0 dB	2 dB
EIRP	41 dBm (12.5 W)	49 dBm (80 W)	39 dBm (8W)	43 dBm (20 W)	41 dBm (12.5 W)	43 dBm (20 W)	40 dBm (10 W)	44 dBm (25 W)
Adjacent frequency emission (Transmitter) for VDL specified in Annex 10, Vol. III, Part I, paragraph 6.3.4								
1st adj fr. (16 kHz bandwidth)	Not specified in Annex 10		-18 dBm	-18 dBm	-18 dBm	-18 dBm	-18 dBm	-18 dBm
2nd adj fr. (25 kHz bandwidth)	Not specified in Annex 10		-28 dBm	-28 dBm	-28 dBm	-28 dBm	-28 dBm	-28 dBm
4th adj fr. (25 kHz bandwidth)	Not specified in Annex 10		-38 dBm	-38 dBm	-38 dBm	-38 dBm	-38 dBm	-38 dBm
8th adj fr. (25 kHz bandwidth)	Not specified in Annex 10		-43 dBm	-43 dBm	-43 dBm	-43 dBm	-43 dBm	-43 dBm
16th adj fr. (25 kHz bandwidth)	Not specified in Annex 10		-48 dBm	-48 dBm	-48 dBm	-48 dBm	-48 dBm	-48 dBm
32nd adj fr. (25 kHz bandwidth)	Not specified in Annex 10		-53.dBm	-53.dBm	-53.dBm	-53.dBm	-53.dBm	-53.dBm

Table 2 – 1a Typical values for various parameters for VHF communication systems (transmitter)

Parameter	DSB-AM	DSB-AM	VDL-M2	VDL-M2	VDL-M3	VDL-M3	VDL-M4	VDL-M4
RECEIVER								
Min signal at receiver antenna (Annex 10, Vol. III)	75 µV/m (-82 dBm) part II 2.2.1.2	20 µV/m (-93 dBm) part II 2.3.1.2	75 µV/m (-82 dBm) part I 6.2.2.	20 µV/m (-93 dBm) part I 6.3.2	75 µV/m (-82 dBm) part I 6.2.2.	20 µV/m (-93 dBm) part I 6.3.2	35 µV/m (-88 dBm) part I 6.9.5.1.1.1	35 µV/m (-88 dBm) part I 6.9.5.1.1.1
Feeder loss	-3 dB	-3 dB	-3 dB	-3 dB	-3 dB	-3 dB	-3 dB	-3 dB
Antenna gain	0 dB	2 dB	0 dB	2 dB	0 dB	2 dB	0 dB	2 dB
Min. signal at receiver input	-85 dBm	-94 dBm	-85 dBm	-94 dBm	-85 dBm	-94 dBm	-91 dBm	-89 dBm
Out-of-band immunity performance of receiver as per Annex 10, Volume III, Part I, paragraph 6.3.5.3.(VDL) and Volume III, Part II, paragraph 2.3.2.8 (DSB-AM).								
1st adj. Ch			-40 dB	-40 dB	-40 dB	-40 dB	-40 dB	-40 dB
4th adj. Ch	-50 dB	-50 dB	-60 dB	-60 dB	-60 dB	-60 dB	-60 dB	-60 dB

Table 2 – 1b Typical values for various parameters for VHF communication systems (receiver)

Conversion from input power (dBm) to field strength (µV/m and v.v.) was done on the basis of the following formula:
Pr = E - 20logF - 167.2;
Where:
Pr is isotropically received power (dB(W))
E is the electric field strength (dB(µV/m) and
F is the frequency (GHz)
(ITU-R Recommendation PN.525-2 refers).
dBm is power relative to 1 milliwatt.
This formula can be converted in

10logPr = 20logE – 20logF-77.2

where Pr is signal at receiver antenna (in space) in mW, E is the field strength at the antenna in µV/m and F is the frequency f in MHz.
[dB(µV/m) = 20log(µV/m)]

2.4 Allotment of the frequency band 117.975 – 137 MHz.

2.4.1 Annex 10, Volume V, Chapter 4, paragraph 4.1.1 and Table 4 – 1 has established a general allotment of the frequency band 117.975 – 137 MHz. The main sub-divisions of this band are the frequency bands allocated to both international and national services and frequency bands solely allocated to national services. The provisions of this paragraph are reproduced in Appendix B.

2.4.2 Annex 10, Volume V includes provisions for the use of specific frequencies as follows:
121.5 MHz – Emergency frequency; the guard band for this frequency includes the band 121.425 – 121.575 MHz. (See also Annex 10, Volume V, paragraph 4.1.3.1)
121.6 – 121.9917 MHz (121.975 where 25 kHz frequency separation is deployed) – This band is reserved for ground movement communications, pre-flight checking and ATS clearance services.
123.1 MHz – Auxiliary frequency for SAR purposes. The guard band for this frequency includes the band 123.075 – 123.125 MHz. (See also Annex 10, Volume V, paragraph 4.1.4)
123.450 MHz – Air to air communications channel; to be used when the aircraft is out of the range of VHF ground stations. (See also Annex 10, Volume V, paragraph 4.1.3.2)
136.975 MHz – Common signaling frequency for VDL; this frequency uses the VDL Mode 2 modulation scheme. (See also Annex 10, Volume 5, paragraph 4.1.3.3)
Frequencies in the band **136.500 – 137 MHz** are not available for assignment to frequencies with a bandwidth of less than 25 kHz (See Annex 10, Volume V, paragraph 4.1.8.1.1, note 1).

2.4.3 In addition to the general allotment plan, all Regions have developed a more detailed allotment plan through which operational services are allotted to certain frequency bands and included these in the relevant ICAO Air Navigation Plans (ANP). The prime goal of these allotment plans is to accommodate new frequency assignments in the sub-bands allotted to a particular service. **Appendix E** contains a detailed overview of these allotment plans. The Regional allotment plans are incorporated in the ICAO frequency assignment planning program **SEARCH FREQUENCY**.

2.4.4 Frequency assignments should preferably be made in accordance with the provisions of the Regional allotment table. However, in case a particular requirement for a frequency assignment cannot be made from within the sub-band that is allotted to a particular service, other sub-bands can be considered to satisfy the requirement. The Regional frequency allotment plans also include provisions for sub-bands for aeronautical operational control (AOC) communications.

2.5 Frequency separation and channeling

2.5.1 Annex 10 stipulates that the minimum separation between assignable frequencies in the aeronautical mobile (R) service shall be 8.33 kHz. (Annex 10, Volume V, paragraph 4.1.2.1.)

2.5.2 Currently, 8.33 kHz frequency separation has only been introduced in the EUR Region. All other Regions have agreed to base frequency assignment planning on 25 kHz frequency separation. This implies that radio equipment designed for 50 kHz or 100 kHz frequency separation may not always be protected from harmful interference that can be caused by stations operating on adjacent 25 kHz or 8.33 kHz frequencies.

2.5.3 The ICAO program for frequency assignment planning **SEARCH FREQUENCY** has implemented compatibility calculations for all frequency assignments with 25 kHz frequency separation. In this program the user can select to search for frequencies on multiples of 50 kHz and 100 kHz; however, the planning and protection criteria that are applied relate to 25 kHz frequency separation only.

Note: Criteria for frequency assignment planning in a mixed 8.33 kHz/25 kHz environment is being implemented in the program ***SEARCH FREQUENCY****.*

2.5.4 Annex 10, Volume V, Chapter 4 (*Utilization of frequencies above 30 MHz*), Paragraph 4.1.2 (*Utilization in the band 117.975 – 137 MHz; Frequency separation and limits of assignable frequencies*) contains more material regarding the frequency separation and the protection dates of the different systems that can operate in the band 117.975 – 137 MHz.
Note: the protection dates specified in the relevant SARPs require updating.

2.5.5 Protection of 25 kHz frequency assignments

2.5.5.1 In Regions that continue operation with a frequency separation of 25 kHz, frequency assignments are protected from harmful interference from the use of frequencies operating on multiples of 8.33 kHz in (adjacent) Regions (see Annex 10, Volume V, paragraph 4.1.2.2.1, note and 4.1.8.1.1, note 2).

2.5.6 Channeling

2.5.6.1 Normally, in aviation the frequency in use is identified through the frequency (and not a channel number) (e.g. *frequency* 118.150 (as used in radio telephony) is the frequency 118.850 MHz and *frequency* 118.975 is the frequency 118.975 MHz.) For the use of 8.33 kHz frequencies in one single radio that can operate in 8.33 kHz frequency separation mode as well as in 25 kHz frequency separation mode, the frequency identification for 8.33 kHz frequencies was replaced with a channel identification similar to the method used for identifying frequencies. The channel/frequency identification is in accordance with Table 2 – 2. (See also Appendix C).

Frequency (MHz)	Frequency separation (kHz)	Channel #
118.0000	25	118.000
118.0000	8.33	118.005
118.0083	8.33	118.010
118.0167	8.33	118.015
118.0250	25	118.025
118.0250	8.33	118.030
118.0333	8.33	118.035
118.0417	8.33	118.040
118.0500	25	118.050
118.0500	8.33	118.055
118.0583	8.33	118.060
118.0667	8.33	118.065
118.0750	25	118.075
118.0750	8.33	118.080
118.0833	8.33	118.085
118.0917	8.33	118.090
118.1000	25	118.100
etc.		

Table 2 – 2 Channeling / frequency pairing for frequencies with 25 kHz and 8.33 kHz separation

2.6 Services and designated operational coverage

2.6.1 Frequency assignments are made to implement specific aeronautical services as follows:

Aerodrome
TWR Aerodrome control service
AS Aerodrome surface communications
AFIS Aerodrome flight information service

Approach
APP Approach control service
ATIS Automatic terminal information service

En route
FIS Flight information service
ACC Area control service

Other functions
A/A Air-to-air
A/G Air-to-ground
AOC Aeronautical operational control
VOLMET Meteorological broadcast for aircraft in flight
GPS VHF En-Route General Purpose System
EMERGENCY Emergency
SAR Search and rescue

2.6.1.1 No frequency coordination of frequency assignment planning is necessary for the emergency frequency (121.500 MHz) and the SAR frequency (123.100 MHz) as these services are available globally at each station where this service is required. Also, no specific frequency assignment planning is required for the air-to-air communication channel 123.450 MHz as this channel is to be used only in remote and oceanic areas when the aircraft is outside VHF coverage and does not involve ground stations.

2.6.2 Table of uniform values for designated operational coverage (DOC)

Frequencies for aeronautical radio communication services are (normally) implemented to satisfy the operational need for specific services. These services, and their uniform designated operational coverage areas, are as in Table 2 – 3.

Service	Designated Operational Coverage			
	Range (NM)	Height (ft)	Comments	
Aerodrome				
TWR	25	4000*		
PAR	25	4000*	Also APP-PAR	
AFIS	25	4000*		
AS	Limits of aerodrome	surface		

Approach				
APP–L	50	12000	Also APP-SR-L	
APP–I	75	25000	Also APP-SR-I	
APP–U	150	45000	Also APP-SR-U	
En-Route				
ACC–L	Area	25000	Within specified area; also ACC-SR-L	
ACC-I	Area	25000	Within specified area; also ACC-SR-I	
ACC–U	Area	45000	Within specified area; also ACC-SR-U	
FIS	Area	45000	Within specified area	
FIS-L	Area	25000	Within specified area	
FIS-U	Area	45000	Within specified area	
VOLMET	260	45000	Maximum coverage	
Other functions				
ATIS	260	45000	In EUR the uniform DOC is 60/200	
A-A	-	-	DOC to be determined by States	
A-G	-	-	DOC to be determined by States	
AOC	Not protected	Not protected		
EMERG	N/A	N/A		
SAR	N/A	N/A		
GPS			To be determined by States	

Table 2 – 3 Table of uniform designated operational coverage

*Notes: * Height above ground*

Additional functionality in the column “comments” may be added to the services as follows:

CD Clearance delivery
CTA CTA
DF Direction finding
ER Extended range
RCAG Remote controlled air-ground communications
SR Surveillance Radar

These additions do not alter the basic service or the DOC for which the frequency is required and should be included as a remark to the frequency assignment in the COM list in the global table of frequency assignments and the program **SEARCH FREQUENCY**.

2.6.3 Non-standard DOC (Range and Height) may be implemented as and when required. Reduced DOC may alleviate frequency congestion.

2.6.4 The use of common frequencies, preferably Region wide, to satisfy requirements for specific non-protected applications such as light aviation, gliding and balloon activities is recommended as such use increases the efficiency in frequency assignment planning. Normally, these applications operate on a non-protected basis.

2.6.5 Frequencies for aeronautical operational control are not protected through frequency planning. These frequencies are normally assigned on the basis of the traffic loading that is expected. (E.g. within the same area, smaller airlines can share the same frequency for operational control purposes).

2.6.6 The risk of interference from FM broadcasting stations operating in the band 87 – 108 MHz is generally not considered for frequency assignments in the band 117.975 – 137 MHz.

2.6.7 ICAO frequency assignment planning does not include protection against interference that may be caused in case facilities are co-located (e.g. interference due to intermodulation products)

2.6.8 Frequency coordination must take place with all States which may be affected by a proposal for a new frequency assignment or where the characteristics of an existing assignment are modified. Normally, such coordination is effected through the ICAO Regional Offices which have a central and coordinating role in frequency assignment planning.

2.7 Calculation of separation distances

Note: The material contained in this section can be used in areas where frequency assignment planning is based solely on 25 kHz or 8.33 kHz frequency separation. Paragraph 2.7.5 contains material to be considered when establishing separation distances in a mixed 25 kHz and 8.33 kHz environment

2.7.1 Protection of frequency assignments from harmful interference is achieved through frequency and/or distance separation. Normally, the determining factor in frequency assignment planning is the risk of interference between two aircraft, operating within different DOC areas at the closest point. As normally the ground station is located well within the DOC area, the ground station is protected when the aircraft (receiver) is protected from harmful interference.

2.7.2 The separation distances provided in this paragraph are the minimum distances that need to be maintained between the ground stations that provide the relevant service. The separation distances have been established using the method in paragraph 1.3 and 2.2 and the protection requirements as in paragraph 2.3.

2.7.3 Co-frequency separation distances

2.7.3.1 Air/ground communication services. Protection of co-frequency assignments for air/ground communication services (involving aircraft transmissions) is obtained by securing that the D/U ratio is in accordance with the regionally agreed value. The D/U ratio can be either 14 dB or 20 dB. (Re. paragraph 2.3.2).

2.7.3.1.1 Co-frequency separation distance for air/ground communications

D/U is 20 dB (radio line-of-sight)

As described in 1.3.4.2 and 2.2.1, in Regions where a protection ratio (desired over undesired signal, D/U) of 20 dB has been agreed, the minimum separation distance from the edge of the DOC (of the desired) ground station A to another (undesired) aircraft, operating on the same frequency (and outside the desired DOC), should be the sum of the distance to the radio horizon from each aircraft station. As shown in Figure 2 - 2, when the ground stations have a designated operational range of $\mathbf{R_A}$ and $\mathbf{R_B}$ respectively and $\mathbf{RH_A}$ and $\mathbf{R_B}$ is the distance from the respective aircraft to the radio horizon, the minimum separation distance *between the ground stations* should be

$$\mathbf{R_A + RH_A + RH_B + R_B.}$$

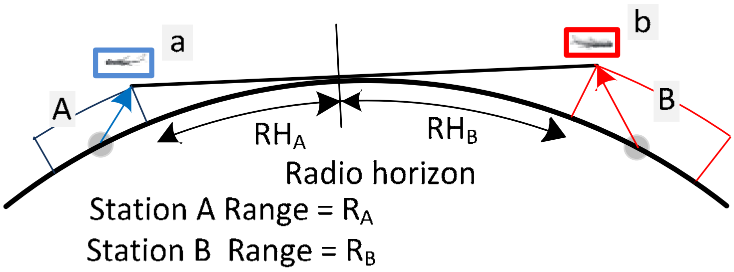


Figure 2 – 2 Separation distance based on Radio line-of-sight

Separation distance for D/U is 14 dB (1 : 5 separation distance ratio)

As described in 1.3.4, where a D/U protection ration of 14 dB is applied, the 1:5 distance ratio is to be used. To meet the 14 dB protection requirement, the distance between the aircraft receiver and the (interfering) aircraft transmitter needs to be at least 5 times the distance between the aircraft receiver and the desired ground station. This assumes that the e.i.r.p of both the [desired] station and the [undesired; interfering] station is the same. Where the e.i.r.p of the transmitters is different, adjustments to this formula are necessary (see paragraph 1.3.4).

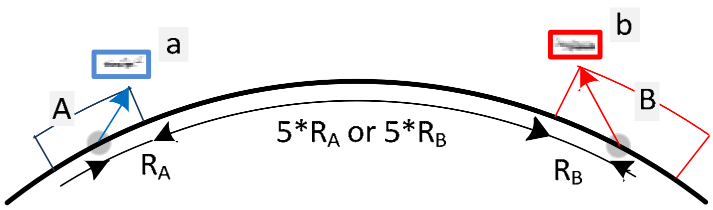


Figure 2 – 3 Separation distance based on 5 to 1 distance ratio

In Figure 2 – 3 the designated operational range for ground station A is $\mathbf{R_A}$ and for ground station B is $\mathbf{R_B}$. If the (minimum separation) distance from aircraft station **a** to aircraft station **b** is at least 5 times the distance from aircraft station a to ground station A (**5*$\mathbf{R_A}$**) aircraft station **a** is protected from interference from aircraft station **b**. Vice versa, if the distance from aircraft station **b** to aircraft station **a** is at least 5 times the distance from aircraft station **b** to ground station B (**5*$\mathbf{R_B}$**) aircraft station **b** is protected from interference from aircraft station a. The minimum separation distance between the two aircraft stations a and b is the largest of **5*$\mathbf{R_A}$** and **5*$\mathbf{R_B}$**. The minimum separation *between the ground stations* is the larger value of

$$\mathbf{R_A + 5R_A + R_B} \; \textit{or} \; \mathbf{R_A + 5R_B + R_B.}$$

In cases where this value is larger than $\mathbf{R_A + RH_{SA} + RH_B + R_B}$ (as described in paragraph 2.7.3.1.1 above) the line-of-sight criterion should be used.

2.7.3.1.2 Area services

For area services (such as ACC or FIS) the minimum separation distance that should be applied is the minimum distance between the closest point between the limit of the area services at maximum height (and, if applicable, also circular). The distance between these points at the limit of the DOC shall be at least the sum of the radio horizon of each aircraft at maximum protected flight level. The minimum separation distance between area services (and in cases where one service is an area service and the other service is a circular service) is $\mathbf{RH_A + RH_B}$ *between* the closest points of the respective service area. (See also paragraph 2.7.6)

The ICAO frequency assignment planning program **SEARCH FREQUENCY** currently has implemented planning criteria applicable to the 20 dB D/U protection ratio (radio line-of-sight), as established in paragraph 2.7.3.1.1. In line with current practice in many Regional Offices, area services are protected as a circular service, with a maximum operational range to the radio horizon for the specified height (e.g. 260 NM for an ACC/U service with a maximum flight level of 450 (45000 ft). The program plots on a map any potential interference that can be predicted within the designated operational coverage of the area service.

2.7.3.1.3 Co-frequency separation distances – broadcast services (ATIS and VOLMET)

Broadcast services such as ATIS and VOLMET are characterized by ground-to-air transmissions only and do not involve airborne transmissions. As a consequence, the separation distance between broadcast (ground) stations can be smaller compared to the case where aircraft transmissions are involved.

To protect an aircraft which is receiving broadcasts from an aeronautical ground broadcast station from interference from another aeronautical ground broadcast station, the minimum co-frequency separation distance between the (wanted) aircraft to the (unwanted) ground station is the distance to the radio horizon from the (wanted) aircraft plus 30 NM. This separation distance secures that the undesired VOLMET or ATIS station is located well beyond the radio horizon of the (desired) aircraft and accommodates a normally higher e.i.r.p for VOLMET (or ATIS) transmitters (typically 100 W). The designated operational coverage for these broadcast stations is normally the maximum that can be achieved (260 NM at flight level 450). The interference mechanism is shown in Figure 2 –45.

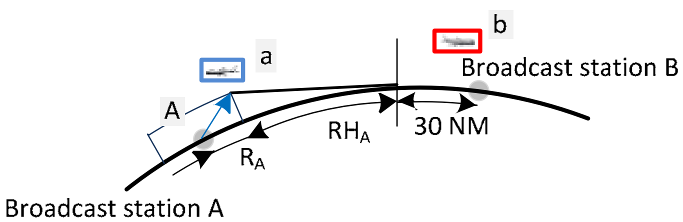


Figure 2 – 4 Interference mechanism between broadcast services

The minimum separation distance between two (ground) broadcast stations is

$$\mathbf{R_A+RH_A+30\ (NM)}$$

To secure compatibility when station B is the wanted broadcast station and aircraft B is the desired receving aircraft station, the minimum separation distance between the (ground) broadcast stations A and B is

$$\mathbf{R_B+RH_B+30\ (NM)}$$

To secure compatibility between the two broadcast stations the minimum separation distance to be maintained *between the ground* broadcast stations **A** and **B** respectively is the larger value of:

$$\text{(Max) } RH_A + RA + 30 \textit{ or } RH_B + RB + 30$$

Where: R_A is the designated operational range for ground broadcasting station “A”
R_B is the designated operational range for ground broadcasting station “B”
RH_A is the distance to the radio horizon of aircraft A
RH_B is the distance to the radio horizon of aircraft B
(Distances in NM)

Note: these values are specified for VOLMET in Annex 10, Volume V, Attachment A paragraph 5.
[In the EUR Region, where the protection requirement of 14 dB D/U is used, the minimum separation distance to the (undesired) broadcast station is 5 times the designated operational range of the (desired) broadcast service or the distance to the radio horizon from the edge of the range of the (desired) broadcast signal, whichever distance is less].

2.7.3.1.4 Co-frequency separation distances – broadcast and air-ground services

To protect an aircraft station receiving broadcasts from a ground station from another station providing air/ground communications the mechanism as shown in Figure 2 - 5 applies

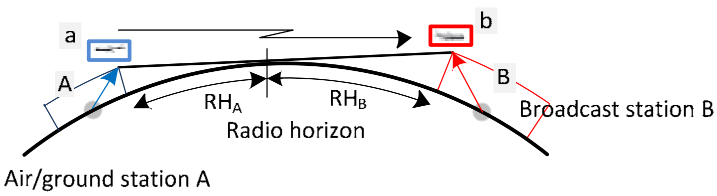


Figure 2-5 Interference mechanism between broadcast service and air/ground service

In order to protect aircraft B, which is receiving (only) broadcast information from ground broadcast station B (e.g. VOLMET or ATIS), from interference that can be caused by transmissions from aircraft station B, the minimum separation between the two aircraft stations needs to be the sum of the radio horizon of aircraft station A (RH_A) and the radio horizon of aircraft station B (RH_B). The minimum separation distance between the two ground stations then becomes:

$$\mathbf{R_A + RH_A + RH_B + RB}$$

Where: R_A is the designated operational range for station “A”

R_B is the designated operational range for broadcasting station "B"
RH_A is the distance to the radio horizon of aircraft A
RH_B is the distance to the radio horizon of aircraft B
(Distances in NM)

This distance is the same as in the case where both services are air/ground communication services (see paragraph 2.7.3.1.1).

To protect aircraft A from interference that can be caused by (ground) broadcast station B, the minimum separation between the two ground stations needs to be (see paragraph 2.7.3.1.3):

$$\mathbf{R_A+RH_A+30\ NM}$$

To protect both stations from interference that can be caused by each other, the maximum of the distances to be applied is

$$\mathbf{(Max)\ R_A + RH_A + RH_B + R_B}\ \mathit{or}\ \mathbf{R_A+RH_A+30\ NM}$$

2.7.3.4 Unprotected services.

2.7.3.4.1 Certain services are not protected from interference and in many cases, no coverage has been determined for these services. An example is the use of frequencies for aeronautical operational control or for special uses such as for gliders and balloons.

2.7.3.4.2 Assignment of frequencies to stations is in these cases normally determined on the basis of the traffic loading that can be expected by the users of these -unprotected- frequencies. As long as these frequencies are in operation exclusively for unprotected use, these assignments are not subject to interference calculations. When these frequencies are shared with protected services, consideration needs to be given whether the use of the unprotected frequencies may cause interference to frequencies (co- and adjacent frequency) which do require protection from harmful interference and an assessment of potential interference should be undertaken. This may result in a situation that while the protected service is to be protected from interference from the unprotected service, the unprotected service is in turn also protected from interference from the protected service.

2.7.3.4.4 In the interest of efficient frequency assignment planning it is important to realize that when frequency assignments to unprotected services are being made, these should preferably be concentrated in one (or more) sub-bands solely reserved for unprotected services. Where feasible, such sub-bands should be established.

2.7.3.4.5 The program **SEARCH FREQUENCY** calculates the potential interference between frequency assignments for unprotected services as well as between frequency assignments for unprotected and for protected services. When presenting the calculation results, interference into unprotected services (or between unprotected services) can omitted from the calculation results.

2.7.4 Adjacent frequency separation distances

2.7.4.1 Air/ground communication services (25 kHz frequency separation).

2.7.4.1.1 The minimum separation between aircraft operating on the first adjacent (25 kHz) frequency is 10 NM (Re. Figure 2 – 6). An effective (first) adjacent frequency rejection of 60 dB is assumed which may lead to interference in cases where 50 kHz equipment is still in use. Annex 10 shows that, for aircraft receivers designed for operation in an environment where the minimum frequency separation is 25 kHz and assuming an effective adjacent frequency rejection of 60 dB or better, the minimum separation to be maintained between aircraft operating on adjacent frequencies is 3 NM. This also applies for receivers operating with a frequency separation of 8.33 kHz and to the first adjacent (8.33 kHz) frequency. These criteria protect the receiver by muting. A 20 dB D/U ratio is considered with this separation distance. Current practice is to use a value of 10 NM instead of 3 NM to secure adjacent frequency protection through frequency assignment planning.

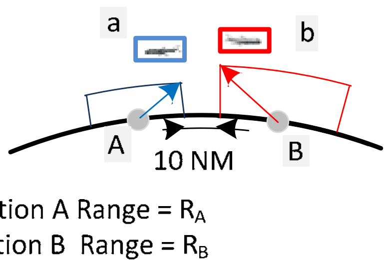


Figure 2 – 6 Adjacent frequency separation for air-ground services.

The minimum separation between two ground stations operating on the first adjacent 25 kHz frequency is:

$$\mathbf{R_A + 10\ NM + R_B}$$

This minimum separation distance prevents adjacent frequency interference between two aircraft and applies when one (or both) aircraft stations provides air/ground communications

2.7.4.2 Adjacent frequency separation distances between broadcast services (ATIS, VOLMET).

2.7.4.2.1 In case both ground stations are broadcast (VOLMET, ATIS) stations, the minimum adjacent frequency separation distance between the aircraft and an unwanted (interfering) ground broadcasting station is 13 NM as shown in Figure 2 – 7.

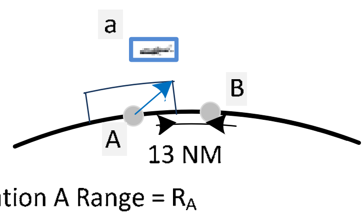


Figure 2 – 7 Adjacent frequency separation between broadcast services

The minimum separation between two ground broadcast stations, operating on adjacent frequency, is

$$\mathbf{R_A + 13\ NM}$$

where: $\mathbf{R_A}$ is the designated operational range for ground broadcast station **A**

Similarly, for broadcast station B, the minimum separation distance between the two ground stations is

$$\mathbf{RB + 13\ NM}$$

where: $\mathbf{R_B}$ is the designated operational range for ground broadcast station B (not shown in Figure 2 – 7)

The minimum separation distance that needs to be secured between the broadcast stations A and B is the larger value of:

$$\text{(Max)}\ \mathbf{R_A + 13\ NM}\ \textit{or}\ \mathbf{RB + 13\ NM}$$

2.7.4.3 Adjacent frequency separation distances – broadcast and air-ground services

2.7.4.3.1 In this case, two different interference mechanisms need to be analyzed. The minimum separation distance can be calculated as follows:

Aircraft a is involved in air/ground communications with ground station A (Range R_A)
Aircraft b is receiving broadcast messages only from ground station B (Range R_B)

a. minimum separation distance between the two ground stations to protect the aircraft station **a** from interference from the (broadcasting) ground station **b,** as described in paragraph 2.7.4.2, is

$$\mathbf{R_A + 13\ NM}$$

where $\mathbf{R_A}$ is the designated operational range of the station providing air/ground communications.

b. minimum separation distance between the two ground stations to protect the broadcast receiver (aircraft station **b**) from interference from aircraft station **a**. With the method as described in paragraph 2.7.4.1, the minimum distance between the aircraft stations is 10 NM. The minimum distance between the ground stations is

$$\mathbf{RA + 10 + RB}$$

where: RA is the designated operational range of the air-ground communication service
RB is the designated operational range of the broadcast service

To secure protection of both services, the minimum separation between the ground stations is the larger value of:

$$\text{(Max)}\ \mathbf{R_A + 13\ NM}\ \textit{or}\ \mathbf{RA + 10 + RB}$$

2.7.5 Co – and adjacent frequency consideration in a mixed environment where 8.33 kHz and 25 kHz frequency separation is being used.

Note: The following criteria are contained in the EUR Frequency management manual and require further consideration, in particular with regard to the protection of frequencies using off-set carrier (CLIMAX) systems.

2.7.5.1 Co-frequency separation criteria should be used when the 8.33 kHz frequency and the 25 kHz frequency are the same (e.g. channel 119.000 and 119.005 operate both on the frequency 119.000 MHz). Co-frequency separation criteria should also be applied between an 8.33 kHz frequency and a 25 kHz frequency which are separated by 8.33 kHz MHz. (e.g. channels 119.010 and 118.990, using frequencies 119.0083 MHz and 118.9917 MHz respectively) are considered both co-frequency to the [25 kHz] frequency 119.000 (119.000 MHz))

2.7.5.2 At least [33] NM should be the separation distance between the edges of the DOC's when the 8.33 kHz and a 25 kHz frequencies are separated by 16.67 MHz (e.g. channels 119.015 and 118.985, using frequencies 119.0167 MHz and 118.9833 MHz).
Note: These frequencies are considered co-frequency to the next 25 kHz frequency (e.g. co-frequency to 119.025 MHz and 118.975 MHz.

2.7.5.3 At least 10 NM should be the separation between the edges of the DOC's when the 8.33 KHz frequency and the 25 kHz frequency are separated by 20 kHz (*i.e.* the same criteria as for a 25 kHz adjacent frequency.

2.7.5.4 At least 4 NM should be the separation distance between an 8.33 kHz frequency and a 25 kHz frequency which are separated by 25 kHz (e.g. channel 118.000 (25 kHz) and 118.030 (8.33 kHz) which use the frequency 118.000 MHz and the frequency 118.025 MHz respectively)

2.7.5.5 Table 2 – 4 gives an overview of the separation distances to be maintained in a mixed 25 / 8.33 kHz environment. The values for the adjacent frequency separation are in NM. "C" indicates that the co-frequency separation criteria (line-of-sight or the 1 : 5 distance ratio needs to be applied.

	118.0000 118.000	118.0000 118.005	118.0083 118.010	118.0167 118.015	118.0250 118.025	118.0250 118.030	118.0333 118.035	118.0417 118.040	118.0500 118.050	118.0500 118.055	118.0583 118.060	118.0667 118.065	118.0750 118.075	118.0750 118.080	118.0833 118.085	118.0917 118.090	118.1000 118.100	118.1000 118.105	118.0000	118.0000	118.0000
118.0000 118.000	C	C	C	33	10	4															
118.0000 118.005	C	C	10		4																
118.0083 118.010	C	10	C	10	33																
118.0167 118.015	33		10	C	C	10			4												
118.0250 118.025	10	4	33	C	C	C	C	33	10												
118.0250 118.030	4			10	C	C	10		4												
118.0333 118.035					C	10	C	10	33												
118.0417 118.040					33		10	C	C	10			4								
118.0500 118.050				4	10	4	33	C	C	C	C	33	10								
118.0500 118.055					4			10	C	C	10		4								
118.0583 118.060									C	10	C	10	33								

118.0667 118.065									33		10	C	C	10							
118.0750 118.075									10	4	33	C	C	C	C	33	10				
118.0750 118.080									4			10	C	C	10		4				
118.0833 118.085													C	10	C	10	33				
118.0917 118.090													33		10	C	C	10			
118.1000 118.100													10	4	33	C	C	C	C		
118.1000 118.105													4			10	C	C			

Table 2 – 4 Adjacent frequency separation distances for a mixed 25 kHz/8.33 kHz environment

2.7.6 Frequency planning criteria for area services

2.7.6.1 For area services, the separation distance is measured from the edge of the coverage of the area service. When the two services considered include a circular service, the separation distance is from the station providing the circular service to the closest point of the edge of coverage of the area service.

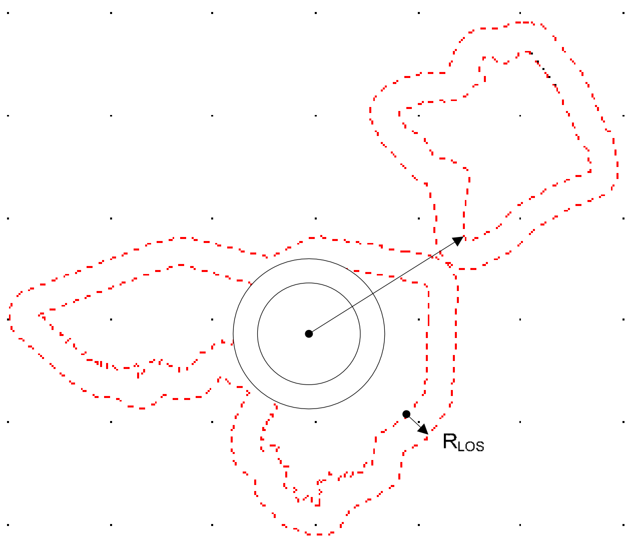


Figure 2 – 8 Minimum separation of area services

Note: R_{LOS} is radio line-of-sight

2.7.6.2 Co-frequency separation

The minimum separation between the designated operational coverage of two area services is equal to the sum of the radio line-of-sight for each area service at the limit of the DOC (coverage). This method provides frequency protection throughout the DOC of the area service. In Figure 2 – 8 around the each of the area services a buffer zone equal to the distance to the radio horizon for an aircraft at maximum altitude of the relevant DOC has been established. The minimum separation to protect the two area services from harmful interference is established at the closest point between the service areas.

2.7.6.2.1 In many cases, for large designated operational coverage areas of area services, a single ground station cannot provide coverage throughout the service area. In these cases, where required, additional coverage is provided through installing extended range stations (forward relay). These stations can operate on the same frequency (using the off-set carrier system as specified in Annex 10, Volume III) or on a discrete frequency. Not in all cases full VHF coverage is provided, in particular for lower flight levels. The program **SEARCH FREQUENCY** can display these coverage areas for Flight Information Regions on a map.

2.7.6.2.2 Frequency protection is being calculated in the program **SEARCH FREQUENCY** for the circular coverage area at the maximum altitude of the station providing the area service. This may lead to overprotection in cases where the coverage of these stations extends outside the area service.

2.7.6.2.3 When the same frequency used by an area service is also used by a broadcasting service (which is a circular service), the minimum separation is the larger value of the following:

a. to protect the aircraft receiver at the edge of the area coverage, the minimum distance to the ground broadcast transmitter should be at least the distance to the radio horizon + 30 NM from the limit of the DOC of the area service

b. the minimum distance from the aircraft broadcast receiver to the airborne transmitter at the edge of the area service should be at least the sum of the distance to the radio horizon (radio line-of-sight) for each aircraft. The minimum distance from the edge of the DOC of the area service to the broadcast transmitter should be at least the sum of the distance to the radio horizon for each aircraft plus the range of the broadcast station.

The methodology for establishing the minimum separation distances is the same as provided in paragraphs 2.7.3 and 2.7.4. However, in order to secure protection of area services throughout the DOC, separation distances are measured from the limit of the DOC rather than from the ground station(s) providing the area service.

2.7.6.3 Adjacent frequency separation for area services.

2.7.6.3.1 The minimum separation distance between the designated operational coverage of two area services are to be separated (at the edge of coverage) by at least 10 NM when in each of the two areas the first adjacent frequencies is being used. (In this case, in figure 2 – 8 the buffer zone around the area service is 10 NM)

2.7.6.3.2 The same condition applies when one of the services is a circular service. In this case, the minimum separation between the edge of the designated operational coverage of the area service and the ground station of the circular service is the range of the circular service + 10 NM

2.7.6.3.3 When the adjacent frequency used by an area service is used by a broadcasting service (which is a circular service), the minimum separation is the larger value of the following:

a. to protect the aircraft receiver at the edge of coverage, the minimum distance to the ground broadcast transmitter from the edge of coverage should be at least 13 NM.

b. the minimum distance from the aircraft broadcast receiving to the airborne transmitter at the edge of the area service should be at least the sum of the distance to the radio horizon (radio line-of-sight) for each aircraft plus 13 NM. The minimum distance from the edge of the DOC of the area service to the broadcast transmitter should be at least 13 NM plus the range of the broadcast station.

2.8 Separation distances for VDL (VDL Mode 2 and VDL Mode 4)

2.8.1 VDL operating co-frequency with other VDL or DSB-AM air/ground communication systems.

The same planning criteria as used between VHF voice systems (20 dB protection ratio) should be used. The separation criteria are those as described in paragraph 2.7.3 above.
Note: This applies to VDL vs. DSB-AM as well as between VDL assignments)

2.8.2 VDL operating on adjacent frequencies:

The 1st frequency, adjacent to either a DSB-AM frequency or a VDL frequency should not be used in the same airspace.

The 2nd frequency, adjacent to a DSB-AM frequency should not be used in the same airspace for VDL Mode 4.

Vs.		Interference source		
		DSB-AM	VDL 2	VDL 4
Victim	DSB-AM		1	2
	VDL 2	1	1	1
	VDL 4	2	1	1

Table 2 – 5 25 kHz guard band (channels) between DSB-AM, VDL mode 2 and VDL mode 4

Note: The numbers in Table 4 are guard-bands (channels). The next frequency that can be used without frequency planning constrain is 1 channel higher (e.g. a desired DSB-AM station that is interfered by a VDL Mode 2 aircraft station requires one 25 kHz guard band.. The next frequency, 50 kHz away, can be used in the same designated operational coverage without any frequency assignment planning constraint.

2.8.3. Attention is drawn to the possibility of interference between DSB-AM and VDL Mode 2/4 when these systems are used on the surface of an airport. Interference can occur if the frequency separation (guard band) is four channels (25 kHz) or less. In this case interference between aircraft stations can be prevented through securing that the minimum field strength of these systems is 70 dBm at the antenna. Any interference that may be caused in ground based receiving stations (i.e. not aircraft stations) can be mitigated through using cavity filters that block in these receivers the reception of unwanted signals from transmissions from aircraft operating on the surface of an airport.

2.9 Separation distances (air ground communication services and ground based broadcasting services)

2.9.1 Applying the methodology as described in paragraph 2.7, separation distances between the edges of the DOC have been calculated using the distance to the radio horizon (R_{LOS}) as below:

Symbol	Service range (NM)	Service height	Radio horizon
TWR	25 NM	4000 ft	78 NM
AFIS	25 NM	4000 ft	78 NM
AS	Limits of aerodrome	Surface	N/A
APP-U	150 NM	45000 ft	260 NM
APP-I	75 NM	25000 ft	195 NM
APP-L	50 NM	12000 ft	134 NM
ACC-U	Specified area	45000 ft	260 NM
ACC-L	Specified area	25000 ft	195 NM
FIS-U	Specified area	45000 ft	260 NM
FIS-L	Specified area	25000 ft	195 NM
VOLMET	260 NM	45000 ft	260 NM
ATIS	260 NM	45000 ft	260 NM

Table 2 – 6 Distance to radio horizon with aircraft at maximum altitude

Note: Radio horizon of the aircraft from the edge of DOC.

The minimum separation distances between the ground stations are summarized in Table 2 – 7 and are in accordance with the methods described in paragraph 2.7.3.

2.9.1.1 Automatic Terminal Information Service, or ATIS, is a continuous broadcast of recorded information in busier terminal (i.e. airport) areas. ATIS broadcasts contain essential information, such as weather information, which runways are active, available approaches, and any other information required by the pilots, such as important NOTAMs. As a terminal service, ATIS may not require a DOC greater than APP/U.*(to be confirmed).* In Tables 2 – 6 and 2 – 7 the designated operational coverage for ATIS is assumed to be the maximum achievable (260 NM / 45000 ft.), in accordance with current practice in various Regions.

		VICTIM											
	Service	**TWR 25/40**	**AFIS 25/40**	**AS 10/1.5**	**APP-U 150/450**	**APP- I 75/250**	**APP-L 50/120**	**ACC-U 260/260**	**ACC-L 195/195**	**FIS-U 260/260**	**FIS- L 195/195**	**VOLMET 260/260**	**ATIS 260/260**
INTERFER	**TWR**	206	206	128	513	373	287	623	493	623	493	623	623
	AFIS	206	206	128	513	373	287	623	493	623	493	623	623
	AS *(Note 2)*	128	128	50	435	295	209	545	415	545	415	545	545
	APP-U	513	513	435	820	680	594	930	800	930	800	930	930
	APP-I	373	373	295	680	540	454	790	660	790	660	790	790
	APP-L	287	287	209	594	454	368	704	574	704	574	704	704
	ACC-U *(Note 1)*	623	623	545	930	790	704	1040	910	1040	910	1040	1040
	ACC-L *(Note 1)*	493	493	415	800	660	574	910	780	910	780	910	910

	FIS-U ***(Note 1)***	623	623	545	930	790	704	1040	910	1040	910	1040	1040
	FIS-L ***(Note 1)***	493	493	415	800	660	574	910	780	910	780	910	910
	VOLMET	133*	133*	55*	440*	300*	214*	550*	420*	550*	420*	550	550
	ATIS	133*	133*	55*	440*	300*	214*	550*	420*	550*	420*	550	550

Table 2 -7 – Minimum geographical co-frequency separation distances between stations

*Note 1: All distances are in NM. Separation distances are between the facilities (ground stations) for (circular) services. For area services, the separation distance between the ground stations has been calculated on the basis of the maximum circular coverage that can be obtained at the maximum flight level or the relevant service. Different combinations of the designated operational range and height will result in minimum separation distances that differ from those in Table 2 – 7. The program **SEARCH FREQENCY** calculates the minimum required separation distance on the actual designated operational coverage as specified in the relevant COM List.*

Note 2: For Aerodrome Surface communications, a co-frequency separation distance of 50 NM between two stations has been used. (A DOC of 10 NM / 150 ft. has been assumed). Frequencies for aerodrome surface communications should be selected from the band 121.600 – 121.975 MHz. This band is reserved exclusively for aerodrome surface communications.

Note 3: The designated operational coverage for area services (ACC and FIS) in Table 2 – 7 is assumed to be circular with the following values:

ACC/L and FIS/L: 194 NM / 25000 ft.
ACC/U and FIS/U: 360 NM / 45000 ft.

Note 4: Separation distances marked with an asterix (*) are sufficient to protect an air/ground communication service from interference that can be caused by a (ground) broadcasting station (VOLMET, ATIS). (ATIS/VOLMET stations are the interferer and the air/ground communication service (at the aircraft) is the victim. However, to protect also the broadcasting service, the separation distances for the air/ground communication services as interferer need to be used. (See also 2.7.3.3, 2.9.1.2 and 2.9.1.2.1.)

(Table2-7A – separation distances based on 5:1 distance ratio (14 dB D/U) to be added)

2.9.1.2 VOLMET and ATIS are one-way transmissions from a ground transmitter to the aircraft. Since the VOLMET DOC has been calculated upon the maximum coverage that can be obtained at 45000 ft (260 NM), protection between VOLMET stations can be secured if the separation distance between these DOC is 30 NM, assuming a VOLMET transmitter height of 100ft and results in a VOLMET/VOLMET co-frequency separation distance of 260 + 30 + 260 = 550 NM. This distance would also be sufficient for the protection of ATIS from interference from VOLMET transmissions.

2.9.1.2.1 Not in all cases where interference can be caused by an air/ground communication service into the on-board reception of ATIS/VOLMET broadcast transmission, the ATIS/VOLMET broadcast transmissions will, vice versa, interfere with the (on-board) reception of the air/ground communication service transmission (see 2.7.3.3).

For example, to protect the reception of a TWR service from interference from the transmission of a (ground) VOLMET station (the VOLMET station is the interfere) , the minimum separation distance between the ground TWR station and the ground VOLMET station is the sum of the DOC-range and the radio horizon for the TWR service and 30 NM:

25 NM + 78 NM +30 NM = 133 NM.

To protect also the reception of the VOLMET service from interference from the transmission of the (airborne) TWR station, the minimum separation between the ground VOLMET station and the ground TWR stations is the sum of the DOC range and the radio horizon of the VOLMET station and the sum of the DOC range and the radio horizon of the TWR service:

260 NM + 260 NM +25 NM +78 NM = 623 NM.

To secure compatibility between both stations / services, the minimum separation distance between the two stations needs to be 633 NM.

Note: In these cases the program ***SEARCH FREQUENCY*** *shows the interference caused by the TWR service into the VOLMET service. The TWR service is printed on the map as a protected service.*

2.9.1.3 Minimum separation distances for aerodrome surface communications (AS) are calculated assuming a designated operational range for AS communications of 10 NM and a designated operational height of 150 ft. This results in a minimum co-frequency separation distance of 50 NM. Should the difference in height between the two aerodromes be significantly different, additional margins may need to be added. Separation distances (between facilities) providing air/ground communications operating on the same frequency as the aerodrome communications service have been calculated as the sum of 25 NM (AS) plus the radio horizon plus DOC-range of the air/ground communication service; (see paragraph 2.7.3.1.1). In case the airborne service is an area service (ACC or FIS), only the distance of the radio horizon to the nearest limit of the airborne service has been provided (25 NM (AS plus DOC range airborne service) should apply. Sharing of frequencies with aerodrome surface communications and air/ground communication services is unlikely to occur since an (exclusive) sub-band has been allotted by ICAO for AS communication (121.600-121.975 MHz).

2.9.10 Geographical separation criteria currently used in the AFI, APAC, CAR, MID and SAM Regions.

2.9.10.1 Currently, minimum co-frequency separation distances are being used in the AFI, APAC, CAR, MID and SAM Regions that differ from the separation distances described in paragraph 2.9.1. The regional plans for these regions include provisions for the designated operational coverage and the minimum co-frequency (and in some cases also adjacent frequency) separation distances as summarized in Table 2 – 8.

For information purposes, Table 2 – 8 includes the co-frequency separation distances that have been incorporated in the program **SEARCH FREQUENCY** for similar services (e.g. TWR vs. TWR)

		Table 1				Separation distances implemented in the program SEARCH FREQUENCY	
Air/ground communication for	Symbol	Designated Operational Coverage (DOC)		Minimum co-frequency separation (NM)	Minimum adjacent frequency separation (NM)	Minimum co-frequency geographical separation (NM)	Minimum adjacent frequency Separation (NM)
		Range (NM)	Height (ft.)				
Aerodrome control	TWR	25	4000	175	25	206	60
Surface movement control	AS	Limits of aerodrome	Surface of aerodrome	25	25	50	30
Approach control up to FL 120	APP-L	50	12000	370	60	368	110
Approach control and Flight information up to FL 250	APP-I	75	25000	550	95	540	160
Approach control up to FL 450	APP-U	100	45000	820	180	822	210
Area control or Flight Information up to FL 250	ACC-L FIS-L	Within area plus 50 NM	25000	390*	95*	780	400
Area control or Flight Information up to FL 120	ACC-U FIS-U	Within area plus 50 NM	45000	520*	180*	1040	530
Area control or Flight Information up to FL 120 extended range (also VHF extended range)	ACC-ER or FIS-ER	To be specified	45000	1000 (1300?)	(380)	1040	530
VOLMET up to FL 450	VOLMET	Maximum onmi-directional available	45000	520	180	550	270

Table 2 – 8

Notes:

1. The figure printed in red are the separation distances for similar services (e.g. TWR vs TWR on the same or the first adjacent (25 kHz) frequency) as implemented in the program SEARCH FREQUENCY. In all cases these are the separation distances between stations. For area services the DOC has been assumed to be the maximum range at the maximum specified height. The margin of 50 NM is not included in these separation distances.
2. Separation distances marked with an asterix (*) are separation distances between the DOC of the relevant area services (ACC and FIS).

2.9.10.2 These separation criteria apply to similar services (e.g. TWR vs TWR) only. The application of the detailed allotment plans in each Region (see paragraph 2.4.3 and 2.4.4 and Appendices E and G) whereby a particular service has to be assigned a frequency only allotted to that service facilitates the application of these separation criteria.

2.9.10.3 However, some of the allotments are already made to dissimilar services (e.g. APP-L and APP-I) and in practice, the principle of assigning only frequency within the frequency range determined by the allotment plan (or frequency pool) is not always applied. In these case is it practical, in the absence of more detailed separation criteria, to apply as a minimum separation distance between to dissimilar service the separation distance that applies to the largest required separation distance.

Under this principle, the minimum separation distance between a TWR service and an APP-U service would be 820 NM (which is also the minimum co-frequency separation distance between two APP-U services).

2.9.10.4 Following the principle outlined in this paragraph, the following table (Table 2 – 9) of minimum co-frequency separation has been established that reflects the current practice in various Regions.

Service	**TWR**	**AFIS**	**AS**	**APP-U**	**APP-I**	**APP-L**	**ACC-U**	**ACC-L**	**FIS-U**	**FIS- L**	**VOLMET**	**ATIS**
TWR	175	175	175	820	550	370	1000	750	1000	750	520	660
AFIS	175	175	175	820	550	370	1000	750	1000	750	520	660
AS *(Note 2)*	175	175	50	820	550	370	1000	750	1000	750	520	660
APP-U	820	820	820	820	820	820	1000	820	1000	820	820	820
APP-I	550	550	550	820	550	550	1000	750	1000	750	520	660
APP-L	370	370	370	820	550	370	1000	750	1000	750	520	660
ACC-U *(Note 1)*	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
ACC-L *(Note 1)*	750	750	750	820	750	750	1000	750	1000	750	750	750
FIS-U *(Note 1)*	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
FIS-L *(Note 1)*	750	750	750	820	750	750	1000	750	1000	750	750	750
VOLMET	520	520	520	820	520	550	1000	750	1000	750	520	660
ATIS	660	660	660	820	660	660	1000	750	1000	750	660	660

Table 2 – 9 Minimum co-frequency separation distances applied in the AFI, APAC, CAR, MID and SAM Regions

Chapter 3 Aeronautical VHF and UHF radio air-ground radio navigation systems operating in the band 108 – 117.975 MHz and 960 – 12156 MHz (ILS, VOR, DME, GBAS and VDL Mode 4)

3.1. Introduction

3.1.1 The frequency bands 108 – 117.975 MHz and 960 – 1215 MHz are allocated by the International Telecommunication Union (ITU) to the aeronautical radionavigation service and used for the ICAO standardized Instrument Landing System (ILS), VHF Omnidirectional Range (VOR) and the Distance measuring Equipment (DME). In addition, the band 108 – 117.975 MHz and the band 960 – 1164 MHz is also allocated to the aeronautical mobile (R) service. In the band 108 – 117.975 MHz this allocation was made to enable the use of this band for GBAS (108 – 117.975 MHz) and VDL Mode 4 (112 – 117.975 MHz). The band 960 – 1164 MHz is considered for the implementation of new air-ground data link systems.

3.1.2 ICAO documents relevant to the frequency assignment planning for ILS, VOR, DME, GBAS and VDL Mode 4 systems include:

- *Annex 10, Volume 1 (Radio Navigation Aids)*
- *Annex 10, Volume III*
- *Annex 10, Volume V*
- *ICAO Regional Air Navigation Plans and relevant ICAO Regional Air Navigation Agreements*

3.1.3 For the different radio navigation systems, interference models have been established by ICAO as further documented in this Chapter.

3.1.4 Frequencies for ILS (Localizer and Glide Path), VOR and DME are paired as shown in Figure 3-1.

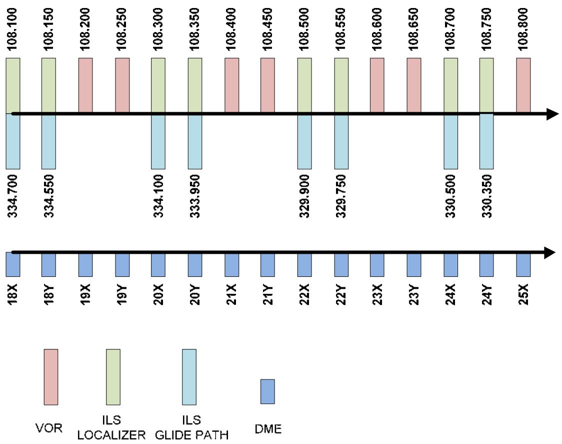


Figure 3-1 Pairing of ILS, VOR and DME frequencies

3.1.4 The coverage of the ILS facility is shown in Figure 3-2. (*For localizer see Annex 10, Volume I,* *3.1.3.3 and for glide path see Annex 10, Volume I, 3.5.3*).

The points P_{LLZ} and P_{GP} in Figure 3 – 2 are the protection points for the localizer and the glide path respectively. However, with the introduction of highly directional localizer antenna arrays, the most critical protection point will not be along the extended runway center line. Directive antennas result in critical protection points at maximum distance, either plus or minus 10 degrees or plus or minus 35 degrees off the runway center line. Protection of these points should be examined during the frequency assignment process. It is therefore safe to assume that the protection points are located throughout the edge of the coverage for the ILS localizer and the ILS glide path.

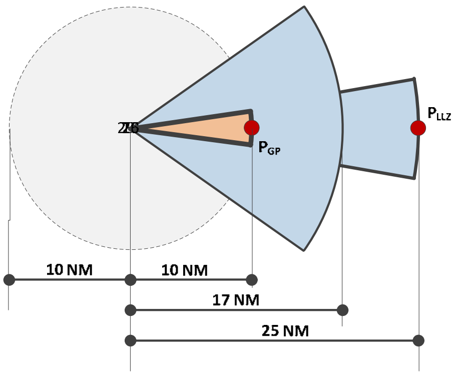


Figure 3 – 2; Coverage of ILS localizer (blue) and ILS glide path (pink)

Where the ILS facility is associated with a DME, the coverage of the DME should be at least that of the ILS facility. In such cases and where the bearing of the ILS is not known and no DME coverage is specified, a circular coverage of 25 NM / 10000 ft could be assumed for frequency assignment planning purposes. The DME coverage can be specified to a DOC different from the ILS DOC.

3.2 Frequency assignment planning criteria for the Instrument Landing System (ILS)

3.2.1 Frequencies and channeling.

The ILS localizer shall operate in the band 108 – 111.950 MHz. The emissions from the localizer are horizontally polarized. (*Annex 10, Volume I, 3.1.2.1).* The channel spacing for ILS localizer frequencies is 100 kHz. In some Regions or areas where congestion for ILS-localizer frequency assignments is expected, the channel spacing is 50 kHz. The correspondent channel spacing for the ILS glide path is either 300 kHz or 150 kHz. ILS localizer frequencies and ILS glide path frequencies are paired as shown in Appendix F. The channel spacing applied in the Regions is as follows (*Note: this list needs to be confirmed*):

Region	Channel spacing
AFI	100/50 kHz
APAC	100/50 kHz
CAR	100 /50kHz
EUR	50 kHz
MID	100/50 kHz
SAM	100/50 kHz

Table 3 – 1 Channel spacing in the VHF band in the Regions

3.2.2 Frequency assignment planning criteria.

3.2.2.1 The frequency assignment planning criteria for the ILS are in *Annex 10, Volume I, Attachment C, paragraph 2.6.* These planning criteria provide for separation distance for areas where ILS localizer receivers are in operation designed for 200 kHz channel spacing, receivers for 100 kHz channel spacing and receivers for 50 kHz channel spacing are in operation.

The minimum separation distances to be applied between ILS facilities are specified in *Annex 10, Volume 1, Attachment C, paragraph 2.6*, as in Table 3 – 2:

	Frequency separation	Minimum separation distance between second facility and the protection point of the first facility (NM)	
		100 kHz channel separation[1]	50 kHz channel separation[2]
Localizer	Co-frequency 50 kHz 100 kHz 150 kHz 200 kHz	80 20 5 0 0	80 5 0 0 0
Glide path	Co-frequency 150 kHz 300 kHz 450 kHz 600 kHz	50 11 1 0 0	50 1 0 0 0

Table 3 – 2 Required separation distances

Note 1.— The above figures are based on the assumption of protection points for the localizer at 46 km (25 NM) distance and 1 900 m (6 250 ft) height and for the ILS glide path at 18.5 km (10 NM) distance and 760 m (2 500 ft) height .
Note 2.— States, in applying the separations shown in the table, have to recognize the necessity to site the ILS and VOR facilities in a manner which will preclude the possibility of airborne receiver error due to overloading by high unwanted signal levels when the aircraft is in the initial and final approach phases.
Note 3.— States, in applying the separations shown in the table, have to recognize the necessity to site the ILS glide path facilities in a manner which will preclude the possibility of erroneous glide path indications due to reception of adjacent channel signals when the desired signal ceases to radiate for any reason while the aircraft is in the final approach phase.

Note: Table for 200 kHz channel separation(which is included in Annex 10) is not shown

Application of these separation distances as per Annex 10 is as follows:

(i) Co-frequency localizer:
The protection distance in Table 3 – 2 should be secured on each point of the limit of the key-hole coverage of the ILS localizer coverage. As in most cases the bearing of the ILS facility is not known, the protection distance (in all azimuths) from the localizer is 80NM +25 NM = 105 NM.
Note: In Europe a different method is applied in case the bearing of the ILS facility is known

(ii) Adjacent frequency localizer:
100/50 kHz channel spacing:
The protection distance in Table 3 – 2 should be secured on each point of the limit of the key-hole coverage of the ILS localizer coverage. As in most cases the bearing of the ILS facility is not known, the protection distance (in all azimuths) from the localizer is 20NM +25

[1] Refers to the use of localizer receivers designed for 100 kHz channel spacing coupled with glide path receivers designed for 300 kHz channel spacing.
[2] Refers to the use of localizer receivers designed for 50 kHz channel spacing coupled with glide path receivers designed for 150 kHz channel spacing.

NM = 62 NM for localizer systems that operate on the first (50 kHz separated) adjacent frequency and 25+ 5 = 30 NM for localizer systems that operate on the second adjacent (100 kHz separated) frequency to protect localizer receivers operating with 100 kHz channel spacing.
50 kHz channel spacing:
To protect localizer receivers operating with 50 kHz channel spacing, the protection distance is 25 + 5 NM on the first adjacent (50 kHz separated) frequency

Note 1: In Europe a different method is applied in case the bearing of the ILS facility is known
Note 2: The provisions in Annex 10 require further clarification. For ILS frequencies operating on 100 kHz frequencies, the first adjacent 100 kHz channel is always a VOR frequency and the nearest ILS frequency is 200 kHz away. In areas where 50 kHz frequency assignments are used for ILS, the nearest ILS frequencies are either 50 kHz, 150 kHz or 200 kHz separated.
Note 3: It is assumed that the channel spacing used in the AFI Region is based on 100 kHz (i.e. ILS localizer receivers designated for 100 kHz channel spacing)

(iii) Co-frequency glide path:
When the co-frequency localizer is protected from harmful interference, the glide path frequency is also protected.

(iv) Adjacent frequency glide path:
300/150 kHz channel spacing: The protection distance in Table 3 – 2 should be secured on each point of the limit of the key-hole coverage of the ILS glide path coverage. As in most cases the bearing of the ILS facility is not known, the protection distance (in all azimuths) from the localizer is 10NM +11 NM = 21 NM for glide path systems that operate on the first (150 kHz separated) adjacent frequency and 10+ 1 = 11 NM for glide path systems that operate on the second adjacent (300 kHz separated) adjacent frequency to protect glide path receivers operating with 300 kHz channel spacing.
150 kHz channel spacing: To protect glide path receivers operating with 50 kHz channel spacing, the protection distance is 10 + 1 NM = 11 on the first adjacent (150 kHz separated) frequency
Note: In Europe a different method is applied in case the bearing of the ILS facility is known

3.2.2.2. Separation distance for ILS / VOR compatibility .

3.2.2.2.1 Co-frequency planning criteria for ILS and VOR.

Annex 10 requires that ILS and VOR cannot operate on the same frequency (see the channeling plan in Appendix E). It may occur that, temporarily an ILS and a VOR share the same frequency. Annex 10, Volume 1, Attachment C, paragraph 3.5.3 gives guidance for the separation distances to be secured in this case.

3.2.2.2.2. Adjacent frequency planning criteria for VOR and ILS

When operating on 100 kHz channels only, each ILS frequency is adjacent to a VOR frequency at 100 kHz frequency separation and to an ILS frequency at 200 kHz separation. For ILS receivers operating designed for 100 kHz channels spacing, the nearest (200 kHz) ILS frequency does not need to be taken into account for frequency assignment planning. In principle, ILS frequencies separated with 200 kHz could be used on the same airport (Figure 3-4).

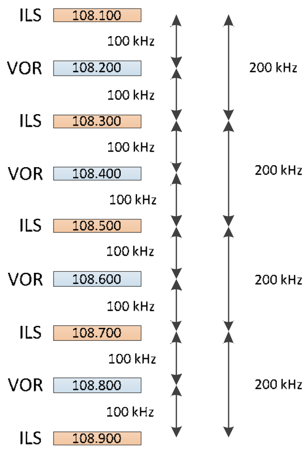


Figure 3-4 Adjacent channels for ILS frequencies with 100 kHz channel spacing.

When operating on 100 kHz <u>and</u> 50 kHz channels, each ILS Localizer frequency is adjacent to a VOR frequency and a Localizer frequency separated with 50 kHz (first adjacent channel).

The second adjacent frequency to an ILS frequency is always a VOR frequency, separated at 100 kHz. (Fig. 3-5).

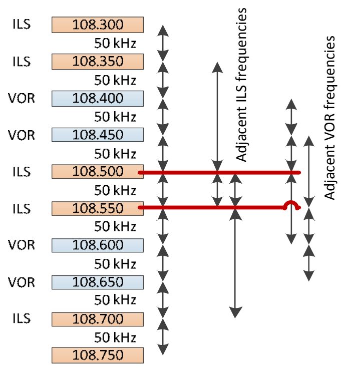


Figure 3-5 Adjacent channels for ILS frequencies with 50 kHz channel spacing

3.2.2.2.2 The separation criteria to protect both the VOR and the ILS localizer are:

a. Protection of the VOR is effectively obtained without geographical separation of the facilities.
b. Protection of the ILS system requires that a VOR spaced at 100 kHz from the ILS frequency (and for a VOR having an e.i.r.p. of 17 dBW (50W)) is located at least 5 NM from the ILS protection point. The minimum separation between an ILS and a VOR facility would be 25 + 5 = 30 NM. (For VOR with an e.i.r.p. of more than 50W, a larger separation distance would be required)

c. Protection of the ILS system requires that a VOR spaced at 50 kHz from the ILS frequency (and for a VOR having an e.i.r.p. of 17 dBW (50W)) is located at least 43 NM from the ILS protection point. The minimum separation between an ILS and a VOR facility would be 25 + 43 = 68 NM. (For VOR with an e.i.r.p. of more than 50W, a larger separation distance would be required).

Note: These separation distances apply in case the localizer receiver is designed for 100 kHz channel spacing. Where localizer receivers designed for 50 kHz channel spacing are used, the separation distance between the ILS and the VOR facility (e.i.r.p is 17 dBW (50W)) is 30 NM.

3.2.2.2.3 Adjacent frequency assignment planning constraints for the ILS glide path.

In paragraph 3.2.2.1 (iv) separation distances to protect the ILS glide path from interference are provided. As shown in Figure 3 – 5, not in all cases the adjacent channel to a localizer frequency is also adjacent to a glide path frequency and vice versa.

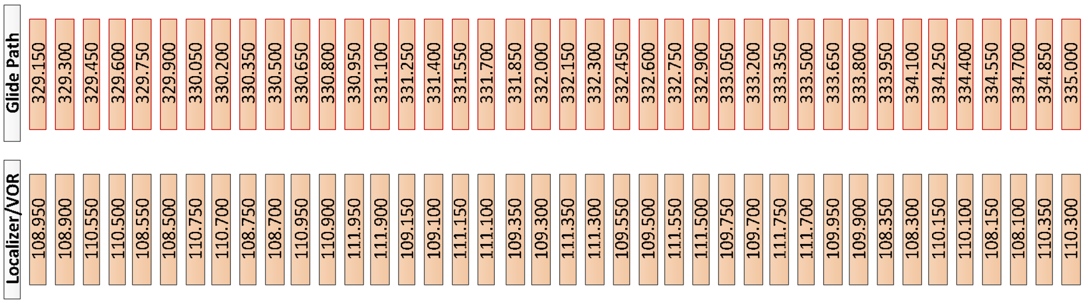


Figure 3 – 5 Overview of adjacent glide path frequencies in relation to the localizer frequency

As an example, when a frequency assignment is being made to the localizer frequency 110.900 MHz, the paired glide path frequency is 330.800 MHz. The adjacent glide path frequencies are as in Table 3 – 3.

To secure protection of the glide path frequencies it is necessary ensure that the adjacent channel protection criteria are met for the glide path frequencies of the ILS facilities with the frequency assignments for the localizer as in Table 3 – 3, even when the localizer frequencies are not adjacent.

Frequency separation (UHF)	Glide path	localizer
- 300 kHz	330.500 MHz	108.700 MHz
- 150 kHz	330.650 MHz	110.950 MHz
0	333.800 MHz	110.900 MHz
+ 150 kHz	330.950 MHz	111.950 MHz
+ 300 kHz	331.100 MHz	111.900 MHz

Table 3 – 3 Adjacent glide path frequencies and not-adjacent localizer frequencies.

3.2.2.2.3.1 In the AFI Region, to date frequency assignments for ILS have only been made on 100 kHz frequencies. In these cases, when the ILS Localizer is protected, the Glide Path is also protected since the adjacent separation distance to protect ILS Localizer is larger than the protection distance necessary to protect the Glide Path.

Only in cases where frequency assignments to ILS are made on 50 kHz frequencies, the protection of (adjacent) Glide Path frequencies needs to be tested. The program **SEARCH FREQUENCY** has not yet incorporated tests of adjacent Glide Path frequencies.

3.2.2.4 Frequency planning criteria FOR ILS used in some Regions.

Current frequency planning criteria for ILS are more conservative. As long as these Regions do not experience or expect congestion on the available frequencies for ILS, these criteria may continue to be used.

Typical values for the protection of ILS facilities are as follows:

ILS Co-frequency separation distance 175 NM

~~ILS Adjacent frequency separation (100 kHz): 45 NM~~

For frequency assignment planning, the frequencies for ILS facilities shall be selected in the following order (*Re. Annex X, Volume V, Chapter 4, paragraph 4.2.2*):

i. localizer frequencies on 100 kHz points and associated glide path frequencies
ii. localizer frequencies on 50 kHz points and associated glide path frequencies

In Regions where the requirements for runway localizer and glide path transmitter frequencies of an ILS does not justify more than 20 pairs, they shall be selected sequentially, as required, in the following order (*Re. Annex 10, Volume I, Chapter 3, paragraph 3.1.6.1.1*):

	Localizer (MHz)	Glide path (MHz)
1	110.3	335.0
2	109.9	333.8
3	109.5	332.6
4	110.1	334.4
5	109.7	333.2
6	109.3	332.0
7	109.1	331.4
8	110.9	330.8
9	110.7	330.2
10	110.5	329.6
11	108.1	334.7
12	108.3	334.1
13	108.5	329.9
14	108.7	330.5
15	108.9	329.3
16	111.1	331.7
17	111.3	332.3
18	111.5	332.9
19	111.7	333.5
20	111.9	333.1

Table 3 -3 Sequence of ILS frequency selection.

Note: the application of this provision in the Regions needs to be confirmed.

In the band 108 – 111.950 MHz, the assignable localizer frequencies are interleaved with VOR frequencies.

The following planning criteria for ILS have been interested in the program **SEARCH FREQUENCY:**

Co-frequency: 175 NM
Adjacent frequency (50 kHz): 43 NM beyond ILS coverage (25 NM +43 NM = 68 NM)
Adjacent frequency (100 kHz): 5 NM beyond ILS coverage (25 NM + 5 NM = 30 NM)

Note: the 1st or 2nd adjacent frequency can be either an ILS of a VOR; the separation distances are as contained in Annex 10, Volume I, Attachment C, 3.5). This material assumes a VOR having an e.i.r.p of 17 dBW (50 W).

3.3 Frequency assignment planning criteria for the VHF Omnidirectional Range (VOR).

3.3.1 Frequencies and channeling.

3.3.1.1 The channeling for VOR is either 50 kHz or 100 kHz. Channeling arrangements for VOR in the band 108 – 112 MHz, which is shared with the ILS Localizer, is shown in paragraph 3.2. In the band 112-117.975 VOR frequencies can be selected on 100 kHz or 50 kHz frequency assignments. Frequencies for VOR are paired with DME as shown in Appendix F.

3.3.1.2 The frequency band 112 – 117.975 MHz is shared with the data link systems GBAS and VDL Mode 4. Compatibility criteria between VOR and these data link systems are contained in paragraphs 3.4 and 3.5 below.

3.3.1.3 Coverage of VOR is specified based on the operational requirements. Normally combinations of a designated operational range and a designated operational height varies from 40 NM / 10.000 ft for a terminal VOR (TVOR) to 200 NM / 45.000 ft for an en-route VOR.

3.3.2 Frequency assignment planning criteria.

3.3.2.1 Detailed considerations of the planning criteria as contained in Annex 10.
(To be added)

3.3.2.2 Planning criteria as agreed in the APAC Region (these criteria are also applicable to the xxx Regions)

For VOR/DME the following criteria have been adopted:

(i) For VORs required to serve en-route flight operations, the geographical separation is:

Co-channel: 550 NM between VOR facilities with a designated operational coverage of 200 NM / 45000 ft
720 NM between VOR facilities with an extended range designated operational coverage of 300 NM / 45000 ft.

For VORs providing a service up to 60000 ft, a minimum geographical separation of 705 NM is appropriate

Adjacent channel (100 kHz): A geographical separation between the facilities of 220 NM is required.

(ii) For VORs required for use in terminal areas, the geographical separation is:

Co-channel: 200 NM for VOR facilities with a designated operational coverage of 40 NM / 25000 ft

Adjacent channel (100 kHz): a geographical separation of between the facilities of 60 NM is required.

(iii) For VORs required for use in final approach and landing, the geographical separation is:

Co-channel: 130 NM NM for VOR facilities with a designated operational coverage of 25 NM / 10000 ft

Adjacent channel (100 kHz): a geographical separation of between the facilities of 30 NM is required.

3.2.2.2.1 These criteria do not provide separation distances in case VORs with a designated operational coverage different from those specified are to be considered. On a provisional basis, subject to further studies, the program **SEARCH FREQUENCY** has implemented the following separation criteria:

Range		Height	Separation distance
≤ 25 NM	**OR**	≤ 10000 ft	130 NM
≤ 40 NM	**OR**	≤ 25000 ft	200 NM
≤ 200 NM	**OR**	≤ 45000 ft	550 NM
≤ 300 NM	**AND**	≤ 45000 ft	720 NM
> 200	**OR**	> 45000 ft	705 NM

Appendix A Aeronautical propagation curves for 125 MHz, 300 MHz, 1200 MHz and 5100 MHz (Source: Recommendation ITU-R P.528)

Appendix B Provisions concerning the deployment of VHF frequencies and the avoidance of harmful interference (Annex 10, Volume V, Chapter 4, paragraph 4.1.5)

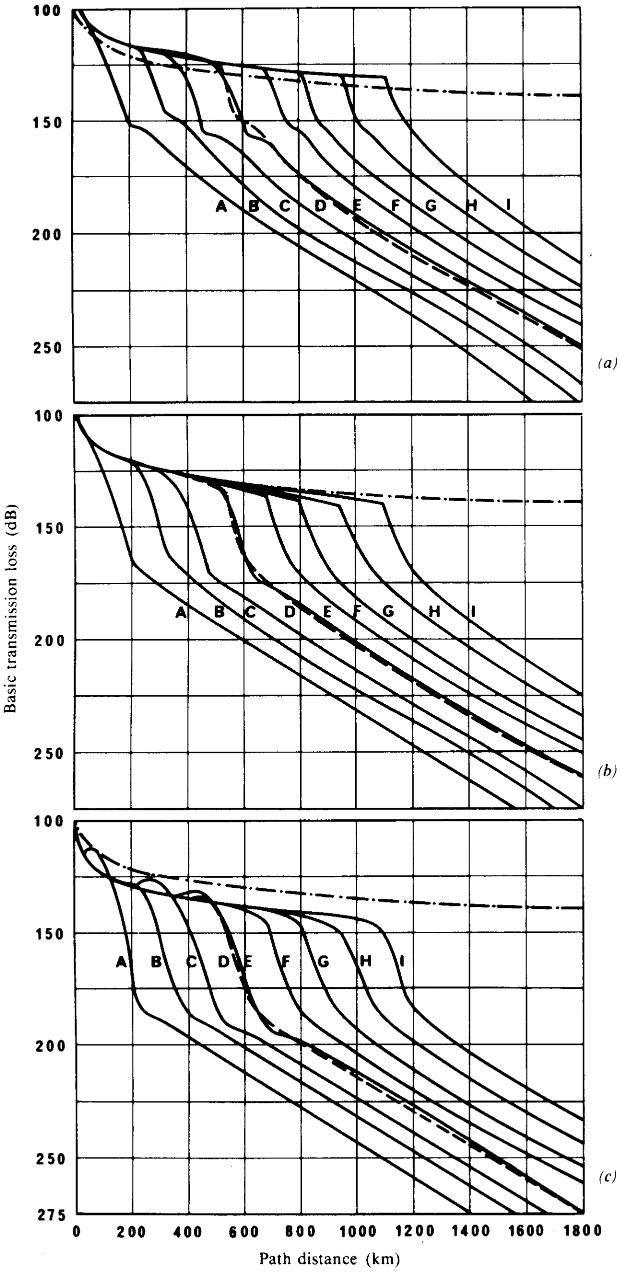
Appendix C Utilization of frequencies above 30 MHz (Annex 10, Volume V, Chapter 4, paragraph 4.1; 4.1.1 – General allotment of frequency band 117.975 – 137 MHz)

Appendix D Terms and definitions

Appendix E Regional frequency allotment plans

Appendix F Frequency/channel pairing between VHF frequencies (localizer and VOR) and UHF frequencies (Glide Path and DME).

Appendix A



Code for antenna heights

Code	H_1 (m)	H_2 (m)
A	15	1000
B	1000	1000
C	15	10000
D	1000	10000
E	15	20000
F	1000	20000
G	10000	10000
H	10000	20000
I	20000	20000

FIGURE 1 – *Basic transmission loss at 125 MHz for 5%, 50% and 95% of the time*

The dotted-line curve is that for free space

D01-sc

Code for antenna heights

Code	H_1 (m)	H_2 (m)
A	15	1000
B	1000	1000
C	15	10000
D	1000	10000
E	15	20000
F	1000	20000
G	10000	10000
H	10000	20000
I	20000	20000

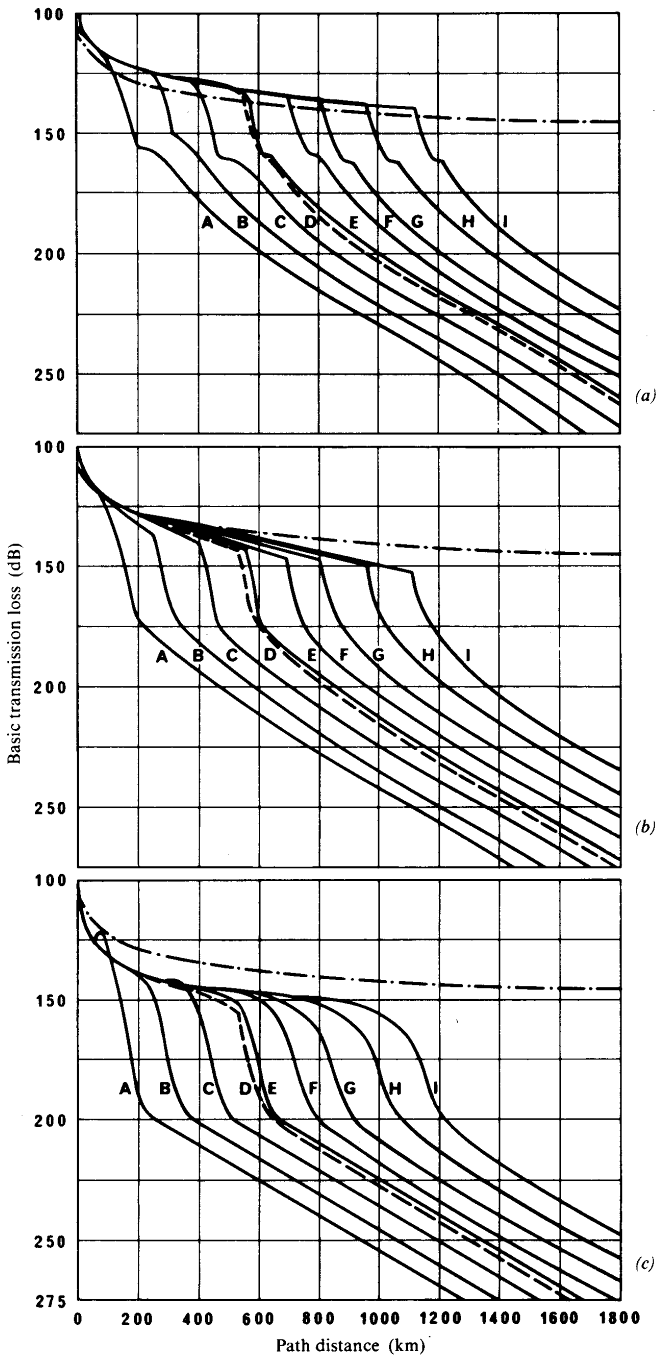
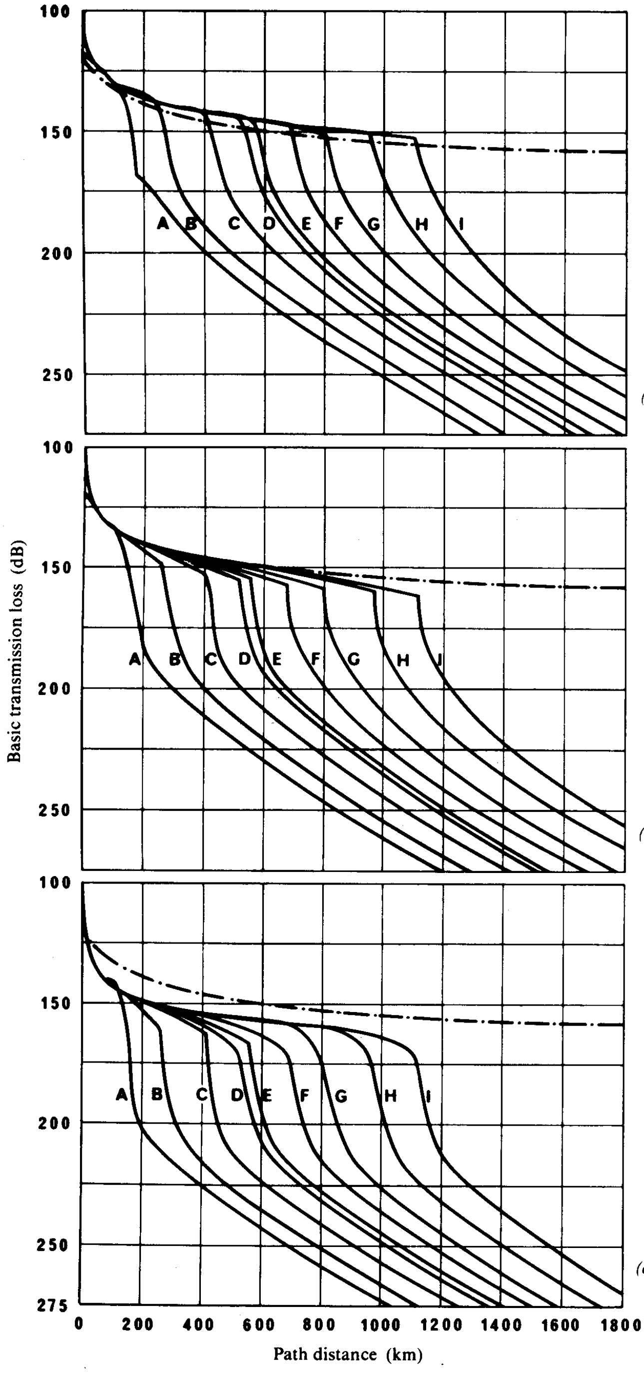


FIGURE 2 – *Basic transmission loss at 300 MHz for 5%, 50% and 95% of the time*

The dotted-line curve is that for free space

D02-sc

Appendix A



Code for antenna heights

Code	H_1 (m)	H_2 (m)
A	15	1000
B	1000	1000
C	15	10000
D	1000	10000
E	15	20000
F	1000	20000
G	10000	10000
H	10000	20000
I	20000	20000

FIGURE 3 – *Basic transmission loss at 1200 MHz for 5%, 50% and 95% of the time*

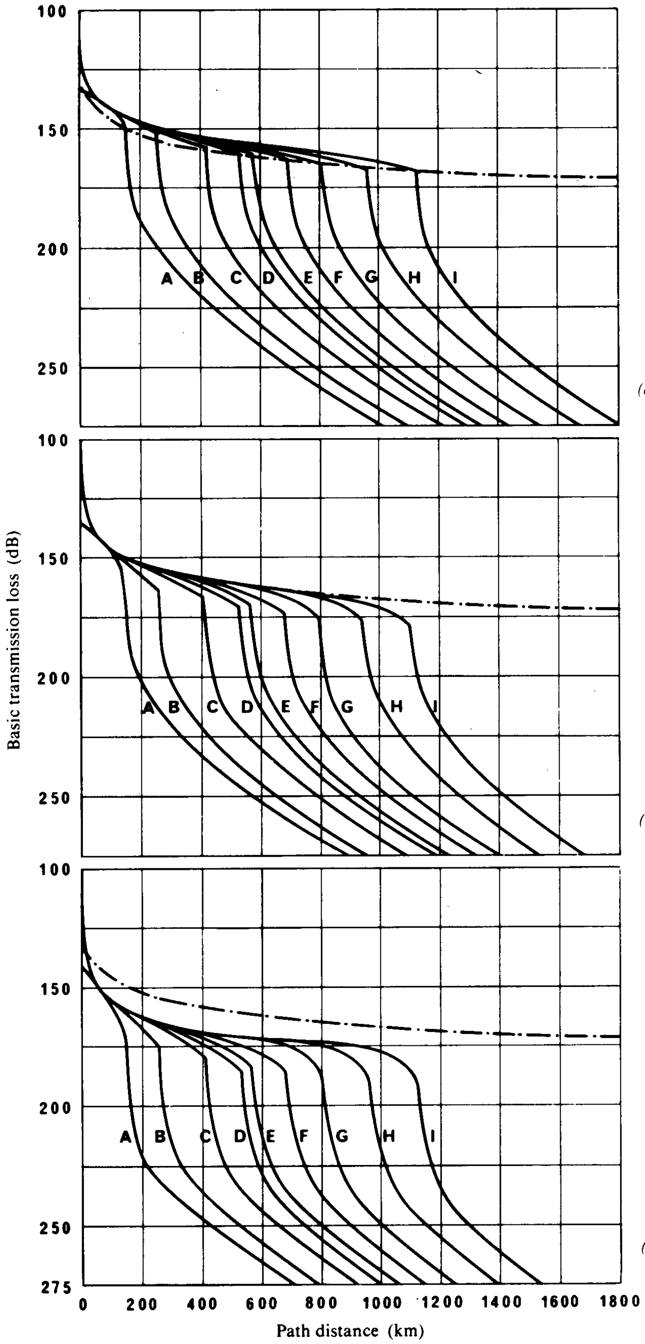
The dotted-line curve is that for free space

D03-sc

Appendix A

Code for antenna heights

Code	H_1 (m)	H_2 (m)
A	15	1000
B	1000	1000
C	15	10000
D	1000	10000
E	15	20000
F	1000	20000
G	10000	10000
H	10000	20000
I	20000	20000



(a) 5100 MHz
$L_b(0.05)$

(b) 5100 MHz
$L_b(0.50)$

(c) 5100 MHz
$L_b(0.95)$

FIGURE 4 – *Basic transmission loss at 5100 MHz for 5%, 50% and 95% of the time*

The dotted-line curve is that for free space

D04-sc

CHAPTER 4. UTILIZATION OF FREQUENCIES ABOVE 30 MHz

4.1 Utilization in the band 117.975 – 137 MHz

Introduction

The band 118 – 132 MHz was allocated in 1947 by the Atlantic City ITU Radio Conference, and again in 1959 by the Geneva Conference, but with extension downwards to 117.975 MHz, for the exclusive use by the aeronautical mobile (R) service.

ITU Radio Conferences subsequent to 1947 also made provisions for the use of the band 132 – 136 MHz for the aeronautical mobile (R) service under conditions which vary for the different ITU Regions, countries or combination of countries. The utilization of this band has been included in the Allotment Table in this chapter. The ITU World Administrative Radio Conference (1979) made provisions for the use of the band 136 – 137 MHz by the aeronautical mobile (R) service, subject to conditions of Nos. S5.203, S5.203A and S5.203B of the Radio Regulations. The use of frequencies in the 136 – 137 MHz part of the band must take account of the conditions contained in these notes. In the utilization of these bands, States' attention is drawn to the possibility of harmful radio interference from non-aeronautical sources of radio frequency energy and the need to take appropriate measures to minimize its effects.

This chapter deals with Standards and Recommended Practices relating to this band and includes matters pertaining to the selection of particular frequencies for various aeronautical purposes. These Standards are introduced by the following preface, which sets out the principles upon which the utilization of VHF on a worldwide basis with due regard to economy has been planned.

Preface

The utilization of VHF on a worldwide basis with due regard to economy and practicability requires a plan that will take into account:

a) the need for an orderly evolution towards improved operation and the required degree of worldwide standardization;

b) the desirability of providing for an economic transition from present utilization to optimum utilization of the frequencies available, taking into account the maximum possible utilization of existing equipment;

c) the need to provide for coordination between international and national utilization so as to ensure mutual protection from interference;

d) the need for providing a framework for the integrated development of Regional Plans;

e) the desirability of incorporating in any group of frequencies to be used those now in use for international air services;

f) the need for keeping the total number of frequencies and their grouping in appropriate relation to the airborne equipment known to be widely used by international air services;

g) a requirement for the provision of a single frequency that may be used for emergency purposes on a worldwide basis and, also, in certain regions, for another frequency that may be used as a common frequency for special purposes; and

h) the need for providing sufficient flexibility to allow for the differences in application necessitated by regional conditions.

4.1.1 General allotment of frequency band 117.975 – 137 MHz

Note.— The plan includes a general Allotment Table that subdivides the complete band 117.975 – 137 MHz, the chief subdivisions being the bands of frequencies allocated to both national and international services, and the bands allocated to national services. Observance of this general subdivision should keep to a minimum the problem of coordinating national and international application.

4.1.1.1 The block allotment of the frequency band 117.975 – 137 MHz shall be as shown in Table 4-1.

4.1.1.2 **Recommendation.—** *In the case of the band 136 – 137 MHz, international applications have not yet been agreed, and these frequencies should be brought into use on a regional basis where and in the manner required.*

4.1.2 Frequency separation and limits of assignable frequencies

Note.— In the following text the channel spacing for 8.33 kHz channel assignments is defined as 25 kHz divided by 3 which is 8.333 ... kHz.

4.1.2.1 The minimum separation between assignable frequencies in the aeronautical mobile (R) service shall be 8.33 kHz.

Note.— It is recognized that in some regions or areas, 100 kHz, 50 kHz or 25 kHz channel spacing provides an adequate number of frequencies suitably related to international and national air services and that equipment designed specifically for 100 kHz, 50 kHz or 25 kHz channel spacing will remain adequate for services operating within such regions or areas. It is further recognized that assignments based on 25 kHz channel spacing as well as 8.33 kHz channel spacing may continue to co-exist within one region or area.

4.1.2.2 Until at least 1 January 2005, DSB-AM equipment specifically designed for 25 kHz channel spacing shall be safeguarded with respect to its suitability for the aeronautical mobile (R) service (AM(R)S) except in those regions or areas where regional agreement permits the use of equipment specifically designed for 8.33 kHz channel spacing or for VDL Mode 3 when used for air-ground voice communications.

Table 4-1 Allotment table

Block allotment of frequencies (MHz)	*Worldwide utilization*	*Remarks*
a) 118 – 121.4 inclusive	International and National Aeronautical Mobile Services	International and National Aeronautical Mobile Services Specific international allotments will be determined in the light of regional agreement. National assignments are covered by the provisions in 4.1.5.9.
b) 121.5	Emergency frequency	In order to provide a guard band for the protection of the aeronautical emergency frequency, the nearest assignable frequencies on either side of 121.5 MHz are emergency frequency, the nearest assignable frequencies on either side of 121.5 MHz are 121.4 MHz and 121.6 MHz, except that by regional agreement it may be decided that the nearest assignable frequencies are 121.3 MHz and 121.7 MHz
c) 121.6 – 121.9917 inclusive	International and National Aerodrome Surface Communications	Reserved for ground movement, pre-flight checking, air traffic services clearances, and associated operations.
d) 122 – 123.05 inclusive	National Aeronautical Mobile Services	Reserved for national allotments.
e) 123.1	Auxiliary frequency SAR	See 4.1.4.1.
f)123.15 – 123.6917 inclusive	National Aeronautical Mobile Services	Reserved for national allotments, with the exception of 123.45 MHz which is also used as the worldwide air-to-air communications channel (see g)).

g) 123.45	Air-to-air communications	Designated for use as provided for in 4.1.3.2.1.
h) 123.7 – 129.6917 inclusive	International and National Aeronautical Mobile Services	Specific international allotments will be determined in light of regional agreement. National assignments are covered by the provisions in 4.1.5.9.
i) 129.7 – 130.8917 inclusive	National Aeronautical Mobile Services	Reserved for national allotments but may be used in whole or in part, subject to regional agreement, to meet the requirements mentioned in 4.1.8.1.3.
j) 130.9 – 136.875 inclusive	International and National Aeronautical Mobile Services	Specific international allotments will be determined in light of regional agreement. National assignments are covered by the provisions in 4.1.5.9. (See the Introduction to 4.1 regarding the band 132 – 137 MHz.)
k) 136.9 – 136.975 inclusive	International and National Aeronautical Mobile Services	Reserved for VHF air-ground data link communications.

4.1.2.2.1 Requirements for mandatory carriage of equipment specifically designed for 8.33 kHz channel spacing shall be made on the basis of regional air navigation agreements which specify the airspace of operation and the implementation timescales for the carriage of equipment, including the appropriate lead time.

Note.— No changes will be required to aircraft systems or ground systems operating solely in regions not using 8.33 kHz channel spacing.

4.1.2.2.2 Until at least 1 January 2005, equipment specifically designed for 8.33 kHz channel spacing shall be safeguarded with respect to its suitability for the AM(R)S.

4.1.2.2.3 Requirements for mandatory carriage of equipment specifically designed for VDL Mode 3 and VDL Mode 4 shall be made on the basis of regional air navigation agreements which specify the airspace of operation and the implementation timescales for the carriage of equipment, including the appropriate lead time.

4.1.2.2.3.1 The agreement indicated in 4.1.2.2.3 shall provide at least two years' notice of mandatory carriage of airborne systems.

4.1.2.2.4 Until at least 1 January 2010, equipment specifically designed to the VDL Mode 3 and VDL Mode 4 SARPs shall be safeguarded with respect to its suitability for the AM(R)S.

4.1.2.3 In the band 117.975 – 137 MHz, the lowest assignable frequency shall be 118 MHz and the highest 136.975 MHz.

4.1.2.4 In regions where 25 kHz channel spacing (DSBAM and VHF digital link (VDL)) and 8.33 kHz DSB-AM channel spacing are in operation, the publication of the assigned frequency or channel of operation shall conform to the channel contained in Table 4-1 (*bis*).

Note.— Table 4-1 (bis) *provides the frequency channel pairing plan which retains the numerical designator of the 25 kHz DSB-AM environment and allows unique identification of a 25 kHz VDL and 8.33 kHz channel.*

Table 4-1 *(bis)*. Channelling/frequency pairing

Frequency MHz)	*Time slot**	*Channel spacing (kHz)*	*Channel*
118.0000		25	118.000
118.0000	A	25	118.001
118.0000	B	25	118.002
118.0000	C	25	118.003

118.0000	D	25	118.004
118.0000		8.33	118.005
118.0083		8.33	118.010
118.0167		8.33	118.015
118.0250	A	25	118.021
118.0250	B	25	118.022
118.0250	C	25	118.023
118.0250	D	25	118.024
118.0250		25	118.025
118.0250		8.33	118.030
118.0333		8.33	118.035
118.0417		8.33	118.040
118.0500		25	118.050
118.0500	A	25	118.051
118.0500	B	25	118.052
118.0500	C	25	118.053
118.0500	D	25	118.054
118.0500		8.33	118.055
118.0583		8.33	118.060
118.0667		8.33	118.065
118.0750	A	25	118.071
118.0750	B	25	118.072
118.0750	C	25	118.073
118.0750	D	25	118.074
118.0750		25	118.075
118.0750		8.33	118.080
118.0833		8.33	118.085
118.0917		8.33	118.090
118.1000		25	118.100
etc.			

* Time slot indication is for VDL Mode 3 channels. (Ref. Annex 10, Volume III, Part I, Chapter 6 for characteristics of VDL Mode 3 operation)

4.1.3 Frequencies used for particular functions

4.1.3.1 *Emergency channel*

4.1.3.1.1 The emergency channel (121.5 MHz) shall be used only for genuine emergency purposes, as broadly outlined in the following:

a) to provide a clear channel between aircraft in distress or emergency and a ground station when the normal channels are being utilized for other aircraft;

b) to provide a VHF communication channel between aircraft and aerodromes, not normally used by international air services, in case of an emergency condition arising;

c) to provide a common VHF communication channel between aircraft, either civil or military, and between such aircraft, and surface services, involved in common search and rescue operations, prior to changing when necessary to the appropriate frequency;

d) to provide air-ground communication with aircraft when airborne equipment failure prevents the use of the regular channels;

e) to provide a channel for the operation of emergency locator transmitters (ELTs), and for communication between survival craft and aircraft engaged in search and rescue operations;

f) to provide a common VHF channel for communication between civil aircraft and intercepting aircraft or intercept control units and between civil or intercepting aircraft and air traffic services units in the event of interception of the civil aircraft.

Note 1.— The use of the frequency 121.5 MHz for the purpose outlined in c) is to be avoided if it interferes in any way with the efficient handling of distress traffic.

Note 2.— The current Radio Regulations make provisions that the aeronautical emergency frequency 121.5 MHz may also be used by mobile stations of the maritime mobile service, using A3E emission to communicate on this frequency for safety purposes with stations of the aeronautical mobile service (RR S5.200 and Appendix S13, Part A2).

4.1.3.1.2 The frequency 121.5 MHz shall be provided at:

a) all area control centres and flight information centres;

b) aerodrome control towers and approach control offices serving international aerodromes and international alternate aerodromes; and

c) any additional location designated by the appropriate ATS authority,

where the provision of that frequency is considered necessary to ensure immediate reception of distress calls or to serve the purposes specified in 4.1.3.1.1.

Note.— Where two or more of the above facilities are collocated, provision of 121.5 MHz at one would meet the requirement.

4.1.3.1.3 The frequency 121.5 MHz shall be available to intercept control units where considered necessary for the purpose specified in 4.1.3.1.1 f).

4.1.3.1.4 The emergency channel shall be guarded continuously during the hours of service of the units at which it is installed.

4.1.3.1.5 The emergency channel shall be guarded on a single channel simplex operation basis.

4.1.3.1.6 The emergency channel (121.5 MHz) shall be available only with the characteristics as contained in Annex 10, Volume III, Part II, Chapter 2.

4.1.3.2 *Air-to-air communications channel*

4.1.3.2.1 An air-to-air VHF communications channel on the frequency of 123.45 MHz shall be designated to enable aircraft engaged in flights over remote and oceanic areas out of range of VHF ground stations to exchange necessary operational information and to facilitate the resolution of operational problems.

Note.— Use of the air-to-air channel can cause interference to and from aircraft using the same frequency for air-ground communications.

4.1.3.2.2 In remote and oceanic areas out of range of VHF ground stations, the air-to-air VHF communications channel on the frequency 123.45 MHz shall be available only with the characteristics as contained in Annex 10, Volume III, Part II, Chapter 2.

4.1.3.3 *Common signalling channel.* The frequency 136.975 MHz is reserved on a worldwide basis to provide a common signalling channel (CSC) to the VHF digital link (VDL). This CSC uses the Mode 2 VDL modulation scheme and carrier sense multiple access (CSMA).

4.1.4 Auxiliary frequencies for search and rescue operations

4.1.4.1 Where a requirement is established for the use of a frequency auxiliary to 121.5 MHz, as described in 4.1.3.1.1 c), the frequency 123.1 MHz shall be used.

4.1.4.2 The auxiliary search and rescue channel (123.1 MHz) shall be available only with the characteristics as contained in Annex 10, Volume III, Part II, Chapter 2.

4.1.5 Provisions concerning the deployment of VHF frequencies and the avoidance of harmful interference

4.1.5.1 In the case of those VHF facilities providing service up to the radio horizon, the geographical separation between facilities working on the same frequency shall, except where there is an operational requirement for the use of common frequencies for groups of facilities, be such that points at the protection heights and at the limit of the functional service range of each facility are separated by distances not less than that required to provide a desired to undesired signal ratio of 14 dB. This provision shall be implemented on the basis of a regional air navigation agreement. For areas where frequency assignment congestion is not severe or is not anticipated to become severe, a 20 dB (10 to 1 distance ratio) separation criteria or radio line-of-sight (RLOS) separation criteria (whichever is smaller) may be used.

Note.— Guidance material relating to the establishment of the minimum separation distance based on the desired to undesired signal protection ratio of 14 dB is contained in Attachment A.

4.1.5.2 In the case of those VHF facilities providing service beyond the radio horizon, except where there is an operational requirement for the use of common frequencies for groups of facilities, planning for co-channel operations shall be such that points at the protection heights and at the limits of the functional service area of each facility are separated by distances not less than the sum of distances from each point to its associated radio horizon.

Note 1.— The distance to the radio horizon from a station in an aircraft is normally given by the formula:

$$D = K \sqrt{h}$$

where D = *distance in nautical miles;*
h = *height of the aircraft station above earth;*
K = *(corresponding to an effective earth's radius of 4/3 of the actual radius);*
= *2.22 when* h *is expressed in metres; and*
= *1.23 when* h *is expressed in feet.*

Note 2.— In calculating the radio line-of-sight distance between a ground station and an aircraft station, the distance from the radio horizon of the aircraft station computed from Note 1 must be added to the distance from the radio horizon of the ground station. In calculating the latter the same formula is employed, taking for h *the height of the ground station transmitting antenna.*

Note 3.— The criterion contained in 4.1.5.2 is applicable in establishing minimum geographical separation between VHF facilities, with the object of avoiding co-channel air-to-air interference. Guidance material relating to the establishment of separation distances between ground stations and between aircraft and ground stations for co-channel operations is contained in Section 3 of Attachment A. Guidance material relating to adjacent channel frequency deployment is contained in Section 2 of Attachment A.

Note 4.— Guidance material on the interpretation of 4.1.5.1 and 4.1.5.2 is contained in Attachment A.

4.1.5.3 The geographical separation between facilities working on adjacent channels shall be such that points at the protection heights and at the limit of the functional service range of each facility are separated by a distance sufficient to ensure operations free from harmful interference.
Note.— Guidance material covering separation distances and related system characteristics is contained in Attachment A.

4.1.5.4 The protection height shall be a height above a specified datum associated with a particular facility, such that below it harmful interference is improbable.

4.1.5.5 The protection height to be applied to functions or to specific facilities shall be determined regionally, taking into consideration the following factors:

a) the nature of the service to be provided;

b) the air traffic pattern involved;

c) the distribution of communication traffic;

d) the availability of frequency channels in airborne equipment;

e) probable future developments.

4.1.5.6 **Recommendation.—** *Where the protection heights determined are less than those operationally desirable, separation between facilities operating on the same frequency should not be less than that necessary to ensure that an aircraft at the limit of the functional service range and the operationally desirable protection height of one facility does not come above the radio horizon with respect to* *adjacent facilities.*

Note.— The effect of this recommendation is to establish a geographical separation distance below which harmful interference is probable.

4.1.5.7 The geographical separation between VHF VOLMET stations shall be determined regionally and, generally, shall be such that operations free from harmful interference are secured at the highest altitude flown by aircraft in the area concerned.

Note.— Guidance material on the interpretation of 4.1.5.7 is contained in Attachment A.

4.1.5.8 Frequencies in the aeronautical mobile VHF band used for national services, unless worldwide or regionally allotted to this specific purpose, shall be so deployed that minimum interference is caused to facilities for the international air services in this band.

4.1.5.9 **Recommendation.—** *The problem of inter-State interference on frequencies allotted worldwide or on a regional basis to national services, should be resolved by consultation between the administrations concerned.*

4.1.5.10 The communication coverage provided by a VHF ground transmitter shall, in order to avoid harmful interference to other stations, be kept to the minimum consistent with the operational requirement for the function.

4.1.5.11 **Recommendation.—** *For ground VHF facilities which provide service beyond the radio horizon, any spurious or harmonic radiation outside the band ±250 kHz from the assigned carrier frequency should not exceed an effective radiated power of 1 mW in any azimuth.*

4.1.6 Equipment requirements

Note 1.— Frequency tolerances to which stations operating in the aeronautical mobile band (117.975 – 137 MHz) must conform are contained in Appendix 3 to the Radio Regulations. Tolerances for transmitters used for aeronautical services are not mentioned in this Annex, except in those cases where tighter tolerances than those contained in the Radio Regulations are required (e.g. the equipment specifications in Volume III contain several such instances).

Note 2.— The frequency tolerance applicable to individual components of a multi-carrier or similar system will be determined by the characteristics of the specific system.

4.1.6.1 **Recommendation.—** *The antenna gain of an extended range VHF facility should preferably be such as to ensure that, beyond the limits of ±2 Φ about the centre line of the angular width Φ of the area to be served, it does not exceed 3 dB above that of a dipole. But, in any case, it should be such as to ensure freedom from harmful interference with other radio services.*

Note 1.— The actual azimuth, the angular width of the service area, and the effective radiated power would have to be taken into account in each individual case.

Note 2.— Guidance material on the interpretation of 4.1.6.1 is contained in Attachment A.

4.1.7 Method of operation

4.1.7.1 Single channel simplex operation shall be used in the VHF band 117.975 – 137 MHz at all stations providing for aircraft engaged in international air navigation.

4.1.7.2 In addition to the above, the ground-to-air voice channel associated with an ICAO standard radio navigational aid may be used, subject to regional agreement, for broadcast or communication purposes or both.

4.1.8 Plan of assignable VHF radio frequencies for use in the international aeronautical mobile service

Introduction

This plan designates the list of frequencies available for assignment, together with provision for the use by the aeronautical mobile (R) service of all frequencies with a channel spacing of 25 kHz, and of all frequencies with a channel width and spacing of 8.33 kHz, with the frequencies in Group A continuing to be used wherever they provide a sufficient number to meet the operational requirements.

The plan provides that the total number of frequencies required in any region would be determined regionally. The effect of this will be that frequencies assignable in any particular region may be restricted to a limited number of the frequencies in the list, the actual number being selected as outlined herein.

In order that the assignable frequencies may be coordinated between regions as far as practicable, the plan requires that, whenever the number of frequencies contained in Group A of 4.1.8.1.2 is sufficient to meet the requirements of a region, the frequencies of this Group be used in a sequence commencing with 118 MHz. This ensures that all regions will have in common the frequencies used in the region requiring the least number of frequencies and, in respect to any two regions, the region with the greater number will have in use all the frequencies used by the other.

Group A provides for frequency planning based on 100 kHz channel spacing.

Group B of the list at 4.1.8.1.2 contains the frequencies in the band 117.975 – 132 MHz ending in 50 kHz. Together with the frequencies in Group A, they provide for frequency planning based on 50 kHz channel spacing. In Group C are listed the frequency channels in the band 132 – 137 MHz based upon 50 kHz channel spacing. Group D contains the frequency channels in the band 132 – 137 MHz ending in 25 kHz, and Group E similarly lists the frequency channels in the band 117.975 – 132 MHz. The utilization of channels in Groups B, C, D and E is explained below.

Group F of the list at 4.1.8.1.2 contains the frequencies in the band 117.975 – 137 MHz when 8.33 kHz channel width is used. The utilization of the channels in this Group is explained below.

Whenever the number of frequencies required in a particular region exceeds the number in Group A, frequencies may be selected from the other Groups taking into account the provisions of 4.1.8.1 with respect to the use of channels based on 25 kHz channel spacing and, with regard to the band 132 – 137 MHz, the provisions of the Radio Regulations (see Introduction to 4.1). Although for Groups B, C, D and E a preferred order of selection is not indicated, regional planning may require a particular selection of frequencies from these Groups in order to cater for specific regional circumstances. This may apply particularly to the utilization of frequencies from the band 132 – 137 MHz for reasons of available airborne equipment and/or availability of particular frequency channels for the aeronautical mobile (R) service. It may also be found that, in a particular region, it is desirable to select frequencies from Group B first, before selecting frequencies from Groups C, D or E.

Where all the channels of Groups A, B, C, D and E of the list at 4.1.8.1.2 are insufficient to meet the requirements of a region, a part or parts of the band may be designated as containing 8.33 kHz width channels or designated as supporting VDL Mode 3. For parts of the band containing 8.33 kHz width channels, the appropriate frequencies from Group F should be used in accordance with 4.1.8.1.1.1 and 4.1.8.1.2. It should be noted that the designation of frequencies in Group F differs from that of the corresponding frequencies in Groups A to E to emphasize the difference in channel width. For part of the bands supporting VDL Mode 3, frequencies from Groups A, B, C, D and E are utilized on a time-division basis. A single frequency supports multiple channels, each utilizing the frequency in periodic time frames or time slots. Specific time slots for VDL Mode 3 are identified using the numeric designators of Table 4-1 (bis).

Although for Group F a preferred order of selection is not indicated, regional planning may require a particular selection of frequencies from this group in order to cater for specific regional circumstances.

In many regions particular frequencies have already been assigned for particular functions as, for instance, aerodrome or approach control. The plan does not make such assignments (except in respect to the emergency channel and ground service frequencies), such action being taken regionally if considered desirable.

4.1.8.1 The frequencies in the band 117.975 – 137 MHz for use in the aeronautical mobile (R) service shall be selected from the list in 4.1.8.1.2.

4.1.8.1.1 When the number of frequencies required in a particular region does not exceed the number of frequencies contained in Group A of 4.1.8.1.2, the frequencies to be used shall be selected in sequence, in so far as practicable, from those in Group A of 4.1.8.1.2.

4.1.8.1.1.1 When the number of frequencies required in a particular region exceeds those available in Groups A to E of 4.1.8.1.2, parts of the band shall be designated as containing 8.33 kHz width channels (voice) or as containing VDL Mode 3. Appropriate frequencies shall be selected from Group F of 4.1.8.1.2 for 8.33 kHz channel assignments or from Groups A to E in accordance with the time-slot assignments in accordance with Table 4-1 *(bis)* for VDL Mode 3. The remainder of the band shall continue to be used for 25 kHz width channels selected from the appropriate parts of Groups A to E.

Note 1.— The frequencies 121.425 – 121.575 MHz inclusive, 123.075 – 123.125 MHz inclusive and 136.500 – 136.975 MHz inclusive are not available for assignment to channels of less than 25 kHz width.

Note 2.— Services that continue operation using 25 kHz assignments will be protected in regions implementing 8.33 kHz channel spacing.

4.1.8.1.2 *List of assignable frequencies*

The list of assignable frequencies is shown in the Appendix to this chapter.

4.1.8.1.3 **Recommendation.—** *Frequencies for operational control communications may be required to enable aircraft operating agencies to meet the obligations prescribed in Annex 6, Part I, in which case they should be selected from the bands 128.825 – 132.025 MHz. These frequencies should be chosen, in so far as practicable, from the upper end of the band and in sequential order.*

Note.— It is recognized that the assignment of such frequencies and the licensing of the operation of the related facilities are matters for national determination. However, in regions where a problem exists with respect to the provision of frequencies for operational control purposes, it may be advantageous if States endeavour to coordinate the requirements of aircraft operating agencies for such channels prior to regional meetings.

4.1.8.2 The frequencies that may be allotted for use in the aeronautical mobile (R) service in a particular region shall be limited to the number determined as being necessary for operational needs in the region.

Note.— The number of frequencies required in a particular region is normally determined by the Council on the recommendations of Regional Air Navigation Meetings. The capabilities of VHF airborne equipment known to be widely used in the region will be taken into account in this determination.

APPENDIX TO CHAPTER 4. LIST OF ASSIGNABLE FREQUENCIES

Frequency (MHz)	Annotations	Frequency (MHz)	Annotations
121.5	Emergency frequency		
123.1	Auxiliary frequency SAR		
121.60	Reserved for aerodrome surface communications [see Table 4-1, Item c)]	121.625	Reserved for aerodrome surface communications [see Table 4-1, Item c)]
121.65		121.675	
121.70		121.725	
121.75		121.775	
121.80		121.825	
121.85		121.875	
121.90		121.925	
121.95		121.975	

GROUP A Frequencies (MHz)

118.00	119.00	120.00	121.00	124.00	125.00	126.00	127.00	128.00	129.00	131.00
118.10	119.10	120.10	121.10	124.10	125.10	126.10	127.10	128.10	129.10	131.10
118.20	119.20	120.20	121.20	124.20	125.20	126.20	127.20	128.20	129.20	131.20
118.30	119.30	120.30	121.30	124.30	125.30	126.30	127.30	128.30	129.30	131.30
118.40	119.40	120.40	121.40	124.40	125.40	126.40	127.40	128.40	129.40	131.40
118.50	119.50	120.50	--	124.50	125.50	126.50	127.50	128.50	129.50	131.50
118.60	119.60	120.60	--	124.60	125.60	126.60	127.60	128.60	129.60	131.60
118.70	119.70	120.70	123.70	124.70	125.70	126.70	127.70	128.70	130.90	131.70
118.80	119.80	120.80	123.80	124.80	125.80	126.80	127.80	128.80	129.00	131.80
118.90	119.90	120.90	123.90	124.90	125.90	126.90	127.90	128.90	129.10	131.90

GROUP B Frequencies (MHz)

118.05	119.05	120.05	121.05	124.05	125.05	126.05	127.05	128.05	129.05	131.05
118.15	119.15	120.15	121.15	124.15	125.15	126.15	127.15	128.15	129.15	131.15
118.25	119.25	120.25	121.25	124.25	125.25	126.25	127.25	128.25	129.25	131.25
118.35	119.35	120.35	121.35	124.35	125.35	126.35	127.35	128.35	129.35	131.35
118.45	119.45	120.45	--	124.45	125.45	126.45	127.45	128.45	129.45	131.45
118.55	119.55	120.55	--	124.55	125.55	126.55	127.55	128.55	129.55	131.55
118.65	119.65	120.65	--	124.65	125.65	126.65	127.65	128.65	129.65	131.65
118.75	119.75	120.75	123.75	124.75	125.75	126.75	127.75	128.75	--	131.75
118.85	119.85	120.85	123.85	124.85	125.85	126.85	127.85	128.85	--	131.85
118.95	119.95	120.95	123.95	124.95	125.95	126.95	127.95	128.95	130.95	131.95

GROUP C Frequencies (MHz)

132.00	132.50	133.00	133.50	134.00	134.50	135.00	135.50
132.05	132.55	133.05	133.55	134.05	134.55	135.05	135.55
132.10	132.60	133.10	133.60	134.10	134.60	135.10	135.60
132.15	132.65	133.15	133.65	134.15	134.65	135.15	135.65
132.20	132.70	133.20	133.70	134.20	134.70	135.20	135.70
132.25	132.75	133.25	133.75	134.25	134.75	135.25	135.75
132.30	132.80	133.30	133.80	134.30	134.80	135.30	135.80
132.35	132.85	133.35	133.85	134.35	134.85	135.35	135.85
132.40	132.90	133.40	133.90	134.40	134.90	135.40	135.90
132.45	132.95	133.45	133.95	134.45	134.95	135.45	135.95

GROUP D Frequencies (MHz)

132.025	132.525	133.025	133.525	134.025	134.525	135.025	135.525	136.000	136.250	136.500	136.750
132.075	132.575	133.075	133.575	134.075	134.575	135.075	135.575	136.025	136.275	136.525	136.775
132.125	132.625	133.125	133.625	134.125	134.625	135.125	135.625	136.050	136.300	136.550	136.800
132.175	132.675	133.175	133.675	134.175	134.675	135.175	135.675	136.075	136.325	136.575	136.825
132.225	132.725	133.225	133.725	134.225	134.725	135.225	135.725	136.100	136.350	136.600	136.850
132.275	132.775	133.275	133.775	134.275	134.775	135.275	135.775	136.125	136.375	136.625	136.875
132.325	132.825	133.325	133.825	134.325	134.825	135.325	135.825	136.150	136.400	136.650	136.900
132.375	132.875	133.375	133.875	134.375	134.875	135.375	135.875	136.175	136.425	136.675	136.925
132.425	132.925	133.425	133.925	134.425	134.925	135.425	135.925	136.200	136.450	136.700	136.950
132.475	132.975	133.475	133.975	134.475	134.975	135.475	135.975	136.225	136.475	136.725	136.975

GROUP E Frequencies (MHz)

118.025	119.025	120.025	121.025	124.025	125.025	126.025	127.025	128.025	129.025	131.025
118.075	119.075	120.075	121.075	124.075	125.075	126.075	127.075	128.075	129.075	131.075
118.125	119.125	120.125	121.125	124.125	125.125	126.125	127.125	128.125	129.125	131.125
118.175	119.175	120.175	121.175	124.175	125.175	126.175	127.175	128.175	129.175	131.175
118.225	119.225	120.225	121.225	124.225	125.225	126.225	127.225	128.225	129.225	131.225
118.275	119.275	120.275	121.275	124.275	125.275	126.275	127.275	128.275	129.275	131.275
118.325	119.325	120.325	121.325	124.325	125.325	126.325	127.325	128.325	129.325	131.325
118.375	119.375	120.375	121.375	124.375	125.375	126.375	127.375	128.375	129.375	131.375
118.425	119.425	120.425	--	124.425	125.425	126.425	127.425	128.425	129.425	131.425
118.475	119.475	120.475	--	124.475	125.475	126.475	127.475	128.475	129.475	131.475
118.525	119.525	120.525	--	124.525	125.525	126.525	127.525	128.525	129.525	131.525
118.575	119.575	120.575	--	124.575	125.575	126.575	127.575	128.575	129.575	131.575
118.625	119.625	120.625	--	124.625	125.625	126.625	127.625	128.625	129.625	131.625
118.675	119.675	120.675	--	124.675	125.675	126.675	127.675	128.675	129.675	131.675

118.725	119.725	120.725	123.725	124.725	125.725	126.725	127.725	128.725	--	131.725
118.775	119.775	120.775	123.775	124.775	125.775	126.775	127.775	128.775	--	131.775
118.825	119.825	120.825	123.825	124.825	125.825	126.825	127.825	128.825	--	131.825
118.875	119.875	120.875	123.875	124.875	125.875	126.875	127.875	128.875	--	131.875
118.925	119.925	120.925	123.925	124.925	125.925	126.925	127.925	128.925	130.925	131.925
118.975	119.975	120.975	123.975	124.975	125.975	126.975	127.975	128.975	130.975	131.975

GROUP F (see also Table 4-1 *(bis)*)

118.000 – 121.400 in 8.33 kHz steps	121.600 – 123.050 in 8.33 kHz steps	123.150 – 136.475 in 8.33 kHz steps

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ATTACHMENT A. CONSIDERATIONS AFFECTING THE DEPLOYMENT OF VHF COMMUNICATION FREQUENCIES

Introduction

Paragraphs 4.1.5.2 and 4.1.5.3 specify the geographical separation required for co-channel operation of VHF facilities in the aeronautical mobile service. in Figure A-1 the distance AB indicates the separation required between facilities in order that aircraft a *and* b *operating at the protection heights and at the limits of the functional service range of stations A and B respectively, will not experience harmful interference.*

Paragraph 4.1.6.1 recommends the maximum antenna gain outside the main beam of facilities which provide service beyond the radio horizon. Figure A-2 illustrates the azimuthal angle to be protected and the method of derivation. Smaller beamwidths than 30 degrees are not considered practical at present.

Note.— The term “main beam” includes all azimuths where antenna gain exceeds 3 dB above that of a dipole.

1. Criteria employed in establishing geographical separation between ground stations for co-channel operation of VHF facilities that have a service area up to the radio horizon

1.1 To provide co-channel interference protection of 14 dB (5 to 1 distance ratio, as shown below) desired signal to undesired signal (D/U), the free-space loss (FSL) formula is used to calculate both the free-space loss of the desired signal (FSL_D) and the free-space loss of the undesired signal (FSL_U):

FSL (in dB) = 32.4 + 20 log f + 20 log d ;   where f = frequency in MHz and d = distance in km.

In comparing the FSL_D versus the FSL_U, the subtraction of the formula results in:

$$FSL_U - FSL_D = 20 \log dU - 20 \log dD = 20 \log dU/dD$$

If $FSL_U - FSL_D$ = 14 dB, then log dU/dD = 14/20 = 0.7; then dU/dD =5.01.

Note.— It is necessary to take into account that the effective radiated powers of transmitting stations may not be equal.

1.2 The desired distance (dD) is the distance between the desired ground facility and the limit of the functional service range of that ground facility (see Figure A-3).

Note.— When making assignments using a 14 dB D/U signal ratio, the potential effects of interference caused by mute lifts due to high communications loading on co-channel assignments should be considered.

1.3 The undesired distance (dU) is the distance between the limit of the functional service ranges of the desired facility and that of the undesired facility (i.e. the distance between the aircraft at the edges of the respective service ranges). See Figure A-1.

1.4 The required geographical separation between the desired and the undesired facility is therefore dD + dU plus the service range of the undesired facility (see Figure A-1).

1.5 If the calculated dU exceeds the RLOS between the aircraft, then a distance as small as the RLOS can be used as the distance between the edges of the service volumes.

2. Criteria employed in establishing adjacent channel frequency deployment with respect to receiver rejection and other system characteristics

2.1 For aircraft receivers designed for operation in a 50 kHz channel spacing environment and a ground station frequency tolerance of 50 parts in 10^6 (±0.005 per cent), an effective adjacent channel rejection characteristic of 60 dB or better is assumed. This assumption will result in a geographical separation distance between the nearest limits of the functional service ranges of the two facilities of at least 5.6 km (3 NM).

2.2 For aircraft receivers designed for operation in a 25 kHz channel spacing environment and a ground station frequency tolerance of ±0.002 per cent, and for aircraft receivers designed for operation in a 8.33 kHz spacing environment, and a ground station frequency tolerance of ±.0001 per cent, an effective adjacent channel rejection characteristic of 60 dB or better is assumed. This assumption will result in a geographical separation distance between the nearest limits of the functional service ranges between two facilities using 25 kHz spacing or between two facilities using 8.33 kHz spacing of at least 5.6 km (3 NM).

2.3 The above criteria are based on the concept of protection by receiver muting, except in the case of area control and FIR channels where a minimum field strength is specified in order to secure the desired wanted-to-unwanted signal ratio.

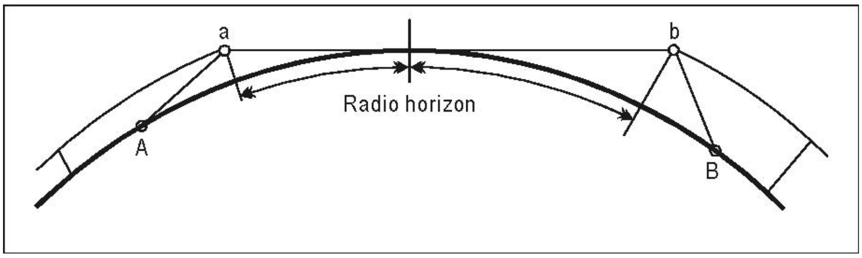

Figure A-1. Geographical separation required for co-channel operation of VHF facilities

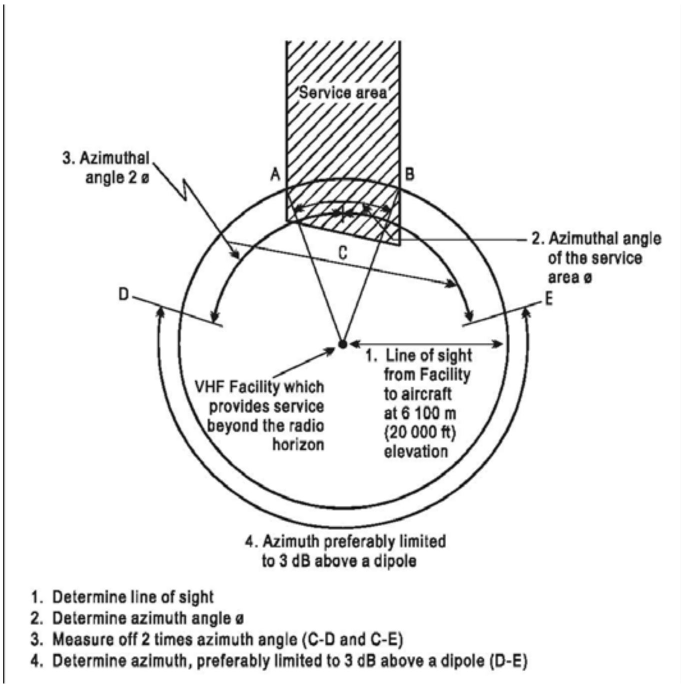

Figure A-2. Limit of azimuth protection for VHF facilities which provide a service beyond the radio horizon

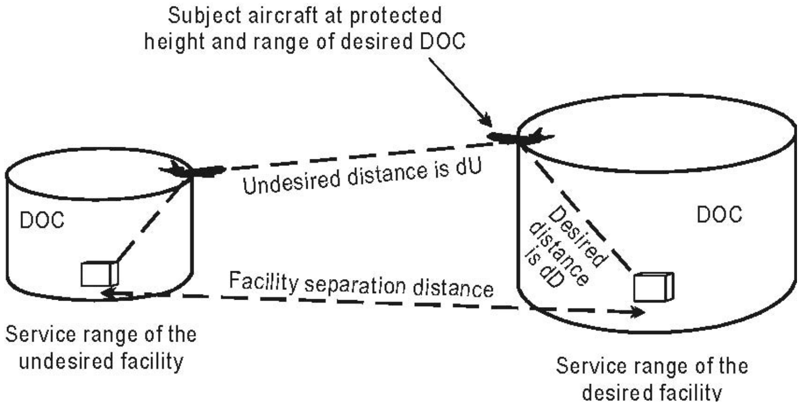

Figure A-3. Co-channel configuration for undesired/desired distance ratio

2.4 The following additional assumptions were made in establishing the criteria:

1) *Propagation*: free space propagation between aircraft. The ITU-R curves for 100 MHz vertical polarization over land in conjunction with an assumed ground antenna height of 20 m (65 ft) were used in computing ground-air field strengths.

2) *Minimum field strength at limit of functional service range*: 45 dB above 1 microvolt per metre at 3 000 m (10 000 ft) in the case of area control and FIR channels.

Note.— To meet this requirement, a station radiating 100 W from an antenna 20 m (65 ft) high should be not more than 185 km (100 NM) from the limit of its functional service range.

3) *Effective radiated power (ERP)*: a maximum ERP of 20 W from ground and airborne stations with the exception that, in case of ground stations providing flight information or area control service communications, it was necessary to assume a minimum ERP of 100 W.

4) *Airborne antenna polar patterns*: total variations not exceeding 10 dB. Since a maximum ERP was assumed (and therefore all variations are downwards from this figure), no allowance was necessary in respect of airborne transmitter polar diagrams.

5) *Wanted-to-unwanted signal ratio*: 20 dB at the receiver output.

6) *Receiver muting characteristics*: a muting threshold corresponding to a received field strength of 5 microvolts per metre.

2.5 The following criteria were based on all relevant assumptions made in 2.4. Two cases related to adjacent channel interference are considered separately:

a) receiver mute lift; and

b) desired-to-undesired signal ratio.

These cases might cause different planning criteria to be observed

2.5.1 Where it is necessary to take account on a regional basis of receivers not specifically designed for an 8.33 kHz environment, the following characteristics should be assumed:

a) an 8.33 kHz channel, which is assigned 8.33 kHz away from the assigned frequency of a 25 kHz channel, is assumed to be co-channel with that 25 kHz channel;

b) an 8.33 kHz channel, spaced ±16.67 kHz from the assigned frequency of a 25 kHz channel is assumed under all operating conditions (including all instabilities and doppler shifts), to have an adjacent channel rejection ratio of:

i) 23 dB aircraft against ground offset carrier systems;

ii) 30 dB aircraft against ground non-offset carrier systems; and

iii) 27 dB aircraft against aircraft systems.

Worst case conditions for planning purposes are used here for a mixed environment of 8.33 kHz and 25 kHz systems.

c) an 8.33 kHz channel which is assigned 25 kHz away from the assigned frequency of a 25 kHz channel is assumed to have an effective adjacent channel characteristic of at least 60 dB.

2.5.2 Where it is necessary to take account of the implementation of VHF stations which use 8.33 kHz channel spacing, in a region where 25 kHz assignments occur, the assumptions of 2.5.1 a) to c) result in the following:

a) where 8.33 kHz services are spaced ±8.33 kHz away from the assigned frequency of a 25 kHz channel, the regionally agreed planning criteria for co-channel assignments should be used, applying either the radio horizon method (assumed to give at least 20 dB D/U) or a desired-to-undesired signal ratio of 14 dB;

b) where 8.33 kHz services are spaced ±16.67 kHz away from the assigned frequency of a 25 kHz channel, the following criteria should be applied:

i) Receiver mute lift criteria.

The minimum separation distance required for the prevention of receiver mute lifts is:

187 NM aircraft against ground offset carrier systems;

84 NM aircraft against ground non-offset carrier systems; and

118 NM aircraft against aircraft systems.

ii) Desired-to-undesired signal ratio.

The minimum distance required to provide sufficient adjacent channel protection based upon a D/U ratio (assuming equal ERP from the wanted and unwanted signals) can be calculated given the maximum service range of the wanted signal by:

Dadj = service range/(10 (*ACR – D/U*)/20)

Dadj = distance required between the edges of the two service ranges operating on adjacent channels

ACR = adjacent channel rejection

Dadj and service range expressed in the same units.

The D/U ratio used will depend on regionally agreed planning criteria.

Note.— The application of the 14 dB planning criteria assumes that it is highly unlikely that two aircraft will be at the maximum edge of their respective service volumes and at the closest point between these two volumes.

c) 8.33 kHz channels spaced 25 kHz away from an assigned frequency of a 25 kHz channel should be planned in accordance with 2.2.

3. Criteria to be employed in establishing adjacent channel frequency deployment of VHF facilities that have a service range beyond the radio horizon

For the most economical use of frequencies and to ensure freedom from interference, planning must be based on an accurate knowledge of equipment used. When the equipment characteristics and field strength (or attenuation) curves are on hand for the troposcatter regions, it is relatively easy to determine the required geographical separation. When these are not known, the maximum permitted antenna gain stipulated in 4.1.6.1 will be assumed. There are several conditions that must be calculated and compared to determine the appropriate separation to be used. The conditions to be compared are:

1) ground facility-to-aircraft;

2) aircraft-to-ground facility;

3) aircraft-to-aircraft; and

4) ground facility-to-ground facility.

Case 1.— For the case of protection of aircraft A from a ground facility (see Figure A-4):

A. Determine the signal level *S* (dB rel. 1 μV/m) received from the desired station at the limit of the service radius at the protection altitude.

B. Assign the desired protection ratio *P* (dB) required at the aircraft receiver.

C. Let receiver adjacent channel rejection be represented by *A* (dB). Then the level *L* (dB rel. 1 μV/m) that can be tolerated at the receiver antenna can be determined by:

$L = S - P + A$

D. Distance *d* (km) from protection point to undesired facility to provide protection established by "C", is found by application of *L* to the appropriate curves.

Note 1.— Figures A-8 to A-15 are field strength curves appropriate for the average temperate climate over land or sea, which may be used to determine geographical separation for situations where these field strengths will not normally be exceeded more than 5 per cent of the time. These curves were established by the Institute for Telecommunications Sciences and Aeronomy of the Environmental Science Services Administration of the United States.

Note 2.— For power levels other than 1 kW the necessary corrections under "C" would have to be made. For example, 5 kW ERP requires a minus 7 dB correction.

E. The facility-to-facility separation D is d (km) plus service radius (km).

Case 2.— Aircraft (A)-to-ground facility (see Figure A-4):

A. Determine signal level *Sg* at the ground facility receiving antenna for proper system operation.

B. Proceed as in Case 1, where

$$L = Sg - P + A$$

C. Ground facility-to-ground facility separation will also be determined as in Case 1 (D = d + service radius (km)).

Note.— Where ground facility receivers have sensitivities of less than 1 microvolt across 50 ohms, Case 2 is most likely to yield the separation to be used.

Case 3.— Aircraft (A)-to-aircraft (B) (see Figure A-5):

A. Establish service radius and protection altitude for facility to be protected (see aircraft A in Figure A-5).

B. Determine closest point to aircraft A that aircraft B will be transmitting to the ground facility site and the altitude where this will take place.

C. Proceed as in Case 1, using the aircraft (B) contacting ground facilities as the undesired signal.

D. Then $L = S - P + A$

E. The distance *d* to aircraft B (undesired) obtained from the curves, plus the service radius of the facility to be protected, will determine the separation between aircraft B and the ground facility protected.

F. Facility-to-facility separation may then be determined graphically or by trigonometric means.

Case 4.— Ground facility-to-ground facility (see Figure A-5).

A. Determine signal level that can be tolerated at the receiver antenna at one facility by $L = Sg - P + A$ (see Case 1).

B. Then facility-to-facility separation for these conditions is read directly from the curves (after correcting for transmitter power of other facilities if different from 1kW).

C. Should equipment at the two facilities have different characteristics, repeat procedure in "A" and "B" for the other combinations of equipment.

D. Of the two distances derived, use the greater to compare with other cases (see below).

Note.— In most instances, it will be found that the facility-to-facility consideration will not be the controlling factor in determining geographical separation.

Facility separation will then be the greatest distance derived for Cases 1 to 4.

4. Criteria to be employed in establishing geographical separation between ground stations and between aircraft and ground stations for co-channel operation of VHF facilities that have a service area beyond the radio horizon

Geographical separation of co-channel facilities can be calculated by using the method given in 2 above except that the adjacent channel rejection *A* is omitted from consideration.

5. Criteria employed in establishing co-channel frequency deployment of VHF VOLMET facilities

In the case of VHF VOLMET services, the geographical separation between co-channel stations should be 55.6 km (30

NM) plus twice the distance to the radio horizon from an aircraft at the highest altitude flown by aircraft in the area concerned. (See Figure A-6.)

Note.— At 27.8 km (15 NM) beyond the radio horizon, the field strength at 13 500 m (45 000 ft), from a transmitter of 100 W ERP, will be approximately at the receiver muting level of 5 microvolts per metre.

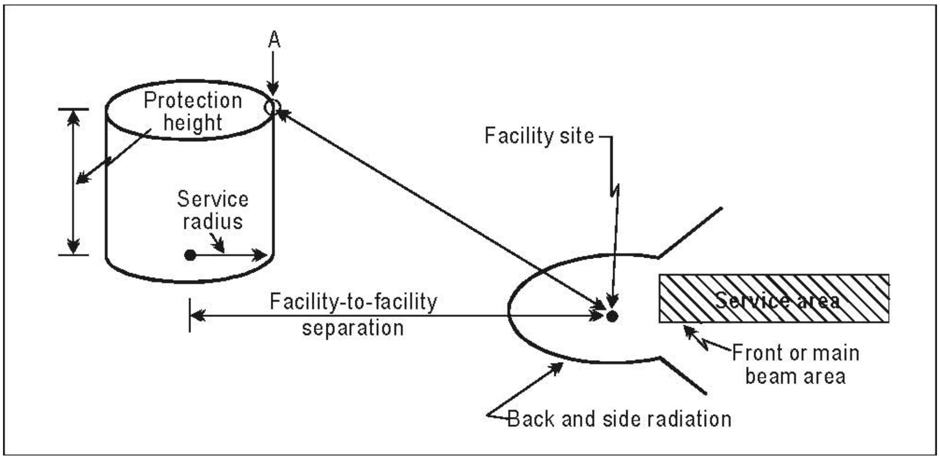

Figure A-4. Air-to-ground (facility from A) and ground-to-air (A from facility)

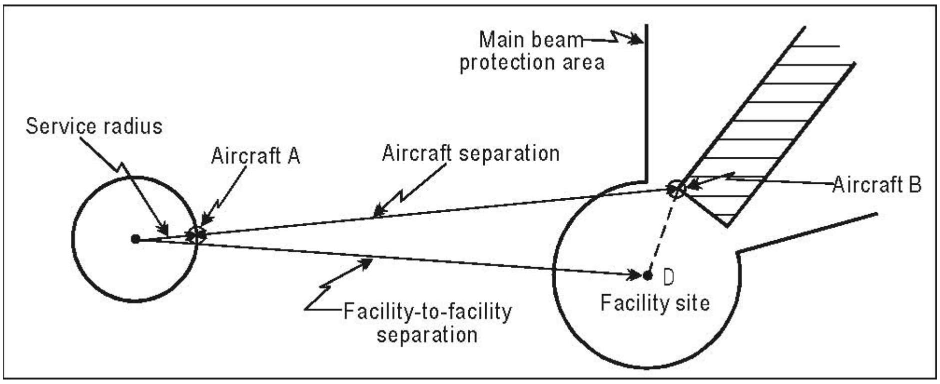

Figure A-5. Facility-to-facility separation based on air-to-air (A from B) and ground-to-ground (C and D)

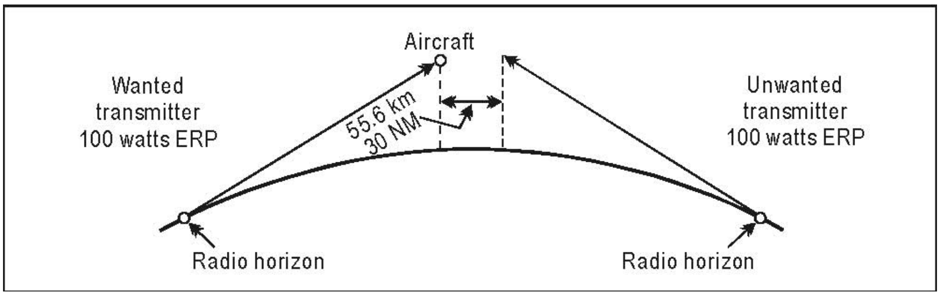

Figure A-6. VOLMET planning (illustrating co-channel protection)

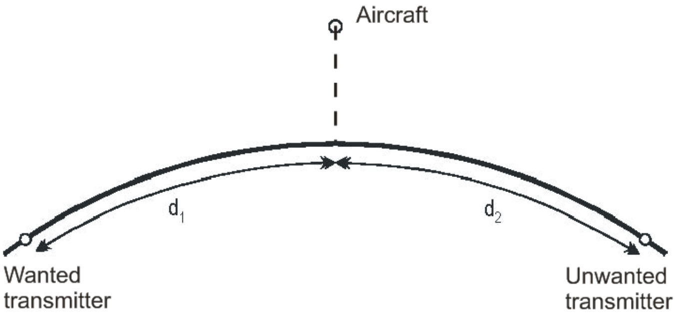

Figure A-7. VOLMET planning (illustrating adjacent-channel protection)

6. Criteria employed in establishing adjacent channel frequency deployment of VHF VOLMET facilities

6.1 For aircraft receivers designed for operation in a 25 kHz channel spacing environment, an effective adjacent channel rejection characteristic of 60 dB or better is assumed. This assumption will result in a geographical separation distance *D* between VHF VOLMET ground transmitters derived as follows (nautical miles may be substituted for kilometres):

$D = (d_1 + d_2)$ km where

d_1 = distance between aircraft and wanted ground station = radio horizon + 27.8 km (15 NM) and

d_2 = distance between aircraft and unwanted ground station = 24.1 km (13 NM).

Altitude	*Receiver rejection characteristic*	*d1 km (NM)*	*d2 km (NM)*	*D km (NM)*
13 500 m (45 000 ft)	60 dB	491 (265)	24.1 (13)	515 (278)
13 500 m (45 000 ft)	40 dB	491 (265)	241 (130)	732 (395)
20 000 m (66 000 ft)	60 dB	619 (334)	24.1 (13)	643 (347)
20 000 m (66 000 ft)	40 dB	619 (334)	241 (130)	860 (464)

(See Figure A-7.)

6.2 Where it is necessary to take account, on a regional basis, of receivers not specifically designed for 25 kHz channel spacing and used in a 25 kHz channel spacing environment, an effective adjacent channel rejection characteristic of the receiver of the order of 40 dB is assumed. This assumption will result in a minimum geographical separation distance *D* between VHF VOLMET ground transmitters derived as follows:

$D = (d_1 + d_2)$ km where d_1 = distance between aircraft and wanted ground station = radio horizon + 27.8 km (15 NM) d_2 = distance between aircraft and unwanted ground station = 240.9 km (130 NM).

6.3 Application of the above criteria in the case of aircraft altitudes of 13 500 m (45 000 ft) and 20 000 m (66 000 ft) results in the following separation distances:

6.4 The above criteria are based on the following additional assumptions:

1) *Effective radiated power*: an ERP of 100 W for the ground stations.

Note.— If an ERP of 20 W is assumed, this would result in separation distances for 13 500 m (45 000 ft) of 472 km (255 NM) for 60 dB receiver adjacent channel rejection and 572 km (309 NM) for 40 dB receiver adjacent channel rejection.

2) *Interfering signal strength*: if the received signal strength is in excess of the free space propagation value, then the maximum value will not exceed the free space value by more than 5 dB over average earth. This condition is satisfied when transmitters of 20 W ERP or more are used in conjunction with a receiver adjacent channel rejection of not less than 35 dB. Thus, the minimum distance for d_2 can be derived from a consideration of receiver muting level, receiver adjacent channel rejection and transmitter ERP.

7. RF — Characteristics for digital VHF systems, interference immunity performance

7.1 *Receiving function — interference immunity performance*. The standard measurement technique for digital systems provides that the desired signal field strength be doubled, and that the undesired signal be applied in increasing levels until the channel performance, that is the specified error rate, degrades to a value equal to the value found at the specified receiver sensitivity.

For the VDL, the effect of the measurement technique is that the desired signal strength is increased from 20 microvolts per metre to 40 microvolts per metre. Then the undesired signal on the adjacent or any other assignable channel is raised to the specified level higher than the desired signal until the specified error rate is exceeded.

Care should be taken to ensure that on-channel noise power is not included in the measurement of the undesired signal.

7.2 *Assignment criteria.* Assignment of frequencies for VHF digital link should take into account the VDL RF system characteristics in order to avoid harmful interference to or from co-channel and adjacent channel assignments, in keeping with regionally and nationally agreed spectrum management policies

Note: Propagation curves not included

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Appendix D

Terms and definitions

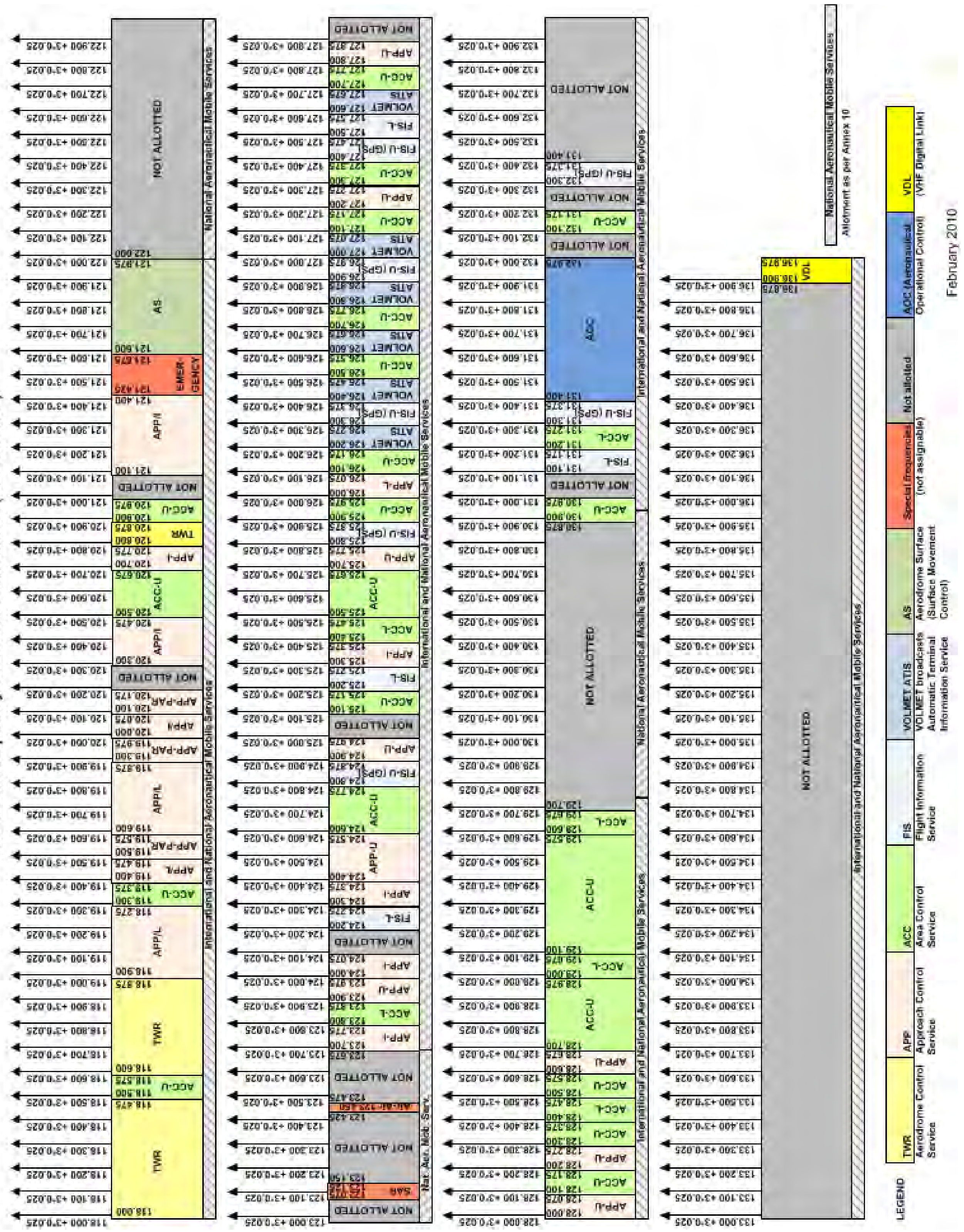
Designated operational range or height (DOR or DOH) – The range or height to which an aid is needed operationally in order to provide a particular service and within which the facility is afforded frequency protection.

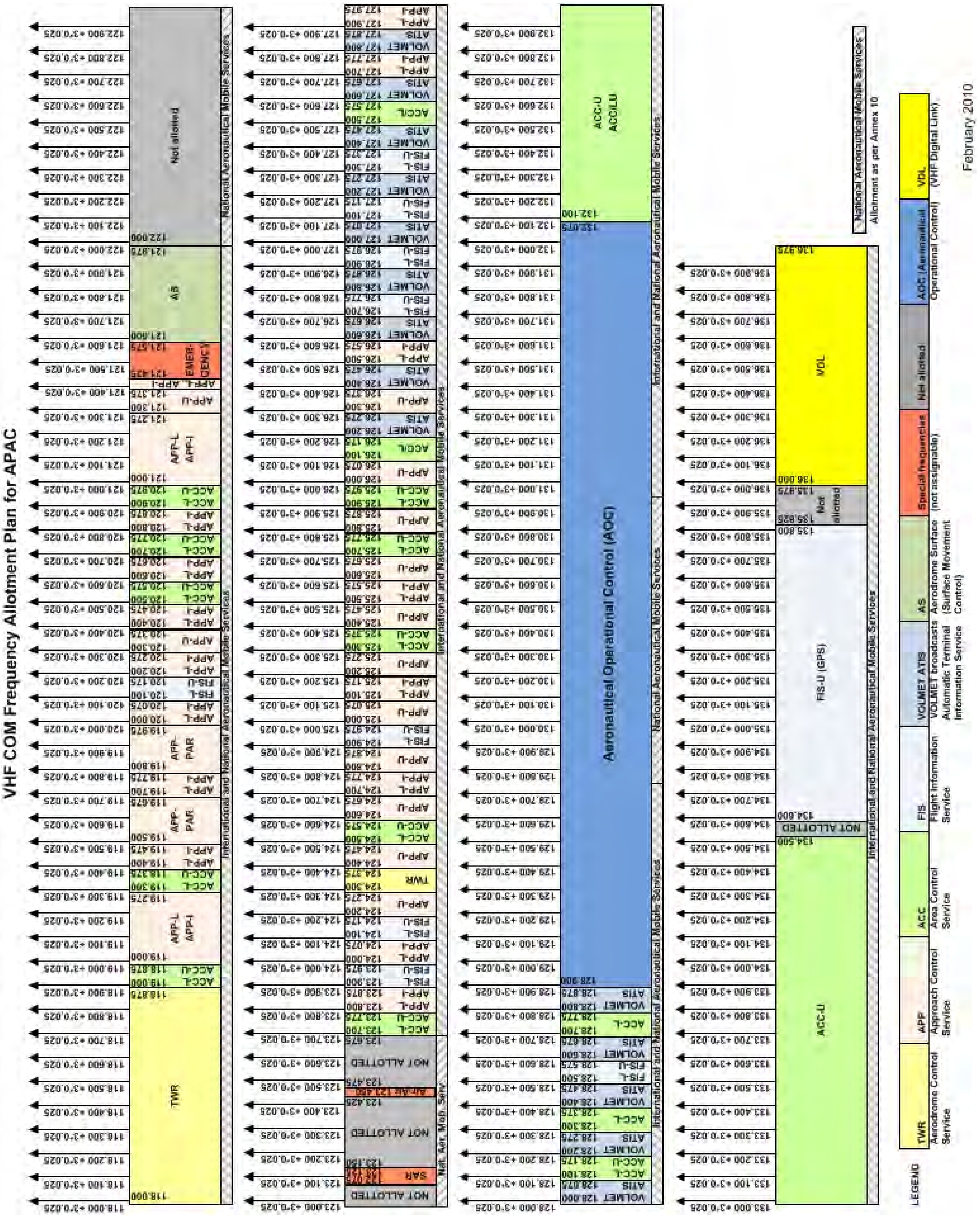
Note 1 – The designated value for range or height is determined in accordance with the criteria for the deployment of the aid in question.

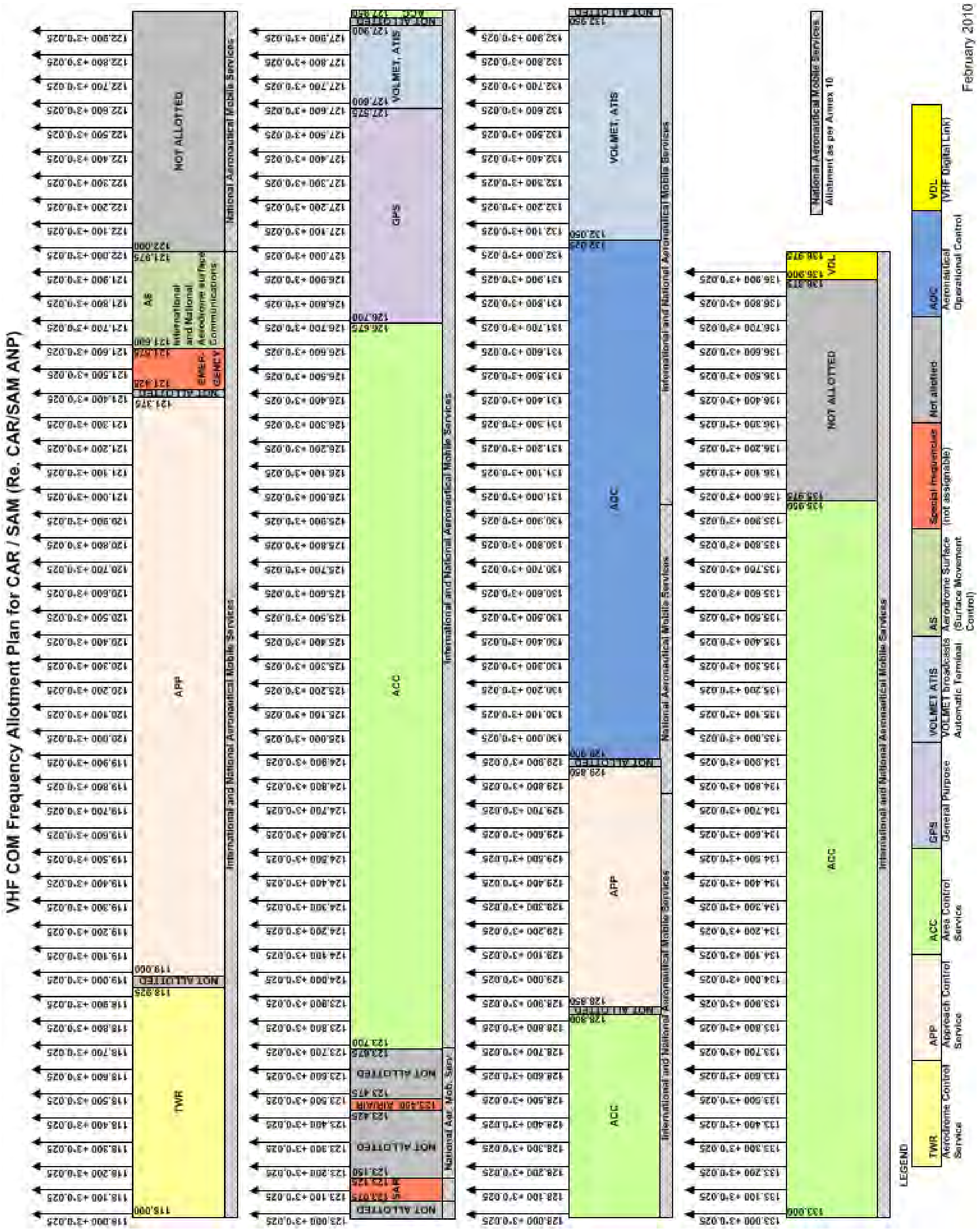
Note 2 – The designated value for range or height forms the basis for the technical planning of aids.

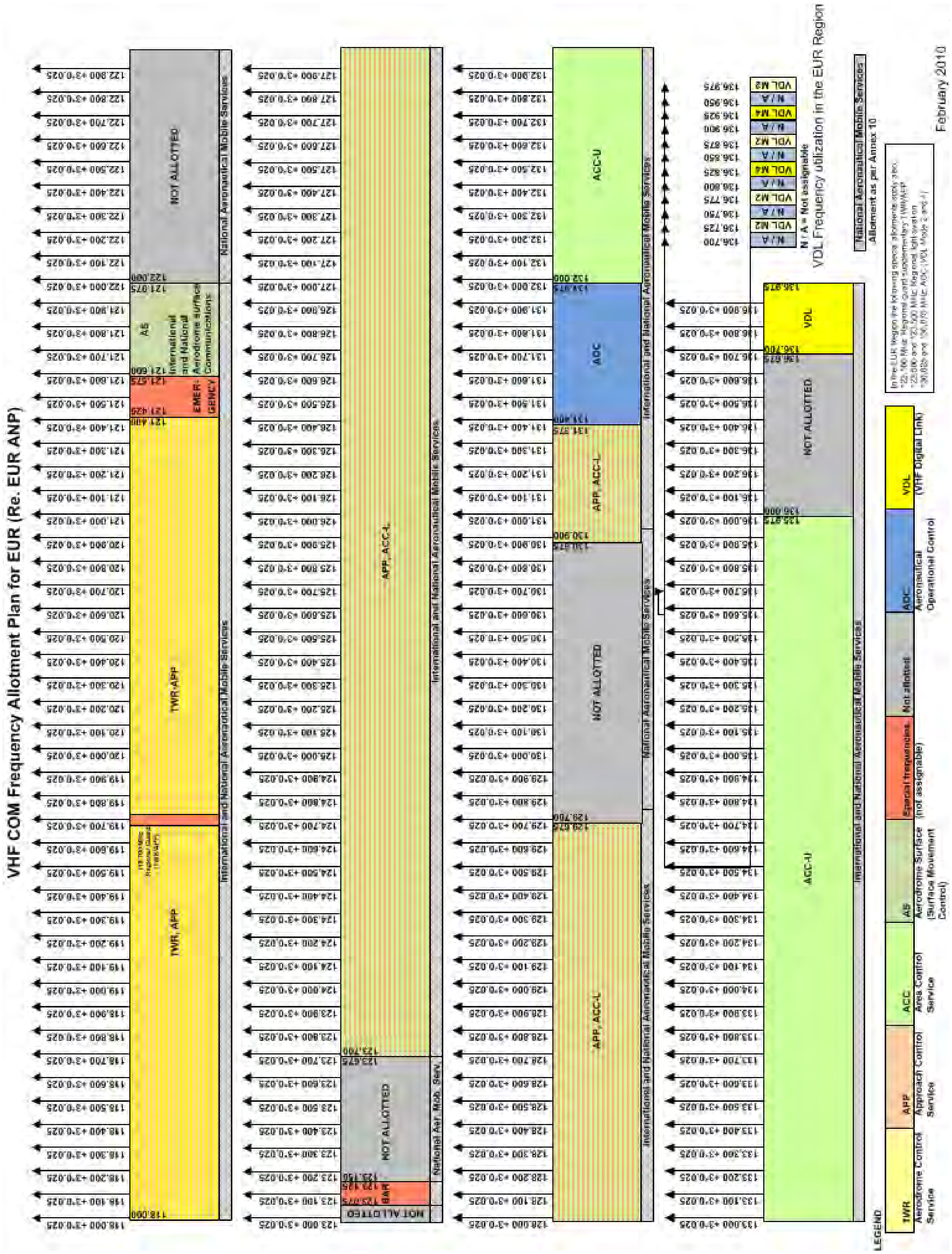
Designated operational coverage (DOC) – The combination of the designated operational range and the designated operational height (e.g. 200NM/FL500 is the designated operational coverage for an aid with a designated operational range of 500 NM and a designated operational height of 50.000 ft (Flight Level 500).

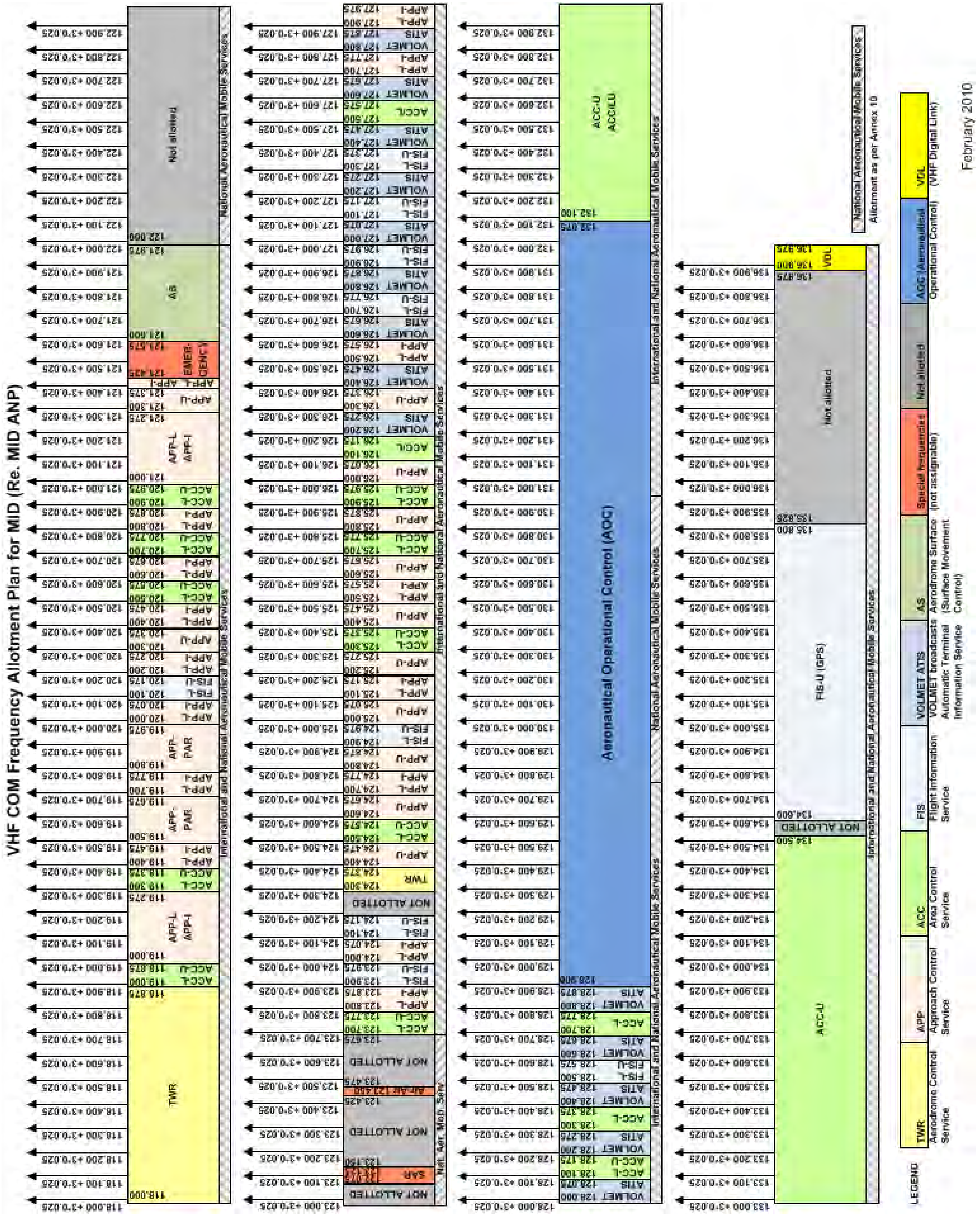
VHF COM Frequency Allotment Plan for AFI (Re. AFI ANP)




VHF COM Frequency Allotment Plan for APAC
February 2010
Aeronautical Operational Control (AOC)
LEGEND
TWR Aerodrome Control Service
APP Approach Control Service
ACC Area Control Service
FIS Flight Information Service
VOLMET ATIS VOLMET broadcasts Automatic Terminal Information Service
AS Aerodrome Surface (Surface Movement Control)
Special frequencies (not assignable)
Not allotted
AOC (Aeronautical Operational Control)
VDL (VHF Digital Link)
National Aeronautical Mobile Services
Allotment as per Annex 10


VHF COM Frequency Allotment Plan for CAR / SAM (Re. CAR/SAM ANP)
February 2010
National Aeronautical Mobile Services
Allotment as per Annex 10
LEGEND
TWR Aerodrome Control Service
APP Approach Control Service
ACC Area Control Service
GPS General Purpose
VOLMET ATIS VOLMET broadcasts Automatic Terminal
AS Aerodrome Surface (Surface Movement Control)
Special frequencies (not assignable)
Not allotted
AOC Aeronautical Operational Control
VDL (VHF Digital Link)


VHF COM Frequency Allotment Plan for EUR (Re. EUR ANP)
VDL Frequency utilization in the EUR Region
N / A = Not assignable
National Aeronautical Mobile Services
Allotment as per Annex 10
LEGEND
TWR Aerodrome Control Service
APP Approach Control Service
ACC Area Control Service
AS Aerodrome Surface (Surface Movement Control)
Special frequencies (not assignable)
Not allotted
AOC Aeronautical Operational Control
VDL (VHF Digital Link)
February 2010


VHF COM Frequency Allotment Plan for MID (Re. MID ANP)
February 2010

Appendix F

Channel pairing between ILS localizer, ILS-glide path and DME and between VOR and DME.

Localizer/VOR	Glide Path	DME channel
108.000		17X
108.050		17Y
108.100	334.700	18X
108.150	334.550	18Y
108.200		19X
108.250		19Y
108.300	334.100	20X
108.350	333.950	20Y
108.400		21X
108.450		21Y
108.500	329.900	22X
108.550	329.750	22Y
108.600		23X
108.650		23Y
108.700	330.500	24X
108.750	330.350	24Y
108.800		25X
108.850		25Y
108.900	329.300	26X
108.950	329.150	26Y
109.000		27X
109.050		27Y
109.100	331.400	28X
109.150	331.250	28Y
109.200		29X
109.250		29Y
109.300	332.000	30X
109.350	331.850	30Y
109.400		31X
109.450		31Y
109.500	332.600	32X
109.550	332.450	32Y
109.600		33X
109.650		33Y
109.700	333.200	34X
109.750	333.050	34Y
109.800		35X
109.850		35Y
109.900	333.800	36X
109.950	333.650	36Y
110.000		37X
110.050		37Y
110.100	334.400	38X
110.150	334.250	38Y
110.200		39X
110.250		39Y
110.300	335.000	40X
110.350	334.850	40Y
110.400		41X
110.450		41Y
110.500	329.600	42X
110.550	329.450	42Y
110.600		43X
110.650		43Y
110.700	330.200	44X
110.750	330.050	44Y
110.800		45X
110.850		45Y
110.900	330.800	46X
110.950	330.650	46Y
111.000		47X
111.050		47Y
111.100	331.700	48X
111.150	331.550	48Y
111.200		49X
111.250		49Y
111.300	332.300	50X
111.350	332.150	50Y
111.400		51X
111.450		51Y

Localizer/VOR	Glide Path	DME channel
111.500	332.900	52X
111.550	332.750	52Y
111.600		53X
111.650		53Y
111.700	333.500	54X
111.750	333.350	54Y
111.800		55X
111.850		55Y
111.900	331.100	56X
111.950	330.950	56Y
112.000		57X
112.050		57Y
112.100		58X
112.150		58Y
112.200		59X
112.250		59Y
112.300		70X
112.350		70Y
112.400		71X
112.450		71Y
112.500		72X
112.550		72Y
112.600		73X
112.650		73Y
112.700		74X
112.750		74Y
112.800		75X
112.850		75Y
112.900		76X
112.950		76Y
113.000		77X
113.050		77Y
113.100		78X
113.150		78Y
113.200		79X
113.250		79Y
113.300		80X
113.350		80Y
113.400		81X
113.450		81Y
113.500		82X
113.550		82Y
113.600		83X
113.650		83Y
113.700		84X
113.750		84Y
113.800		85X
113.850		85Y
113.900		86X
113.950		86Y
114.000		87X
114.050		87Y
114.100		88X
114.150		88Y
114.200		89X
114.250		89Y
114.300		90X
114.350		90Y
114.400		91X
114.450		91Y
114.500		92X
114.550		92Y
114.600		93X
114.650		93Y
114.700		94X
114.750		94Y
114.800		95X
114.850		95Y
114.900		96X
114.950		96Y

Localizer/VOR	DME channel
115.000	97X
115.050	97Y
115.100	98X
115.150	98Y
115.200	99X
115.250	99Y
115.300	100X
115.350	100Y
115.400	101X
115.450	101Y
115.500	102X
115.550	102Y
115.600	103X
115.650	103Y
115.700	104X
115.750	104Y
115.800	105X
115.850	105Y
115.900	106X
115.950	106Y
116.000	107X
116.050	107Y
116.100	108X
116.150	108Y
116.200	109X
116.250	109Y
116.300	110X
116.350	110Y
116.400	111X
116.450	111Y
116.500	112X
116.550	112Y
116.600	113X
116.650	113Y
116.700	114X
116.750	114Y
116.800	115X
116.850	115Y
116.900	116X
116.950	116Y
117.000	117X
117.050	117Y
117.100	118X
117.150	118Y
117.200	119X
117.250	119Y
117.300	120X
117.350	120Y
117.400	121X
117.450	121Y
117.500	122X
117.550	122Y
117.600	123X
117.650	123Y
117.700	124X
117.750	124Y
117.800	125X
117.850	125Y
117.900	126X
117.950	125Y

Regional frequency utilization table

Appendix G

Frequency	**Channel**	**AFI**	**APAC**	**CAR**	**EUR**	**MID**	**SAM**
118.0000	118.005	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.0000	118.000	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.0083	118.010	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.0167	118.015	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.0250	118.025	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.0250	118.030	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.0333	118.035	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.0417	118.040	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.0500	118.055	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.0500	118.050	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.0583	118.060	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.0667	118.065	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.0750	118.080	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.0750	118.075	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.0833	118.085	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.0917	118.090	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.1000	118.100	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.1000	118.105	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.1083	118.110	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.1167	118.115	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.1250	118.125	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.1250	118.130	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.1333	118.135	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.1417	118.140	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.1500	118.150	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.1500	118.155	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.1583	118.160	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.1667	118.165	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.1750	118.175	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.1750	118.180	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.1833	118.185	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.1917	118.190	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.2000	118.200	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.2000	118.205	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.2083	118.210	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.2167	118.215	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.2250	118.230	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.2250	118.225	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.2333	118.235	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.2417	118.240	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.2500	118.250	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.2500	118.255	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.2583	118.260	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.2667	118.265	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.2750	118.275	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.2750	118.280	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.2833	118.285	Not used	Not used	Not used	TWR, APP	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
118.2917	118.290	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.3000	118.300	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.3000	118.305	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.3083	118.310	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.3167	118.315	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.3250	118.330	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.3250	118.325	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.3333	118.335	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.3417	118.340	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.3500	118.355	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.3500	118.350	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.3583	118.360	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.3667	118.365	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.3750	118.380	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.3750	118.375	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.3833	118.385	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.3917	118.390	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.4000	118.400	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.4000	118.405	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.4083	118.410	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.4167	118.415	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.4250	118.425	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.4250	118.430	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.4333	118.435	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.4417	118.440	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.4500	118.450	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.4500	118.455	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.4583	118.460	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.4667	118.465	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.4750	118.475	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.4750	118.480	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.4833	118.485	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.4917	118.490	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.5000	118.500	ACC-U	TWR	TWR	TWR, APP	TWR	TWR
118.5000	118.505	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.5083	118.510	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.5167	118.515	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.5250	118.525	ACC-U	TWR	TWR	TWR, APP	TWR	TWR
118.5250	118.530	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.5333	118.535	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.5417	118.540	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.5500	118.550	ACC-U	TWR	TWR	TWR, APP	TWR	TWR
118.5500	118.555	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.5583	118.560	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.5667	118.565	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.5750	118.575	ACC-U	TWR	TWR	TWR, APP	TWR	TWR
118.5750	118.580	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.5833	118.585	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.5917	118.590	Not used	Not used	Not used	TWR, APP	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
118.6000	118.600	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.6000	118.605	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.6083	118.610	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.6167	118.615	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.6250	118.625	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.6250	118.630	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.6333	118.635	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.6417	118.640	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.6500	118.650	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.6500	118.655	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.6583	118.660	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.6667	118.665	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.6750	118.675	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.6750	118.680	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.6833	118.685	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.6917	118.690	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.7000	118.700	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.7000	118.705	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.7083	118.710	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.7167	118.715	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.7250	118.725	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.7250	118.730	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.7333	118.735	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.7417	118.740	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.7500	118.750	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.7500	118.755	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.7583	118.760	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.7667	118.765	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.7750	118.775	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.7750	118.780	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.7833	118.785	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.7917	118.790	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.8000	118.800	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.8000	118.805	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.8083	118.810	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.8167	118.815	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.8250	118.825	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.8250	118.830	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.8333	118.835	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.8417	118.840	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.8500	118.850	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.8500	118.855	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.8583	118.860	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.8667	118.865	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.8750	118.875	TWR	TWR	TWR	TWR, APP	TWR	TWR
118.8750	118.880	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.8833	118.885	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.8917	118.890	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.9000	118.900	TWR	ACC-L, ACC-U	TWR	TWR, APP	ACC-L, ACC-U	TWR

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
118.9000	118.905	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.9083	118.910	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.9167	118.915	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.9250	118.925	TWR	ACC-L, ACC-U	TWR	TWR, APP	ACC-L, ACC-U	TWR
118.9250	118.930	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.9333	118.935	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.9417	118.940	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.9500	118.950	TWR	ACC-L, ACC-U	Not allotted	TWR, APP	ACC-L, ACC-U	Not allotted
118.9500	118.955	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.9583	118.960	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.9667	118.965	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.9750	118.975	TWR	ACC-L, ACC-U	Not allotted	TWR, APP	ACC-L, ACC-U	Not allotted
118.9750	118.980	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.9833	118.985	Not used	Not used	Not used	TWR, APP	Not used	Not used
118.9917	118.990	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.0000	119.000	APP-L	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
119.0000	119.005	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.0083	119.010	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.0167	119.015	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.0250	119.025	APP-L	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
119.0250	119.030	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.0333	119.035	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.0417	119.040	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.0500	119.050	APP-L	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
119.0500	119.055	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.0583	119.060	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.0667	119.065	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.0750	119.075	APP-L	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
119.0750	119.080	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.0833	119.085	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.0917	119.090	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.1000	119.100	APP-L	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
119.1000	119.105	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.1083	119.110	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.1167	119.115	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.1250	119.125	APP-L	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
119.1250	119.130	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.1333	119.135	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.1417	119.140	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.1500	119.150	APP-L	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
119.1500	119.155	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.1583	119.160	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.1667	119.165	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.1750	119.175	APP-L	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
119.1750	119.180	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.1833	119.185	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.1917	119.190	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.2000	119.200	APP-L	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
119.2000	119.205	Not used	Not used	Not used	TWR, APP	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
119.2083	119.210	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.2167	119.215	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.2250	119.225	APP-L	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
119.2250	119.230	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.2333	119.235	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.2417	119.240	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.2500	119.250	APP-L	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
119.2500	119.255	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.2583	119.260	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.2667	119.265	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.2750	119.275	APP-L	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
119.2750	119.280	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.2833	119.285	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.2917	119.290	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.3000	119.300	ACC-U	ACC-L, ACC-U	APP	TWR, APP	ACC-L, ACC-U	APP
119.3000	119.305	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.3083	119.310	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.3167	119.315	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.3250	119.325	ACC-U	ACC-L, ACC-U	APP	TWR, APP	ACC-L, ACC-U	APP
119.3250	119.330	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.3333	119.335	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.3417	119.340	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.3500	119.350	ACC-U	ACC-L, ACC-U	APP	TWR, APP	ACC-L, ACC-U	APP
119.3500	119.355	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.3583	119.360	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.3667	119.365	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.3750	119.375	ACC-U	ACC-L, ACC-U	APP	TWR, APP	ACC-L, ACC-U	APP
119.3750	119.380	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.3833	119.385	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.3917	119.390	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.4000	119.400	APP-L	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
119.4000	119.405	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.4083	119.410	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.4167	119.415	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.4250	119.425	APP-L	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
119.4250	119.430	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.4333	119.435	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.4417	119.440	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.4500	119.450	APP-L	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
119.4500	119.455	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.4583	119.460	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.4667	119.465	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.4750	119.475	APP-L	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
119.4750	119.480	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.4833	119.485	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.4917	119.490	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.5000	119.505	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.5000	119.500	APP-PAR	APP-PAR	APP	TWR, APP	APP-PAR	APP
119.5083	119.510	Not used	Not used	Not used	TWR, APP	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
119.5167	119.515	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.5250	119.525	APP-PAR	APP-PAR	APP	TWR, APP	APP-PAR	APP
119.5250	119.530	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.5333	119.535	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.5417	119.540	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.5500	119.550	APP-PAR	APP-PAR	APP	TWR, APP	APP-PAR	APP
119.5500	119.555	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.5583	119.560	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.5667	119.565	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.5750	119.575	APP-PAR	APP-PAR	APP	TWR, APP	APP-PAR	APP
119.5750	119.580	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.5833	119.585	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.5917	119.590	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.6000	119.600	APP-L	APP-PAR	APP	TWR, APP	APP-PAR	APP
119.6000	119.605	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.6083	119.610	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.6167	119.615	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.6250	119.625	APP-L	APP-PAR	APP	TWR, APP	APP-PAR	APP
119.6250	119.630	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.6333	119.635	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.6417	119.640	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.6500	119.650	APP-L	APP-PAR	APP	TWR, APP	APP-PAR	APP
119.6500	119.655	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.6583	119.660	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.6667	119.665	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.6750	119.675	APP-L	APP-PAR	APP	TWR, APP	APP-PAR	APP
119.6750	119.680	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.6833	119.685	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.6917	119.690	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.7000	119.700	APP-L	APP-L, APP-I	APP	RGA (TWR, APP)	APP-L, APP-I	APP
119.7000	119.705	Not used	Not used	Not used	RGA (TWR, APP)	Not used	Not used
119.7083	119.710	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.7167	119.715	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.7250	119.725	APP-L	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
119.7250	119.730	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.7333	119.735	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.7417	119.740	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.7500	119.750	APP-L	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
119.7500	119.755	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.7583	119.760	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.7667	119.765	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.7750	119.775	APP-L	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
119.7750	119.780	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.7833	119.785	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.7917	119.790	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.8000	119.800	APP-L	APP-PAR	APP	TWR, APP	APP-PAR	APP
119.8000	119.805	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.8083	119.810	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.8167	119.815	Not used	Not used	Not used	TWR, APP	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
119.8250	119.825	APP-L	APP-PAR	APP	TWR, APP	APP-PAR	APP
119.8250	119.830	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.8333	119.835	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.8417	119.840	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.8500	119.850	APP-L	APP-PAR	APP	TWR, APP	APP-PAR	APP
119.8500	119.855	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.8583	119.860	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.8667	119.865	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.8750	119.875	APP-L	APP-PAR	APP	TWR, APP	APP-PAR	APP
119.8750	119.880	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.8833	119.885	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.8917	119.890	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.9000	119.900	APP-PAR	APP-PAR	APP	TWR, APP	APP-PAR	APP
119.9000	119.905	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.9083	119.910	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.9167	119.915	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.9250	119.930	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.9250	119.925	APP-PAR	APP-PAR	APP	TWR, APP	APP-PAR	APP
119.9333	119.935	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.9417	119.940	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.9500	119.950	APP-PAR	APP-PAR	APP	TWR, APP	APP-PAR	APP
119.9500	119.955	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.9583	119.960	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.9667	119.965	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.9750	119.975	APP-PAR	APP-PAR	APP	TWR, APP	APP-PAR	APP
119.9750	119.980	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.9833	119.985	Not used	Not used	Not used	TWR, APP	Not used	Not used
119.9917	119.990	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.0000	120.000	APP-I	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
120.0000	120.005	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.0083	120.010	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.0167	120.015	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.0250	120.025	APP-I	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
120.0250	120.030	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.0333	120.035	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.0417	120.040	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.0500	120.055	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.0500	120.050	APP-I	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
120.0583	120.060	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.0667	120.065	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.0750	120.075	APP-I	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
120.0750	120.080	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.0833	120.085	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.0917	120.090	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.1000	120.100	APP-PAR	FIS-L, FIS-U	APP	TWR, APP	FIS-L, FIS-U	APP
120.1000	120.105	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.1083	120.110	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.1167	120.115	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.1250	120.125	APP-PAR	FIS-L, FIS-U	APP	TWR, APP	FIS-L, FIS-U	APP

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
120.1250	120.130	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.1333	120.135	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.1417	120.140	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.1500	120.150	APP-PAR	FIS-L, FIS-U	APP	TWR, APP	FIS-L, FIS-U	APP
120.1500	120.155	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.1583	120.160	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.1667	120.165	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.1750	120.175	APP-PAR	FIS-L, FIS-U	APP	TWR, APP	FIS-L, FIS-U	APP
120.1750	120.180	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.1833	120.185	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.1917	120.190	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.2000	120.200	Not allotted	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
120.2000	120.205	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.2083	120.210	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.2167	120.215	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.2250	120.225	Not allotted	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
120.2250	120.230	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.2333	120.235	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.2417	120.240	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.2500	120.250	Not allotted	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
120.2500	120.255	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.2583	120.260	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.2667	120.265	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.2750	120.275	Not allotted	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
120.2750	120.280	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.2833	120.285	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.2917	120.290	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.3000	120.300	APP-I	APP-U	APP	TWR, APP	APP-U	APP
120.3000	120.305	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.3083	120.310	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.3167	120.315	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.3250	120.325	APP-I	APP-U	APP	TWR, APP	APP-U	APP
120.3250	120.330	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.3333	120.335	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.3417	120.340	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.3500	120.350	APP-I	APP-U	APP	TWR, APP	APP-U	APP
120.3500	120.355	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.3583	120.360	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.3667	120.365	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.3750	120.375	APP-I	APP-U	APP	TWR, APP	APP-U	APP
120.3750	120.380	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.3833	120.385	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.3917	120.390	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.4000	120.400	APP-I	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
120.4000	120.405	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.4083	120.410	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.4167	120.415	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.4250	120.425	APP-I	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
120.4250	120.430	Not used	Not used	Not used	TWR, APP	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
120.4333	120.435	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.4417	120.440	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.4500	120.450	APP-I	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
120.4500	120.455	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.4583	120.460	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.4667	120.465	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.4750	120.475	APP-I	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
120.4750	120.480	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.4833	120.485	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.4917	120.490	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.5000	120.500	ACC-U	ACC-L, ACC-U	APP	TWR, APP	ACC-L, ACC-U	APP
120.5000	120.505	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.5083	120.510	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.5167	120.515	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.5250	120.525	ACC-U	ACC-L, ACC-U	APP	TWR, APP	ACC-L, ACC-U	APP
120.5250	120.530	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.5333	120.535	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.5417	120.540	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.5500	120.550	ACC-U	ACC-L, ACC-U	APP	TWR, APP	ACC-L, ACC-U	APP
120.5500	120.555	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.5583	120.560	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.5667	120.565	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.5750	120.575	ACC-U	ACC-L, ACC-U	APP	TWR, APP	ACC-L, ACC-U	APP
120.5750	120.580	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.5833	120.585	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.5917	120.590	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.6000	120.600	ACC-U	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
120.6000	120.605	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.6083	120.610	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.6167	120.615	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.6250	120.625	ACC-U	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
120.6250	120.630	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.6333	120.635	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.6417	120.640	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.6500	120.650	ACC-U	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
120.6500	120.655	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.6583	120.660	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.6667	120.665	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.6750	120.675	ACC-U	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
120.6750	120.680	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.6833	120.685	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.6917	120.690	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.7000	120.700	APP-I	ACC-L, ACC-U	APP	TWR, APP	ACC-L, ACC-U	APP
120.7000	120.705	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.7083	120.710	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.7167	120.715	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.7250	120.725	APP-I	ACC-L, ACC-U	APP	TWR, APP	ACC-L, ACC-U	APP
120.7250	120.730	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.7333	120.735	Not used	Not used	Not used	TWR, APP	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
120.7417	120.740	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.7500	120.750	APP-I	ACC-L, ACC-U	APP	TWR, APP	ACC-L, ACC-U	APP
120.7500	120.755	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.7583	120.760	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.7667	120.765	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.7750	120.775	APP-I	ACC-L, ACC-U	APP	TWR, APP	ACC-L, ACC-U	APP
120.7750	120.780	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.7833	120.785	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.7917	120.790	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.8000	120.800	TWR	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
120.8000	120.805	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.8083	120.810	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.8167	120.815	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.8250	120.825	TWR	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
120.8250	120.830	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.8333	120.835	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.8417	120.840	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.8500	120.850	TWR	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
120.8500	120.855	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.8583	120.860	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.8667	120.865	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.8750	120.875	TWR	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
120.8750	120.880	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.8833	120.885	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.8917	120.890	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.9000	120.900	ACC-U	ACC-L, ACC-U	APP	TWR, APP	ACC-L, ACC-U	APP
120.9000	120.905	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.9083	120.910	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.9167	120.915	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.9250	120.925	ACC-U	ACC-L, ACC-U	APP	TWR, APP	ACC-L, ACC-U	APP
120.9250	120.930	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.9333	120.935	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.9417	120.940	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.9500	120.950	ACC-U	ACC-L, ACC-U	APP	TWR, APP	ACC-L, ACC-U	APP
120.9500	120.955	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.9583	120.960	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.9667	120.965	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.9750	120.980	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.9750	120.975	ACC-U	ACC-L, ACC-U	APP	TWR, APP	ACC-L, ACC-U	APP
120.9833	120.985	Not used	Not used	Not used	TWR, APP	Not used	Not used
120.9917	120.990	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.0000	121.000	Not allotted	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
121.0000	121.005	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.0083	121.010	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.0167	121.015	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.0250	121.025	Not allotted	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
121.0250	121.030	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.0333	121.035	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.0417	121.040	Not used	Not used	Not used	TWR, APP	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
121.0500	121.050	Not allotted	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
121.0500	121.055	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.0583	121.060	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.0667	121.065	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.0750	121.075	Not allotted	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
121.0750	121.080	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.0833	121.085	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.0917	121.090	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.1000	121.100	APP-I	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
121.1000	121.105	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.1083	121.110	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.1167	121.115	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.1250	121.125	APP-I	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
121.1250	121.130	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.1333	121.135	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.1417	121.140	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.1500	121.150	APP-I	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
121.1500	121.155	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.1583	121.160	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.1667	121.165	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.1750	121.175	APP-I	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
121.1750	121.180	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.1833	121.185	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.1917	121.190	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.2000	121.200	APP-I	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
121.2000	121.205	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.2083	121.210	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.2167	121.215	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.2250	121.225	APP-I	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
121.2250	121.230	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.2333	121.235	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.2417	121.240	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.2500	121.250	APP-I	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
121.2500	121.255	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.2583	121.260	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.2667	121.265	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.2750	121.275	APP-I	APP-L, APP-I	APP	TWR, APP	APP-L, APP-I	APP
121.2750	121.280	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.2833	121.285	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.2917	121.290	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.3000	121.300	APP-I	APP-U	APP	TWR, APP	APP-U	APP
121.3000	121.305	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.3083	121.310	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.3167	121.315	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.3250	121.325	APP-I	APP-U	APP	TWR, APP	APP-U	APP
121.3250	121.330	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.3333	121.335	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.3417	121.340	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.3500	121.350	APP-I	APP-U	APP	TWR, APP	APP-U	APP

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
121.3500	121.355	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.3583	121.360	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.3667	121.365	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.3750	121.375	APP-I	APP-U	APP	TWR, APP	APP-U	APP
121.3750	121.380	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.3833	121.385	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.3917	121.390	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.4000	121.405	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.4000	121.400	APP-I	APP-L, APP-I	Not allotted	TWR, APP	APP-L, APP-I	Not allotted
121.4083	121.410	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.4167	121.415	Not used	Not used	Not used	TWR, APP	Not used	Not used
121.4250	121.425	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.4250	121.430	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.4333	121.435	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.4417	121.440	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.4500	121.450	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.4500	121.455	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.4583	121.460	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.4667	121.465	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.4750	121.475	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.4750	121.480	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.4833	121.485	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.4917	121.490	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.5000	121.500	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.5000	121.505	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.5083	121.510	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.5167	121.515	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.5250	121.525	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.5250	121.530	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.5333	121.535	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.5417	121.540	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.5500	121.550	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.5500	121.555	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.5583	121.560	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.5667	121.565	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.5750	121.575	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
121.5750	121.580	Not used	Not used	Not used	AS	Not used	Not used
121.5833	121.585	Not used	Not used	Not used	AS	Not used	Not used
121.5917	121.590	Not used	Not used	Not used	AS	Not used	Not used
121.6000	121.600	AS	AS	AS	AS	AS	AS
121.6000	121.605	Not used	Not used	Not used	AS	Not used	Not used
121.6083	121.610	Not used	Not used	Not used	AS	Not used	Not used
121.6167	121.615	Not used	Not used	Not used	AS	Not used	Not used
121.6250	121.630	Not used	Not used	Not used	AS	Not used	Not used
121.6250	121.625	AS	AS	AS	AS	AS	AS
121.6333	121.635	Not used	Not used	Not used	AS	Not used	Not used
121.6417	121.640	Not used	Not used	Not used	AS	Not used	Not used
121.6500	121.650	AS	AS	AS	AS	AS	AS
121.6500	121.655	Not used	Not used	Not used	AS	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
121.6583	121.660	Not used	Not used	Not used	AS	Not used	Not used
121.6667	121.665	Not used	Not used	Not used	AS	Not used	Not used
121.6750	121.675	AS	AS	AS	AS	AS	AS
121.6750	121.680	Not used	Not used	Not used	AS	Not used	Not used
121.6833	121.685	Not used	Not used	Not used	AS	Not used	Not used
121.6917	121.690	Not used	Not used	Not used	AS	Not used	Not used
121.7000	121.700	AS	AS	AS	AS	AS	AS
121.7000	121.705	Not used	Not used	Not used	AS	Not used	Not used
121.7083	121.710	Not used	Not used	Not used	AS	Not used	Not used
121.7167	121.715	Not used	Not used	Not used	AS	Not used	Not used
121.7250	121.725	AS	AS	AS	AS	AS	AS
121.7250	121.730	Not used	Not used	Not used	AS	Not used	Not used
121.7333	121.735	Not used	Not used	Not used	AS	Not used	Not used
121.7417	121.740	Not used	Not used	Not used	AS	Not used	Not used
121.7500	121.750	AS	AS	AS	AS	AS	AS
121.7500	121.755	Not used	Not used	Not used	AS	Not used	Not used
121.7583	121.760	Not used	Not used	Not used	AS	Not used	Not used
121.7667	121.765	Not used	Not used	Not used	AS	Not used	Not used
121.7750	121.775	AS	AS	AS	AS	AS	AS
121.7750	121.780	Not used	Not used	Not used	AS	Not used	Not used
121.7833	121.785	Not used	Not used	Not used	AS	Not used	Not used
121.7917	121.790	Not used	Not used	Not used	AS	Not used	Not used
121.8000	121.800	AS	AS	AS	AS	AS	AS
121.8000	121.805	Not used	Not used	Not used	AS	Not used	Not used
121.8083	121.810	Not used	Not used	Not used	AS	Not used	Not used
121.8167	121.815	Not used	Not used	Not used	AS	Not used	Not used
121.8250	121.825	AS	AS	AS	AS	AS	AS
121.8250	121.830	Not used	Not used	Not used	AS	Not used	Not used
121.8333	121.835	Not used	Not used	Not used	AS	Not used	Not used
121.8417	121.840	Not used	Not used	Not used	AS	Not used	Not used
121.8500	121.850	AS	AS	AS	AS	AS	AS
121.8500	121.855	Not used	Not used	Not used	AS	Not used	Not used
121.8583	121.860	Not used	Not used	Not used	AS	Not used	Not used
121.8667	121.865	Not used	Not used	Not used	AS	Not used	Not used
121.8750	121.875	AS	AS	AS	AS	AS	AS
121.8750	121.880	Not used	Not used	Not used	AS	Not used	Not used
121.8833	121.885	Not used	Not used	Not used	AS	Not used	Not used
121.8917	121.890	Not used	Not used	Not used	AS	Not used	Not used
121.9000	121.900	AS	AS	AS	AS	AS	AS
121.9000	121.905	Not used	Not used	Not used	AS	Not used	Not used
121.9083	121.910	Not used	Not used	Not used	AS	Not used	Not used
121.9167	121.915	Not used	Not used	Not used	AS	Not used	Not used
121.9250	121.925	AS	AS	AS	AS	AS	AS
121.9250	121.930	Not used	Not used	Not used	AS	Not used	Not used
121.9333	121.935	Not used	Not used	Not used	AS	Not used	Not used
121.9417	121.940	Not used	Not used	Not used	AS	Not used	Not used
121.9500	121.950	AS	AS	AS	AS	AS	AS
121.9500	121.955	Not used	Not used	Not used	AS	Not used	Not used
121.9583	121.960	Not used	Not used	Not used	AS	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
121.9667	121.965	Not used	Not used	Not used	AS	Not used	Not used
121.9750	121.975	AS	AS	AS	AS	AS	AS
121.9750	121.980	Not used	Not used	Not used	AS	Not used	Not used
121.9833	121.985	Not used	Not used	Not used	AS	Not used	Not used
121.9917	121.990	Not used	Not used	Not used	AS	Not used	Not used
122.0000	122.000	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.0000	122.005	Not used	Not used	Not used	Not allotted	Not used	Not used
122.0083	122.010	Not used	Not used	Not used	Not allotted	Not used	Not used
122.0167	122.015	Not used	Not used	Not used	Not allotted	Not used	Not used
122.0250	122.025	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.0250	122.030	Not used	Not used	Not used	Not allotted	Not used	Not used
122.0333	122.035	Not used	Not used	Not used	Not allotted	Not used	Not used
122.0417	122.040	Not used	Not used	Not used	Not allotted	Not used	Not used
122.0500	122.050	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.0500	122.055	Not used	Not used	Not used	Not allotted	Not used	Not used
122.0583	122.060	Not used	Not used	Not used	Not allotted	Not used	Not used
122.0667	122.065	Not used	Not used	Not used	Not allotted	Not used	Not used
122.0750	122.075	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.0750	122.080	Not used	Not used	Not used	Not allotted	Not used	Not used
122.0833	122.085	Not used	Not used	Not used	Not allotted	Not used	Not used
122.0917	122.090	Not used	Not used	Not used	Not allotted	Not used	Not used
122.1000	122.100	Not allotted	Not allotted	Not allotted	RGA TWR, APP	Not allotted	Not allotted
122.1000	122.105	Not used	Not used	Not used	RGA TWR, APP	Not used	Not used
122.1083	122.110	Not used	Not used	Not used	Not allotted	Not used	Not used
122.1167	122.115	Not used	Not used	Not used	Not allotted	Not used	Not used
122.1250	122.125	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.1250	122.130	Not used	Not used	Not used	Not allotted	Not used	Not used
122.1333	122.135	Not used	Not used	Not used	Not allotted	Not used	Not used
122.1417	122.140	Not used	Not used	Not used	Not allotted	Not used	Not used
122.1500	122.150	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.1500	122.155	Not used	Not used	Not used	Not allotted	Not used	Not used
122.1583	122.160	Not used	Not used	Not used	Not allotted	Not used	Not used
122.1667	122.165	Not used	Not used	Not used	Not allotted	Not used	Not used
122.1750	122.175	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.1750	122.180	Not used	Not used	Not used	Not allotted	Not used	Not used
122.1833	122.185	Not used	Not used	Not used	Not allotted	Not used	Not used
122.1917	122.190	Not used	Not used	Not used	Not allotted	Not used	Not used
122.2000	122.200	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.2000	122.205	Not used	Not used	Not used	Not allotted	Not used	Not used
122.2083	122.210	Not used	Not used	Not used	Not allotted	Not used	Not used
122.2167	122.215	Not used	Not used	Not used	Not allotted	Not used	Not used
122.2250	122.225	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.2250	122.230	Not used	Not used	Not used	Not allotted	Not used	Not used
122.2333	122.235	Not used	Not used	Not used	Not allotted	Not used	Not used
122.2417	122.240	Not used	Not used	Not used	Not allotted	Not used	Not used
122.2500	122.250	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.2500	122.255	Not used	Not used	Not used	Not allotted	Not used	Not used
122.2583	122.260	Not used	Not used	Not used	Not allotted	Not used	Not used
122.2667	122.265	Not used	Not used	Not used	Not allotted	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
122.2750	122.275	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.2750	122.280	Not used	Not used	Not used	Not allotted	Not used	Not used
122.2833	122.285	Not used	Not used	Not used	Not allotted	Not used	Not used
122.2917	122.290	Not used	Not used	Not used	Not allotted	Not used	Not used
122.3000	122.300	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.3000	122.305	Not used	Not used	Not used	Not allotted	Not used	Not used
122.3083	122.310	Not used	Not used	Not used	Not allotted	Not used	Not used
122.3167	122.315	Not used	Not used	Not used	Not allotted	Not used	Not used
122.3250	122.325	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.3250	122.330	Not used	Not used	Not used	Not allotted	Not used	Not used
122.3333	122.335	Not used	Not used	Not used	Not allotted	Not used	Not used
122.3417	122.340	Not used	Not used	Not used	Not allotted	Not used	Not used
122.3500	122.350	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.3500	122.355	Not used	Not used	Not used	Not allotted	Not used	Not used
122.3583	122.360	Not used	Not used	Not used	Not allotted	Not used	Not used
122.3667	122.365	Not used	Not used	Not used	Not allotted	Not used	Not used
122.3750	122.375	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.3750	122.380	Not used	Not used	Not used	Not allotted	Not used	Not used
122.3833	122.385	Not used	Not used	Not used	Not allotted	Not used	Not used
122.3917	122.390	Not used	Not used	Not used	Not allotted	Not used	Not used
122.4000	122.400	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.4000	122.405	Not used	Not used	Not used	Not allotted	Not used	Not used
122.4083	122.410	Not used	Not used	Not used	Not allotted	Not used	Not used
122.4167	122.415	Not used	Not used	Not used	Not allotted	Not used	Not used
122.4250	122.425	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.4250	122.430	Not used	Not used	Not used	Not allotted	Not used	Not used
122.4333	122.435	Not used	Not used	Not used	Not allotted	Not used	Not used
122.4417	122.440	Not used	Not used	Not used	Not allotted	Not used	Not used
122.4500	122.450	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.4500	122.455	Not used	Not used	Not used	Not allotted	Not used	Not used
122.4583	122.460	Not used	Not used	Not used	Not allotted	Not used	Not used
122.4667	122.465	Not used	Not used	Not used	Not allotted	Not used	Not used
122.4750	122.475	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.4750	122.480	Not used	Not used	Not used	Not allotted	Not used	Not used
122.4833	122.485	Not used	Not used	Not used	Not allotted	Not used	Not used
122.4917	122.490	Not used	Not used	Not used	Not allotted	Not used	Not used
122.5000	122.500	Not allotted	Not allotted	Not allotted	RLA	Not allotted	Not allotted
122.5000	122.505	Not used	Not used	Not used	RLA	Not used	Not used
122.5083	122.510	Not used	Not used	Not used	Not allotted	Not used	Not used
122.5167	122.515	Not used	Not used	Not used	Not allotted	Not used	Not used
122.5250	122.525	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.5250	122.530	Not used	Not used	Not used	Not allotted	Not used	Not used
122.5333	122.535	Not used	Not used	Not used	Not allotted	Not used	Not used
122.5417	122.540	Not used	Not used	Not used	Not allotted	Not used	Not used
122.5500	122.550	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.5500	122.555	Not used	Not used	Not used	Not allotted	Not used	Not used
122.5583	122.560	Not used	Not used	Not used	Not allotted	Not used	Not used
122.5667	122.565	Not used	Not used	Not used	Not allotted	Not used	Not used
122.5750	122.575	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
122.5750	122.580	Not used	Not used	Not used	Not allotted	Not used	Not used
122.5833	122.585	Not used	Not used	Not used	Not allotted	Not used	Not used
122.5917	122.590	Not used	Not used	Not used	Not allotted	Not used	Not used
122.6000	122.600	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.6000	122.605	Not used	Not used	Not used	Not allotted	Not used	Not used
122.6083	122.610	Not used	Not used	Not used	Not allotted	Not used	Not used
122.6167	122.615	Not used	Not used	Not used	Not allotted	Not used	Not used
122.6250	122.625	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.6250	122.630	Not used	Not used	Not used	Not allotted	Not used	Not used
122.6333	122.635	Not used	Not used	Not used	Not allotted	Not used	Not used
122.6417	122.640	Not used	Not used	Not used	Not allotted	Not used	Not used
122.6500	122.650	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.6500	122.655	Not used	Not used	Not used	Not allotted	Not used	Not used
122.6583	122.660	Not used	Not used	Not used	Not allotted	Not used	Not used
122.6667	122.665	Not used	Not used	Not used	Not allotted	Not used	Not used
122.6750	122.675	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.6750	122.680	Not used	Not used	Not used	Not allotted	Not used	Not used
122.6833	122.685	Not used	Not used	Not used	Not allotted	Not used	Not used
122.6917	122.690	Not used	Not used	Not used	Not allotted	Not used	Not used
122.7000	122.700	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.7000	122.705	Not used	Not used	Not used	Not allotted	Not used	Not used
122.7083	122.710	Not used	Not used	Not used	Not allotted	Not used	Not used
122.7167	122.715	Not used	Not used	Not used	Not allotted	Not used	Not used
122.7250	122.725	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.7250	122.730	Not used	Not used	Not used	Not allotted	Not used	Not used
122.7333	122.735	Not used	Not used	Not used	Not allotted	Not used	Not used
122.7417	122.740	Not used	Not used	Not used	Not allotted	Not used	Not used
122.7500	122.750	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.7500	122.755	Not used	Not used	Not used	Not allotted	Not used	Not used
122.7583	122.760	Not used	Not used	Not used	Not allotted	Not used	Not used
122.7667	122.765	Not used	Not used	Not used	Not allotted	Not used	Not used
122.7750	122.775	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.7750	122.780	Not used	Not used	Not used	Not allotted	Not used	Not used
122.7833	122.785	Not used	Not used	Not used	Not allotted	Not used	Not used
122.7917	122.790	Not used	Not used	Not used	Not allotted	Not used	Not used
122.8000	122.800	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.8000	122.805	Not used	Not used	Not used	Not allotted	Not used	Not used
122.8083	122.810	Not used	Not used	Not used	Not allotted	Not used	Not used
122.8167	122.815	Not used	Not used	Not used	Not allotted	Not used	Not used
122.8250	122.825	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.8250	122.830	Not used	Not used	Not used	Not allotted	Not used	Not used
122.8333	122.835	Not used	Not used	Not used	Not allotted	Not used	Not used
122.8417	122.840	Not used	Not used	Not used	Not allotted	Not used	Not used
122.8500	122.850	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.8500	122.855	Not used	Not used	Not used	Not allotted	Not used	Not used
122.8583	122.860	Not used	Not used	Not used	Not allotted	Not used	Not used
122.8667	122.865	Not used	Not used	Not used	Not allotted	Not used	Not used
122.8750	122.875	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.8750	122.880	Not used	Not used	Not used	Not allotted	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
122.8833	122.885	Not used	Not used	Not used	Not allotted	Not used	Not used
122.8917	122.890	Not used	Not used	Not used	Not allotted	Not used	Not used
122.9000	122.900	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.9000	122.905	Not used	Not used	Not used	Not allotted	Not used	Not used
122.9083	122.910	Not used	Not used	Not used	Not allotted	Not used	Not used
122.9167	122.915	Not used	Not used	Not used	Not allotted	Not used	Not used
122.9250	122.925	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.9250	122.930	Not used	Not used	Not used	Not allotted	Not used	Not used
122.9333	122.935	Not used	Not used	Not used	Not allotted	Not used	Not used
122.9417	122.940	Not used	Not used	Not used	Not allotted	Not used	Not used
122.9500	122.950	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.9500	122.955	Not used	Not used	Not used	Not allotted	Not used	Not used
122.9583	122.960	Not used	Not used	Not used	Not allotted	Not used	Not used
122.9667	122.965	Not used	Not used	Not used	Not allotted	Not used	Not used
122.9750	122.975	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
122.9750	122.980	Not used	Not used	Not used	Not allotted	Not used	Not used
122.9833	122.985	Not used	Not used	Not used	Not allotted	Not used	Not used
122.9917	122.990	Not used	Not used	Not used	Not allotted	Not used	Not used
123.0000	123.000	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.0000	123.005	Not used	Not used	Not used	Not allotted	Not used	Not used
123.0083	123.010	Not used	Not used	Not used	Not allotted	Not used	Not used
123.0167	123.015	Not used	Not used	Not used	Not allotted	Not used	Not used
123.0250	123.025	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.0250	123.030	Not used	Not used	Not used	Not allotted	Not used	Not used
123.0333	123.035	Not used	Not used	Not used	Not allotted	Not used	Not used
123.0417	123.040	Not used	Not used	Not used	Not allotted	Not used	Not used
123.0500	123.050	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.0500	123.055	Not used	Not used	Not used	Not allotted	Not used	Not used
123.0583	123.060	Not used	Not used	Not used	Not allotted	Not used	Not used
123.0667	123.065	Not used	Not used	Not used	Not allotted	Not used	Not used
123.0750	123.075	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
123.0750	123.080	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
123.0833	123.085	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
123.0917	123.090	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
123.1000	123.100	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
123.1000	123.105	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
123.1083	123.110	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
123.1167	123.115	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
123.1250	123.125	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
123.1250	123.130	Not used	Not used	Not used	Not allotted	Not used	Not used
123.1333	123.135	Not used	Not used	Not used	Not allotted	Not used	Not used
123.1417	123.140	Not used	Not used	Not used	Not allotted	Not used	Not used
123.1500	123.150	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.1500	123.155	Not used	Not used	Not used	Not allotted	Not used	Not used
123.1583	123.160	Not used	Not used	Not used	Not allotted	Not used	Not used
123.1667	123.165	Not used	Not used	Not used	Not allotted	Not used	Not used
123.1750	123.175	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.1750	123.180	Not used	Not used	Not used	Not allotted	Not used	Not used
123.1833	123.185	Not used	Not used	Not used	Not allotted	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
123.1917	123.190	Not used	Not used	Not used	Not allotted	Not used	Not used
123.2000	123.200	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.2000	123.205	Not used	Not used	Not used	Not allotted	Not used	Not used
123.2083	123.210	Not used	Not used	Not used	Not allotted	Not used	Not used
123.2167	123.215	Not used	Not used	Not used	Not allotted	Not used	Not used
123.2250	123.225	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.2250	123.230	Not used	Not used	Not used	Not allotted	Not used	Not used
123.2333	123.235	Not used	Not used	Not used	Not allotted	Not used	Not used
123.2417	123.240	Not used	Not used	Not used	Not allotted	Not used	Not used
123.2500	123.255	Not used	Not used	Not used	Not allotted	Not used	Not used
123.2500	123.250	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.2583	123.260	Not used	Not used	Not used	Not allotted	Not used	Not used
123.2667	123.265	Not used	Not used	Not used	Not allotted	Not used	Not used
123.2750	123.275	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.2750	123.280	Not used	Not used	Not used	Not allotted	Not used	Not used
123.2833	123.285	Not used	Not used	Not used	Not allotted	Not used	Not used
123.2917	123.290	Not used	Not used	Not used	Not allotted	Not used	Not used
123.3000	123.300	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.3000	123.305	Not used	Not used	Not used	Not allotted	Not used	Not used
123.3083	123.310	Not used	Not used	Not used	Not allotted	Not used	Not used
123.3167	123.315	Not used	Not used	Not used	Not allotted	Not used	Not used
123.3250	123.325	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.3250	123.330	Not used	Not used	Not used	Not allotted	Not used	Not used
123.3333	123.335	Not used	Not used	Not used	Not allotted	Not used	Not used
123.3417	123.340	Not used	Not used	Not used	Not allotted	Not used	Not used
123.3500	123.350	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.3500	123.355	Not used	Not used	Not used	Not allotted	Not used	Not used
123.3583	123.360	Not used	Not used	Not used	Not allotted	Not used	Not used
123.3667	123.365	Not used	Not used	Not used	Not allotted	Not used	Not used
123.3750	123.375	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.3750	123.380	Not used	Not used	Not used	Not allotted	Not used	Not used
123.3833	123.385	Not used	Not used	Not used	Not allotted	Not used	Not used
123.3917	123.390	Not used	Not used	Not used	Not allotted	Not used	Not used
123.4000	123.400	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.4000	123.405	Not used	Not used	Not used	Not allotted	Not used	Not used
123.4083	123.410	Not used	Not used	Not used	Not allotted	Not used	Not used
123.4167	123.415	Not used	Not used	Not used	Not allotted	Not used	Not used
123.4250	123.425	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.4250	123.430	Not used	Not used	Not used	Not allotted	Not used	Not used
123.4333	123.435	Not used	Not used	Not used	Not allotted	Not used	Not used
123.4417	123.440	Not used	Not used	Not used	Not allotted	Not used	Not used
123.4500	123.450	Air-Air	Air-Air	Air-Air	Not allotted	Air-Air	Air-Air
123.4500	123.455	Not used	Not used	Not used	Not allotted	Not used	Not used
123.4583	123.460	Not used	Not used	Not used	Not allotted	Not used	Not used
123.4667	123.465	Not used	Not used	Not used	Not allotted	Not used	Not used
123.4750	123.475	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.4750	123.480	Not used	Not used	Not used	Not allotted	Not used	Not used
123.4833	123.485	Not used	Not used	Not used	Not allotted	Not used	Not used
123.4917	123.490	Not used	Not used	Not used	Not allotted	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
123.5000	123.500	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.5000	123.505	Not used	Not used	Not used	Not allotted	Not used	Not used
123.5083	123.510	Not used	Not used	Not used	Not allotted	Not used	Not used
123.5167	123.515	Not used	Not used	Not used	Not allotted	Not used	Not used
123.5250	123.525	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.5250	123.530	Not used	Not used	Not used	Not allotted	Not used	Not used
123.5333	123.535	Not used	Not used	Not used	Not allotted	Not used	Not used
123.5417	123.540	Not used	Not used	Not used	Not allotted	Not used	Not used
123.5500	123.550	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.5500	123.555	Not used	Not used	Not used	Not allotted	Not used	Not used
123.5583	123.560	Not used	Not used	Not used	Not allotted	Not used	Not used
123.5667	123.565	Not used	Not used	Not used	Not allotted	Not used	Not used
123.5750	123.575	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.5750	123.580	Not used	Not used	Not used	Not allotted	Not used	Not used
123.5833	123.585	Not used	Not used	Not used	Not allotted	Not used	Not used
123.5917	123.590	Not used	Not used	Not used	Not allotted	Not used	Not used
123.6000	123.600	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.6000	123.605	Not used	Not used	Not used	Not allotted	Not used	Not used
123.6083	123.610	Not used	Not used	Not used	Not allotted	Not used	Not used
123.6167	123.615	Not used	Not used	Not used	Not allotted	Not used	Not used
123.6250	123.625	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.6250	123.630	Not used	Not used	Not used	Not allotted	Not used	Not used
123.6333	123.635	Not used	Not used	Not used	Not allotted	Not used	Not used
123.6417	123.640	Not used	Not used	Not used	Not allotted	Not used	Not used
123.6500	123.650	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.6500	123.655	Not used	Not used	Not used	Not allotted	Not used	Not used
123.6583	123.660	Not used	Not used	Not used	Not allotted	Not used	Not used
123.6667	123.665	Not used	Not used	Not used	Not allotted	Not used	Not used
123.6750	123.675	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted	Not allotted
123.6750	123.680	Not used	Not used	Not used	Not allotted	Not used	Not used
123.6833	123.685	Not used	Not used	Not used	Not allotted	Not used	Not used
123.6917	123.690	Not used	Not used	Not used	Not allotted	Not used	Not used
123.7000	123.700	APP-I	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
123.7000	123.705	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.7083	123.710	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.7167	123.715	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.7250	123.725	APP-I	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
123.7250	123.730	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.7333	123.735	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.7417	123.740	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.7500	123.750	APP-I	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
123.7500	123.755	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.7583	123.760	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.7667	123.765	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.7750	123.775	APP-I	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
123.7750	123.780	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.7833	123.785	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.7917	123.790	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.8000	123.800	ACC-L	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
123.8000	123.805	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.8083	123.810	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.8167	123.815	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.8250	123.825	ACC-L	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
123.8250	123.830	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.8333	123.835	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.8417	123.840	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.8500	123.850	ACC-L	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
123.8500	123.855	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.8583	123.860	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.8667	123.865	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.8750	123.875	ACC-L	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
123.8750	123.880	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.8833	123.885	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.8917	123.890	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.9000	123.900	APP-U	FIS-L, FIS-U	ACC	APP, ACC-L	FIS-L, FIS-U	ACC
123.9000	123.905	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.9083	123.910	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.9167	123.915	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.9250	123.925	APP-U	FIS-L, FIS-U	ACC	APP, ACC-L	FIS-L, FIS-U	ACC
123.9250	123.930	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.9333	123.935	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.9417	123.940	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.9500	123.950	APP-U	FIS-L, FIS-U	ACC	APP, ACC-L	FIS-L, FIS-U	ACC
123.9500	123.955	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.9583	123.960	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.9667	123.965	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.9750	123.975	APP-U	FIS-L, FIS-U	ACC	APP, ACC-L	FIS-L, FIS-U	ACC
123.9750	123.980	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.9833	123.985	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
123.9917	123.990	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.0000	124.000	APP-I	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
124.0000	124.005	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.0083	124.010	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.0167	124.015	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.0250	124.025	APP-I	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
124.0250	124.030	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.0333	124.035	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.0417	124.040	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.0500	124.050	APP-I	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
124.0500	124.055	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.0583	124.060	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.0667	124.065	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.0750	124.075	APP-I	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
124.0750	124.080	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.0833	124.085	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.0917	124.090	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.1000	124.100	Not allotted	FIS-L, FIS-U	ACC	APP, ACC-L	FIS-L, FIS-U	ACC
124.1000	124.105	Not used	Not used	Not used	APP, ACC-L	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
124.1083	124.110	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.1167	124.115	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.1250	124.125	Not allotted	FIS-L, FIS-U	ACC	APP, ACC-L	FIS-L, FIS-U	ACC
124.1250	124.130	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.1333	124.135	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.1417	124.140	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.1500	124.150	Not allotted	FIS-L, FIS-U	ACC	APP, ACC-L	FIS-L, FIS-U	ACC
124.1500	124.155	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.1583	124.160	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.1667	124.165	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.1750	124.175	Not allotted	FIS-L, FIS-U	ACC	APP, ACC-L	FIS-L, FIS-U	ACC
124.1750	124.180	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.1833	124.185	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.1917	124.190	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.2000	124.200	FIS-L	APP-U	ACC	APP, ACC-L	Not allotted	ACC
124.2000	124.205	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.2083	124.210	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.2167	124.215	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.2250	124.225	FIS-L	APP-U	ACC	APP, ACC-L	Not allotted	ACC
124.2250	124.230	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.2333	124.235	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.2417	124.240	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.2500	124.250	FIS-L	APP-U	ACC	APP, ACC-L	Not allotted	ACC
124.2500	124.255	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.2583	124.260	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.2667	124.265	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.2750	124.275	FIS-L	APP-U	ACC	APP, ACC-L	Not allotted	ACC
124.2750	124.280	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.2833	124.285	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.2917	124.290	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.3000	124.300	APP-I	TWR	ACC	APP, ACC-L	TWR	ACC
124.3000	124.305	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.3083	124.310	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.3167	124.315	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.3250	124.325	APP-I	TWR	ACC	APP, ACC-L	TWR	ACC
124.3250	124.330	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.3333	124.335	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.3417	124.340	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.3500	124.350	APP-I	TWR	ACC	APP, ACC-L	TWR	ACC
124.3500	124.355	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.3583	124.360	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.3667	124.365	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.3750	124.375	APP-I	TWR	ACC	APP, ACC-L	TWR	ACC
124.3750	124.380	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.3833	124.385	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.3917	124.390	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.4000	124.400	APP-U	APP-U	ACC	APP, ACC-L	APP-U	ACC
124.4000	124.405	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.4083	124.410	Not used	Not used	Not used	APP, ACC-L	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
124.4167	124.415	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.4250	124.425	APP-U	APP-U	ACC	APP, ACC-L	APP-U	ACC
124.4250	124.430	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.4333	124.435	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.4417	124.440	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.4500	124.450	APP-U	APP-U	ACC	APP, ACC-L	APP-U	ACC
124.4500	124.455	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.4583	124.460	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.4667	124.465	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.4750	124.475	APP-U	APP-U	ACC	APP, ACC-L	APP-U	ACC
124.4750	124.480	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.4833	124.485	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.4917	124.490	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.5000	124.500	APP-U	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
124.5000	124.505	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.5083	124.510	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.5167	124.515	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.5250	124.525	APP-U	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
124.5250	124.530	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.5333	124.535	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.5417	124.540	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.5500	124.550	APP-U	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
124.5500	124.555	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.5583	124.560	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.5667	124.565	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.5750	124.575	APP-U	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
124.5750	124.580	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.5833	124.585	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.5917	124.590	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.6000	124.600	ACC-U	APP-U	ACC	APP, ACC-L	APP-U	ACC
124.6000	124.605	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.6083	124.610	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.6167	124.615	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.6250	124.625	ACC-U	APP-U	ACC	APP, ACC-L	APP-U	ACC
124.6250	124.630	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.6333	124.635	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.6417	124.640	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.6500	124.650	ACC-U	APP-U	ACC	APP, ACC-L	APP-U	ACC
124.6500	124.655	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.6583	124.660	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.6667	124.665	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.6750	124.675	ACC-U	APP-U	ACC	APP, ACC-L	APP-U	ACC
124.6750	124.680	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.6833	124.685	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.6917	124.690	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.7000	124.700	ACC-U	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
124.7000	124.705	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.7083	124.710	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.7167	124.715	Not used	Not used	Not used	APP, ACC-L	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
124.7250	124.725	ACC-U	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
124.7250	124.730	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.7333	124.735	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.7417	124.740	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.7500	124.750	ACC-U	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
124.7500	124.755	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.7583	124.760	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.7667	124.765	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.7750	124.775	ACC-U	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
124.7750	124.780	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.7833	124.785	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.7917	124.790	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.8000	124.800	FIS-U (GPS)	APP-U	ACC	APP, ACC-L	APP-U	ACC
124.8000	124.805	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.8083	124.810	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.8167	124.815	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.8250	124.825	FIS-U (GPS)	APP-U	ACC	APP, ACC-L	APP-U	ACC
124.8250	124.830	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.8333	124.835	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.8417	124.840	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.8500	124.850	FIS-U (GPS)	APP-U	ACC	APP, ACC-L	APP-U	ACC
124.8500	124.855	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.8583	124.860	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.8667	124.865	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.8750	124.875	FIS-U (GPS)	APP-U	ACC	APP, ACC-L	APP-U	ACC
124.8750	124.880	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.8833	124.885	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.8917	124.890	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.9000	124.900	APP-U	FIS-L, FIS-U	ACC	APP, ACC-L	FIS-L, FIS-U	ACC
124.9000	124.905	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.9083	124.910	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.9167	124.915	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.9250	124.925	APP-U	FIS-L, FIS-U	ACC	APP, ACC-L	FIS-L, FIS-U	ACC
124.9250	124.930	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.9333	124.935	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.9417	124.940	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.9500	124.950	APP-U	FIS-L, FIS-U	ACC	APP, ACC-L	FIS-L, FIS-U	ACC
124.9500	124.955	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.9583	124.960	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.9667	124.965	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.9750	124.975	APP-U	FIS-L, FIS-U	ACC	APP, ACC-L	FIS-L, FIS-U	ACC
124.9750	124.980	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.9833	124.985	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
124.9917	124.990	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.0000	125.000	Not allotted	APP-U	ACC	APP, ACC-L	APP-U	ACC
125.0000	125.005	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.0083	125.010	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.0167	125.015	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.0250	125.025	Not allotted	APP-U	ACC	APP, ACC-L	APP-U	ACC

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
125.0250	125.030	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.0333	125.035	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.0417	125.040	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.0500	125.050	Not allotted	APP-U	ACC	APP, ACC-L	APP-U	ACC
125.0500	125.055	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.0583	125.060	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.0667	125.065	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.0750	125.075	Not allotted	APP-U	ACC	APP, ACC-L	APP-U	ACC
125.0750	125.080	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.0833	125.085	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.0917	125.090	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.1000	125.100	ACC-U	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
125.1000	125.105	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.1083	125.110	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.1167	125.115	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.1250	125.125	ACC-U	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
125.1250	125.130	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.1333	125.135	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.1417	125.140	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.1500	125.150	ACC-U	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
125.1500	125.155	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.1583	125.160	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.1667	125.165	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.1750	125.175	ACC-U	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
125.1750	125.180	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.1833	125.185	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.1917	125.190	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.2000	125.200	FIS-L	APP-U	ACC	APP, ACC-L	APP-U	ACC
125.2000	125.205	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.2083	125.210	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.2167	125.215	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.2250	125.225	FIS-L	APP-U	ACC	APP, ACC-L	APP-U	ACC
125.2250	125.230	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.2333	125.235	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.2417	125.240	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.2500	125.250	FIS-L	APP-U	ACC	APP, ACC-L	APP-U	ACC
125.2500	125.255	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.2583	125.260	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.2667	125.265	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.2750	125.275	FIS-L	APP-U	ACC	APP, ACC-L	APP-U	ACC
125.2750	125.280	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.2833	125.285	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.2917	125.290	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.3000	125.300	APP-I	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
125.3000	125.305	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.3083	125.310	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.3167	125.315	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.3250	125.325	APP-I	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
125.3250	125.330	Not used	Not used	Not used	APP, ACC-L	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
125.3333	125.335	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.3417	125.340	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.3500	125.350	APP-I	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
125.3500	125.355	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.3583	125.360	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.3667	125.365	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.3750	125.375	APP-I	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
125.3750	125.380	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.3833	125.385	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.3917	125.390	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.4000	125.400	ACC-L	APP-U	ACC	APP, ACC-L	APP-U	ACC
125.4000	125.405	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.4083	125.410	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.4167	125.415	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.4250	125.425	ACC-L	APP-U	ACC	APP, ACC-L	APP-U	ACC
125.4250	125.430	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.4333	125.435	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.4417	125.440	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.4500	125.450	ACC-L	APP-U	ACC	APP, ACC-L	APP-U	ACC
125.4500	125.455	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.4583	125.460	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.4667	125.465	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.4750	125.475	ACC-L	APP-U	ACC	APP, ACC-L	APP-U	ACC
125.4750	125.480	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.4833	125.485	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.4917	125.490	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.5000	125.500	ACC-U	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
125.5000	125.505	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.5083	125.510	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.5167	125.515	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.5250	125.525	ACC-U	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
125.5250	125.530	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.5333	125.535	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.5417	125.540	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.5500	125.550	ACC-U	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
125.5500	125.555	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.5583	125.560	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.5667	125.565	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.5750	125.575	ACC-U	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
125.5750	125.580	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.5833	125.585	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.5917	125.590	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.6000	125.600	ACC-U	APP-U	ACC	APP, ACC-L	APP-U	ACC
125.6000	125.605	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.6083	125.610	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.6167	125.615	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.6250	125.625	ACC-U	APP-U	ACC	APP, ACC-L	APP-U	ACC
125.6250	125.630	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.6333	125.635	Not used	Not used	Not used	APP, ACC-L	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
125.6417	125.640	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.6500	125.650	ACC-U	APP-U	ACC	APP, ACC-L	APP-U	ACC
125.6500	125.655	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.6583	125.660	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.6667	125.665	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.6750	125.675	ACC-U	APP-U	ACC	APP, ACC-L	APP-U	ACC
125.6750	125.680	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.6833	125.685	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.6917	125.690	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.7000	125.700	APP-U	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
125.7000	125.705	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.7083	125.710	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.7167	125.715	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.7250	125.725	APP-U	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
125.7250	125.730	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.7333	125.735	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.7417	125.740	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.7500	125.750	APP-U	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
125.7500	125.755	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.7583	125.760	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.7667	125.765	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.7750	125.775	APP-U	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
125.7750	125.780	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.7833	125.785	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.7917	125.790	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.8000	125.800	FIS-U (GPS)	APP-U	ACC	APP, ACC-L	APP-U	ACC
125.8000	125.805	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.8083	125.810	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.8167	125.815	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.8250	125.825	FIS-U (GPS)	APP-U	ACC	APP, ACC-L	APP-U	ACC
125.8250	125.830	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.8333	125.835	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.8417	125.840	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.8500	125.850	FIS-U (GPS)	APP-U	ACC	APP, ACC-L	APP-U	ACC
125.8500	125.855	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.8583	125.860	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.8667	125.865	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.8750	125.875	FIS-U (GPS)	APP-U	ACC	APP, ACC-L	APP-U	ACC
125.8750	125.880	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.8833	125.885	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.8917	125.890	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.9000	125.900	ACC-U	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
125.9000	125.905	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.9083	125.910	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.9167	125.915	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.9250	125.925	ACC-U	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
125.9250	125.930	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.9333	125.935	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.9417	125.940	Not used	Not used	Not used	APP, ACC-L	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
125.9500	125.950	ACC-U	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
125.9500	125.955	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.9583	125.960	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.9667	125.965	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.9750	125.975	ACC-U	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
125.9750	125.980	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.9833	125.985	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
125.9917	125.990	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.0000	126.000	APP-L	APP-U	ACC	APP, ACC-L	APP-U	ACC
126.0000	126.005	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.0083	126.010	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.0167	126.015	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.0250	126.025	APP-L	APP-U	ACC	APP, ACC-L	APP-U	ACC
126.0250	126.030	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.0333	126.035	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.0417	126.040	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.0500	126.050	APP-L	APP-U	ACC	APP, ACC-L	APP-U	ACC
126.0500	126.055	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.0583	126.060	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.0667	126.065	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.0750	126.075	APP-L	APP-U	ACC	APP, ACC-L	APP-U	ACC
126.0750	126.080	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.0833	126.085	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.0917	126.090	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.1000	126.100	ACC-U	ACC-L	ACC	APP, ACC-L	ACC-L	ACC
126.1000	126.105	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.1083	126.110	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.1167	126.115	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.1250	126.125	ACC-U	ACC-L	ACC	APP, ACC-L	ACC-L	ACC
126.1250	126.130	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.1333	126.135	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.1417	126.140	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.1500	126.150	ACC-U	ACC-L	ACC	APP, ACC-L	ACC-L	ACC
126.1500	126.155	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.1583	126.160	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.1667	126.165	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.1750	126.175	ACC-U	ACC-L	ACC	APP, ACC-L	ACC-L	ACC
126.1750	126.180	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.1833	126.185	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.1917	126.190	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.2000	126.200	VOLMET, ATIS	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
126.2000	126.205	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.2083	126.210	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.2167	126.215	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.2250	126.225	VOLMET, ATIS	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
126.2250	126.230	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.2333	126.235	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.2417	126.240	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.2500	126.250	VOLMET, ATIS	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
126.2500	126.255	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.2583	126.260	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.2667	126.265	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.2750	126.275	VOLMET, ATIS	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
126.2750	126.280	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.2833	126.285	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.2917	126.290	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.3000	126.300	FIS-U (GPS)	APP-U	ACC	APP, ACC-L	APP-U	ACC
126.3000	126.305	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.3083	126.310	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.3167	126.315	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.3250	126.325	FIS-U (GPS)	APP-U	ACC	APP, ACC-L	APP-U	ACC
126.3250	126.330	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.3333	126.335	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.3417	126.340	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.3500	126.350	FIS-U (GPS)	APP-U	ACC	APP, ACC-L	APP-U	ACC
126.3500	126.355	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.3583	126.360	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.3667	126.365	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.3750	126.375	FIS-U (GPS)	APP-U	ACC	APP, ACC-L	APP-U	ACC
126.3750	126.380	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.3833	126.385	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.3917	126.390	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.4000	126.400	VOLMET, ATIS	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
126.4000	126.405	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.4083	126.410	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.4167	126.415	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.4250	126.425	VOLMET, ATIS	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
126.4250	126.430	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.4333	126.435	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.4417	126.440	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.4500	126.450	VOLMET, ATIS	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
126.4500	126.455	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.4583	126.460	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.4667	126.465	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.4750	126.475	VOLMET, ATIS	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
126.4750	126.480	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.4833	126.485	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.4917	126.490	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.5000	126.500	ACC-U	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
126.5000	126.505	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.5083	126.510	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.5167	126.515	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.5250	126.525	ACC-U	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
126.5250	126.530	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.5333	126.535	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.5417	126.540	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.5500	126.550	ACC-U	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
126.5500	126.555	Not used	Not used	Not used	APP, ACC-L	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
126.5583	126.560	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.5667	126.565	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.5750	126.575	ACC-U	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
126.5750	126.580	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.5833	126.585	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.5917	126.590	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.6000	126.600	VOLMET, ATIS	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
126.6000	126.605	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.6083	126.610	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.6167	126.615	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.6250	126.625	VOLMET, ATIS	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
126.6250	126.630	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.6333	126.635	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.6417	126.640	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.6500	126.650	VOLMET, ATIS	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
126.6500	126.655	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.6583	126.660	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.6667	126.665	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.6750	126.675	VOLMET, ATIS	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
126.6750	126.680	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.6833	126.685	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.6917	126.690	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.7000	126.700	ACC-U	FIS-L, FIS-U	GPS	APP, ACC-L	FIS-L, FIS-U	GPS
126.7000	126.705	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.7083	126.710	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.7167	126.715	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.7250	126.725	ACC-U	FIS-L, FIS-U	GPS	APP, ACC-L	FIS-L, FIS-U	GPS
126.7250	126.730	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.7333	126.735	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.7417	126.740	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.7500	126.750	ACC-U	FIS-L, FIS-U	GPS	APP, ACC-L	FIS-L, FIS-U	GPS
126.7500	126.755	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.7583	126.760	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.7667	126.765	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.7750	126.775	ACC-U	FIS-L, FIS-U	GPS	APP, ACC-L	FIS-L, FIS-U	GPS
126.7750	126.780	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.7833	126.785	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.7917	126.790	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.8000	126.800	VOLMET, ATIS	VOLMET, ATIS	GPS	APP, ACC-L	VOLMET, ATIS	GPS
126.8000	126.805	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.8083	126.810	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.8167	126.815	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.8250	126.825	VOLMET, ATIS	VOLMET, ATIS	GPS	APP, ACC-L	VOLMET, ATIS	GPS
126.8250	126.830	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.8333	126.835	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.8417	126.840	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.8500	126.850	VOLMET, ATIS	VOLMET, ATIS	GPS	APP, ACC-L	VOLMET, ATIS	GPS
126.8500	126.855	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.8583	126.860	Not used	Not used	Not used	APP, ACC-L	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
126.8667	126.865	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.8750	126.875	VOLMET, ATIS	VOLMET, ATIS	GPS	APP, ACC-L	VOLMET, ATIS	GPS
126.8750	126.880	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.8833	126.885	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.8917	126.890	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.9000	126.900	FIS-U (GPS)	FIS-L, FIS-U	GPS	APP, ACC-L	FIS-L, FIS-U	GPS
126.9000	126.905	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.9083	126.910	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.9167	126.915	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.9250	126.925	FIS-U (GPS)	FIS-L, FIS-U	GPS	APP, ACC-L	FIS-L, FIS-U	GPS
126.9250	126.930	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.9333	126.935	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.9417	126.940	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.9500	126.950	FIS-U (GPS)	FIS-L, FIS-U	GPS	APP, ACC-L	FIS-L, FIS-U	GPS
126.9500	126.955	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.9583	126.960	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.9667	126.965	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.9750	126.975	FIS-U (GPS)	FIS-L, FIS-U	GPS	APP, ACC-L	FIS-L, FIS-U	GPS
126.9750	126.980	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.9833	126.985	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
126.9917	126.990	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.0000	127.000	VOLMET, ATIS	VOLMET, ATIS	GPS	APP, ACC-L	VOLMET, ATIS	GPS
127.0000	127.005	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.0083	127.010	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.0167	127.015	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.0250	127.025	VOLMET, ATIS	VOLMET, ATIS	GPS	APP, ACC-L	VOLMET, ATIS	GPS
127.0250	127.030	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.0333	127.035	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.0417	127.040	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.0500	127.050	VOLMET, ATIS	VOLMET, ATIS	GPS	APP, ACC-L	VOLMET, ATIS	GPS
127.0500	127.055	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.0583	127.060	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.0667	127.065	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.0750	127.075	VOLMET, ATIS	VOLMET, ATIS	GPS	APP, ACC-L	VOLMET, ATIS	GPS
127.0750	127.080	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.0833	127.085	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.0917	127.090	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.1000	127.100	ACC-U	FIS-L, FIS-U	GPS	APP, ACC-L	FIS-L, FIS-U	GPS
127.1000	127.105	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.1083	127.110	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.1167	127.115	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.1250	127.125	ACC-U	FIS-L, FIS-U	GPS	APP, ACC-L	FIS-L, FIS-U	GPS
127.1250	127.130	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.1333	127.135	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.1417	127.140	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.1500	127.150	ACC-U	FIS-L, FIS-U	GPS	APP, ACC-L	FIS-L, FIS-U	GPS
127.1500	127.155	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.1583	127.160	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.1667	127.165	Not used	Not used	Not used	APP, ACC-L	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
127.1750	127.175	ACC-U	FIS-L, FIS-U	GPS	APP, ACC-L	FIS-L, FIS-U	GPS
127.1750	127.180	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.1833	127.185	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.1917	127.190	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.2000	127.200	APP-U	VOLMET, ATIS	GPS	APP, ACC-L	VOLMET, ATIS	GPS
127.2000	127.205	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.2083	127.210	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.2167	127.215	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.2250	127.225	APP-U	VOLMET, ATIS	GPS	APP, ACC-L	VOLMET, ATIS	GPS
127.2250	127.230	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.2333	127.235	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.2417	127.240	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.2500	127.250	APP-U	VOLMET, ATIS	GPS	APP, ACC-L	VOLMET, ATIS	GPS
127.2500	127.255	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.2583	127.260	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.2667	127.265	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.2750	127.275	APP-U	VOLMET, ATIS	GPS	APP, ACC-L	VOLMET, ATIS	GPS
127.2750	127.280	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.2833	127.285	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.2917	127.290	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.3000	127.300	ACC-U	FIS-L, FIS-U	GPS	APP, ACC-L	FIS-L, FIS-U	GPS
127.3000	127.305	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.3083	127.310	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.3167	127.315	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.3250	127.325	ACC-U	FIS-L, FIS-U	GPS	APP, ACC-L	FIS-L, FIS-U	GPS
127.3250	127.330	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.3333	127.335	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.3417	127.340	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.3500	127.350	ACC-U	FIS-L, FIS-U	GPS	APP, ACC-L	FIS-L, FIS-U	GPS
127.3500	127.355	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.3583	127.360	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.3667	127.365	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.3750	127.375	ACC-U	FIS-L, FIS-U	GPS	APP, ACC-L	FIS-L, FIS-U	GPS
127.3750	127.380	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.3833	127.385	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.3917	127.390	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.4000	127.400	FIS-U (GPS)	VOLMET, ATIS	GPS	APP, ACC-L	VOLMET, ATIS	GPS
127.4000	127.405	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.4083	127.410	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.4167	127.415	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.4250	127.425	FIS-U (GPS)	VOLMET, ATIS	GPS	APP, ACC-L	VOLMET, ATIS	GPS
127.4250	127.430	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.4333	127.435	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.4417	127.440	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.4500	127.450	FIS-U (GPS)	VOLMET, ATIS	GPS	APP, ACC-L	VOLMET, ATIS	GPS
127.4500	127.455	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.4583	127.460	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.4667	127.465	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.4750	127.475	FIS-U (GPS)	VOLMET, ATIS	GPS	APP, ACC-L	VOLMET, ATIS	GPS

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
127.4750	127.480	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.4833	127.485	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.4917	127.490	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.5000	127.500	FIS-L	ACC-L	GPS	APP, ACC-L	ACC-L	GPS
127.5000	127.505	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.5083	127.510	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.5167	127.515	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.5250	127.525	FIS-L	ACC-L	GPS	APP, ACC-L	ACC-L	GPS
127.5250	127.530	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.5333	127.535	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.5417	127.540	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.5500	127.550	FIS-L	ACC-L	GPS	APP, ACC-L	ACC-L	GPS
127.5500	127.555	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.5583	127.560	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.5667	127.565	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.5750	127.575	FIS-L	ACC-L	GPS	APP, ACC-L	ACC-L	GPS
127.5750	127.580	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.5833	127.585	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.5917	127.590	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.6000	127.600	VOLMET, ATIS	VOLMET, ATIS	VOLMET, ATIS	APP, ACC-L	VOLMET, ATIS	VOLMET, ATIS
127.6000	127.605	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.6083	127.610	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.6167	127.615	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.6250	127.625	VOLMET, ATIS	VOLMET, ATIS	VOLMET, ATIS	APP, ACC-L	VOLMET, ATIS	VOLMET, ATIS
127.6250	127.630	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.6333	127.635	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.6417	127.640	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.6500	127.650	VOLMET, ATIS	VOLMET, ATIS	VOLMET, ATIS	APP, ACC-L	VOLMET, ATIS	VOLMET, ATIS
127.6500	127.655	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.6583	127.660	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.6667	127.665	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.6750	127.675	VOLMET, ATIS	VOLMET, ATIS	VOLMET, ATIS	APP, ACC-L	VOLMET, ATIS	VOLMET, ATIS
127.6750	127.680	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.6833	127.685	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.6917	127.690	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.7000	127.700	ACC-U	APP-L, APP-I	VOLMET, ATIS	APP, ACC-L	APP-L, APP-I	VOLMET, ATIS
127.7000	127.705	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.7083	127.710	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.7167	127.715	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.7250	127.725	ACC-U	APP-L, APP-I	VOLMET, ATIS	APP, ACC-L	APP-L, APP-I	VOLMET, ATIS
127.7250	127.730	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.7333	127.735	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.7417	127.740	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.7500	127.750	ACC-U	APP-L, APP-I	VOLMET, ATIS	APP, ACC-L	APP-L, APP-I	VOLMET, ATIS
127.7500	127.755	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.7583	127.760	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.7667	127.765	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.7750	127.775	ACC-U	APP-L, APP-I	VOLMET, ATIS	APP, ACC-L	APP-L, APP-I	VOLMET, ATIS
127.7750	127.780	Not used	Not used	Not used	APP, ACC-L	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
127.7833	127.785	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.7917	127.790	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.8000	127.800	APP-U	VOLMET, ATIS	VOLMET, ATIS	APP, ACC-L	VOLMET, ATIS	VOLMET, ATIS
127.8000	127.805	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.8083	127.810	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.8167	127.815	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.8250	127.825	APP-U	VOLMET, ATIS	VOLMET, ATIS	APP, ACC-L	VOLMET, ATIS	VOLMET, ATIS
127.8250	127.830	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.8333	127.835	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.8417	127.840	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.8500	127.850	APP-U	VOLMET, ATIS	VOLMET, ATIS	APP, ACC-L	VOLMET, ATIS	VOLMET, ATIS
127.8500	127.855	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.8583	127.860	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.8667	127.865	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.8750	127.875	APP-U	VOLMET, ATIS	VOLMET, ATIS	APP, ACC-L	VOLMET, ATIS	VOLMET, ATIS
127.8750	127.880	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.8833	127.885	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.8917	127.890	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.9000	127.900	Not allotted	APP-L, APP-I	VOLMET, ATIS	APP, ACC-L	APP-L, APP-I	VOLMET, ATIS
127.9000	127.905	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.9083	127.910	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.9167	127.915	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.9250	127.925	Not allotted	APP-L, APP-I	Not allotted	APP, ACC-L	APP-L, APP-I	Not allotted
127.9250	127.930	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.9333	127.935	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.9417	127.940	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.9500	127.950	Not allotted	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
127.9500	127.955	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.9583	127.960	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.9667	127.965	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.9750	127.975	Not allotted	APP-L, APP-I	ACC	APP, ACC-L	APP-L, APP-I	ACC
127.9750	127.980	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.9833	127.985	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
127.9917	127.990	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.0000	128.000	APP-U	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
128.0000	128.005	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.0083	128.010	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.0167	128.015	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.0250	128.025	APP-U	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
128.0250	128.030	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.0333	128.035	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.0417	128.040	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.0500	128.050	APP-U	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
128.0500	128.055	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.0583	128.060	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.0667	128.065	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.0750	128.075	APP-U	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
128.0750	128.080	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.0833	128.085	Not used	Not used	Not used	APP, ACC-L	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
128.0917	128.090	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.1000	128.100	ACC-U	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
128.1000	128.105	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.1083	128.110	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.1167	128.115	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.1250	128.125	ACC-U	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
128.1250	128.130	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.1333	128.135	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.1417	128.140	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.1500	128.150	ACC-U	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
128.1500	128.155	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.1583	128.160	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.1667	128.165	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.1750	128.175	ACC-U	ACC-L, ACC-U	ACC	APP, ACC-L	ACC-L, ACC-U	ACC
128.1750	128.180	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.1833	128.185	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.1917	128.190	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.2000	128.200	APP-U	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
128.2000	128.205	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.2083	128.210	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.2167	128.215	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.2250	128.225	APP-U	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
128.2250	128.230	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.2333	128.235	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.2417	128.240	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.2500	128.250	APP-U	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
128.2500	128.255	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.2583	128.260	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.2667	128.265	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.2750	128.275	APP-U	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
128.2750	128.280	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.2833	128.285	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.2917	128.290	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.3000	128.300	ACC-U	ACC-L	ACC	APP, ACC-L	ACC-L	ACC
128.3000	128.305	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.3083	128.310	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.3167	128.315	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.3250	128.325	ACC-U	ACC-L	ACC	APP, ACC-L	ACC-L	ACC
128.3250	128.330	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.3333	128.335	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.3417	128.340	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.3500	128.350	ACC-U	ACC-L	ACC	APP, ACC-L	ACC-L	ACC
128.3500	128.355	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.3583	128.360	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.3667	128.365	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.3750	128.375	ACC-U	ACC-L	ACC	APP, ACC-L	ACC-L	ACC
128.3750	128.380	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.3833	128.385	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.3917	128.390	Not used	Not used	Not used	APP, ACC-L	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
128.4000	128.400	ACC-L	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
128.4000	128.405	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.4083	128.410	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.4167	128.415	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.4250	128.425	ACC-L	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
128.4250	128.430	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.4333	128.435	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.4417	128.440	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.4500	128.450	ACC-L	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
128.4500	128.455	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.4583	128.460	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.4667	128.465	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.4750	128.475	ACC-L	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
128.4750	128.480	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.4833	128.485	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.4917	128.490	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.5000	128.500	ACC-U	FIS-L, FIS-U	ACC	APP, ACC-L	FIS-L, FIS-U	ACC
128.5000	128.505	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.5083	128.510	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.5167	128.515	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.5250	128.525	ACC-U	FIS-L, FIS-U	ACC	APP, ACC-L	FIS-L, FIS-U	ACC
128.5250	128.530	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.5333	128.535	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.5417	128.540	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.5500	128.550	ACC-U	FIS-L, FIS-U	ACC	APP, ACC-L	FIS-L, FIS-U	ACC
128.5500	128.555	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.5583	128.560	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.5667	128.565	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.5750	128.575	ACC-U	FIS-L, FIS-U	ACC	APP, ACC-L	FIS-L, FIS-U	ACC
128.5750	128.580	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.5833	128.585	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.5917	128.590	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.6000	128.600	APP-U	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
128.6000	128.605	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.6083	128.610	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.6167	128.615	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.6250	128.625	APP-U	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
128.6250	128.630	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.6333	128.635	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.6417	128.640	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.6500	128.650	APP-U	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
128.6500	128.655	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.6583	128.660	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.6667	128.665	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.6750	128.675	APP-U	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
128.6750	128.680	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.6833	128.685	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.6917	128.690	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.7000	128.700	ACC-U	ACC-L	ACC	APP, ACC-L	ACC-L	ACC

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
128.7000	128.705	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.7083	128.710	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.7167	128.715	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.7250	128.725	ACC-U	ACC-L	ACC	APP, ACC-L	ACC-L	ACC
128.7250	128.730	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.7333	128.735	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.7417	128.740	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.7500	128.750	ACC-U	ACC-L	ACC	APP, ACC-L	ACC-L	ACC
128.7500	128.755	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.7583	128.760	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.7667	128.765	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.7750	128.775	ACC-U	ACC-L	ACC	APP, ACC-L	ACC-L	ACC
128.7750	128.780	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.7833	128.785	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.7917	128.790	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.8000	128.800	ACC-U	VOLMET, ATIS	ACC	APP, ACC-L	VOLMET, ATIS	ACC
128.8000	128.805	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.8083	128.810	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.8167	128.815	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.8250	128.825	ACC-U	VOLMET, ATIS	Not allotted	APP, ACC-L	VOLMET, ATIS	Not allotted
128.8250	128.830	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.8333	128.835	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.8417	128.840	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.8500	128.850	ACC-U	VOLMET, ATIS	APP	APP, ACC-L	VOLMET, ATIS	APP
128.8500	128.855	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.8583	128.860	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.8667	128.865	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.8750	128.875	ACC-U	VOLMET, ATIS	APP	APP, ACC-L	VOLMET, ATIS	APP
128.8750	128.880	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.8833	128.885	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.8917	128.890	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.9000	128.900	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
128.9000	128.905	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.9083	128.910	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.9167	128.915	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.9250	128.925	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
128.9250	128.930	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.9333	128.935	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.9417	128.940	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.9500	128.950	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
128.9500	128.955	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.9583	128.960	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.9667	128.965	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.9750	128.975	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
128.9750	128.980	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.9833	128.985	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
128.9917	128.990	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.0000	129.000	ACC-L	AOC	APP	APP, ACC-L	AOC	APP
129.0000	129.005	Not used	Not used	Not used	APP, ACC-L	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
129.0083	129.010	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.0167	129.015	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.0250	129.025	ACC-L	AOC	APP	APP, ACC-L	AOC	APP
129.0250	129.030	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.0333	129.035	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.0417	129.040	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.0500	129.050	ACC-L	AOC	APP	APP, ACC-L	AOC	APP
129.0500	129.055	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.0583	129.060	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.0667	129.065	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.0750	129.075	ACC-L	AOC	APP	APP, ACC-L	AOC	APP
129.0750	129.080	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.0833	129.085	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.0917	129.090	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.1000	129.100	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
129.1000	129.105	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.1083	129.110	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.1167	129.115	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.1250	129.125	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
129.1250	129.130	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.1333	129.135	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.1417	129.140	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.1500	129.150	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
129.1500	129.155	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.1583	129.160	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.1667	129.165	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.1750	129.175	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
129.1750	129.180	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.1833	129.185	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.1917	129.190	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.2000	129.200	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
129.2000	129.205	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.2083	129.210	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.2167	129.215	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.2250	129.225	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
129.2250	129.230	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.2333	129.235	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.2417	129.240	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.2500	129.250	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
129.2500	129.255	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.2583	129.260	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.2667	129.265	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.2750	129.275	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
129.2750	129.280	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.2833	129.285	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.2917	129.290	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.3000	129.300	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
129.3000	129.305	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.3083	129.310	Not used	Not used	Not used	APP, ACC-L	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
129.3167	129.315	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.3250	129.325	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
129.3250	129.330	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.3333	129.335	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.3417	129.340	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.3500	129.350	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
129.3500	129.355	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.3583	129.360	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.3667	129.365	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.3750	129.375	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
129.3750	129.380	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.3833	129.385	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.3917	129.390	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.4000	129.400	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
129.4000	129.405	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.4083	129.410	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.4167	129.415	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.4250	129.425	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
129.4250	129.430	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.4333	129.435	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.4417	129.440	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.4500	129.450	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
129.4500	129.455	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.4583	129.460	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.4667	129.465	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.4750	129.475	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
129.4750	129.480	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.4833	129.485	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.4917	129.490	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.5000	129.500	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
129.5000	129.505	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.5083	129.510	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.5167	129.515	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.5250	129.525	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
129.5250	129.530	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.5333	129.535	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.5417	129.540	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.5500	129.550	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
129.5500	129.555	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.5583	129.560	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.5667	129.565	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.5750	129.575	ACC-U	AOC	APP	APP, ACC-L	AOC	APP
129.5750	129.580	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.5833	129.585	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.5917	129.590	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.6000	129.600	ACC-L	AOC	APP	APP, ACC-L	AOC	APP
129.6000	129.605	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.6083	129.610	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.6167	129.615	Not used	Not used	Not used	APP, ACC-L	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
129.6250	129.625	ACC-L	AOC	APP	APP, ACC-L	AOC	APP
129.6250	129.630	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.6333	129.635	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.6417	129.640	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.6500	129.650	ACC-L	AOC	APP	APP, ACC-L	AOC	APP
129.6500	129.655	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.6583	129.660	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.6667	129.665	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.6750	129.675	ACC-L	AOC	APP	APP, ACC-L	AOC	APP
129.6750	129.680	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.6833	129.685	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.6917	129.690	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
129.7000	129.700	Not allotted	AOC	APP	Not allotted	AOC	APP
129.7000	129.705	Not used	Not used	Not used	Not allotted	Not used	Not used
129.7083	129.710	Not used	Not used	Not used	Not allotted	Not used	Not used
129.7167	129.715	Not used	Not used	Not used	Not allotted	Not used	Not used
129.7250	129.725	Not allotted	AOC	APP	Not allotted	AOC	APP
129.7250	129.730	Not used	Not used	Not used	Not allotted	Not used	Not used
129.7333	129.735	Not used	Not used	Not used	Not allotted	Not used	Not used
129.7417	129.740	Not used	Not used	Not used	Not allotted	Not used	Not used
129.7500	129.750	Not allotted	AOC	APP	Not allotted	AOC	APP
129.7500	129.755	Not used	Not used	Not used	Not allotted	Not used	Not used
129.7583	129.760	Not used	Not used	Not used	Not allotted	Not used	Not used
129.7667	129.765	Not used	Not used	Not used	Not allotted	Not used	Not used
129.7750	129.775	Not allotted	AOC	APP	Not allotted	AOC	APP
129.7750	129.780	Not used	Not used	Not used	Not allotted	Not used	Not used
129.7833	129.785	Not used	Not used	Not used	Not allotted	Not used	Not used
129.7917	129.790	Not used	Not used	Not used	Not allotted	Not used	Not used
129.8000	129.800	Not allotted	AOC	APP	Not allotted	AOC	APP
129.8000	129.805	Not used	Not used	Not used	Not allotted	Not used	Not used
129.8083	129.810	Not used	Not used	Not used	Not allotted	Not used	Not used
129.8167	129.815	Not used	Not used	Not used	Not allotted	Not used	Not used
129.8250	129.825	Not allotted	AOC	APP	Not allotted	AOC	APP
129.8250	129.830	Not used	Not used	Not used	Not allotted	Not used	Not used
129.8333	129.835	Not used	Not used	Not used	Not allotted	Not used	Not used
129.8417	129.840	Not used	Not used	Not used	Not allotted	Not used	Not used
129.8500	129.850	Not allotted	AOC	APP	Not allotted	AOC	APP
129.8500	129.855	Not used	Not used	Not used	Not allotted	Not used	Not used
129.8583	129.860	Not used	Not used	Not used	Not allotted	Not used	Not used
129.8667	129.865	Not used	Not used	Not used	Not allotted	Not used	Not used
129.8750	129.875	Not allotted	AOC	Not allotted	Not allotted	AOC	Not allotted
129.8750	129.880	Not used	Not used	Not used	Not allotted	Not used	Not used
129.8833	129.885	Not used	Not used	Not used	Not allotted	Not used	Not used
129.8917	129.890	Not used	Not used	Not used	Not allotted	Not used	Not used
129.9000	129.900	Not allotted	AOC	AOC	Not allotted	AOC	AOC
129.9000	129.905	Not used	Not used	Not used	Not allotted	Not used	Not used
129.9083	129.910	Not used	Not used	Not used	Not allotted	Not used	Not used
129.9167	129.915	Not used	Not used	Not used	Not allotted	Not used	Not used
129.9250	129.925	Not allotted	AOC	AOC	Not allotted	AOC	AOC

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
129.9250	129.930	Not used	Not used	Not used	Not allotted	Not used	Not used
129.9333	129.935	Not used	Not used	Not used	Not allotted	Not used	Not used
129.9417	129.940	Not used	Not used	Not used	Not allotted	Not used	Not used
129.9500	129.950	Not allotted	AOC	AOC	Not allotted	AOC	AOC
129.9500	129.955	Not used	Not used	Not used	Not allotted	Not used	Not used
129.9583	129.960	Not used	Not used	Not used	Not allotted	Not used	Not used
129.9667	129.965	Not used	Not used	Not used	Not allotted	Not used	Not used
129.9750	129.975	Not allotted	AOC	AOC	Not allotted	AOC	AOC
129.9750	129.980	Not used	Not used	Not used	Not allotted	Not used	Not used
129.9833	129.985	Not used	Not used	Not used	Not allotted	Not used	Not used
129.9917	129.990	Not used	Not used	Not used	Not allotted	Not used	Not used
130.0000	130.000	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.0000	130.005	Not used	Not used	Not used	Not allotted	Not used	Not used
130.0083	130.010	Not used	Not used	Not used	Not allotted	Not used	Not used
130.0167	130.015	Not used	Not used	Not used	Not allotted	Not used	Not used
130.0250	130.025	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.0250	130.030	Not used	Not used	Not used	Not allotted	Not used	Not used
130.0333	130.035	Not used	Not used	Not used	Not allotted	Not used	Not used
130.0417	130.040	Not used	Not used	Not used	Not allotted	Not used	Not used
130.0500	130.050	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.0500	130.055	Not used	Not used	Not used	Not allotted	Not used	Not used
130.0583	130.060	Not used	Not used	Not used	Not allotted	Not used	Not used
130.0667	130.065	Not used	Not used	Not used	Not allotted	Not used	Not used
130.0750	130.075	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.0750	130.080	Not used	Not used	Not used	Not allotted	Not used	Not used
130.0833	130.085	Not used	Not used	Not used	Not allotted	Not used	Not used
130.0917	130.090	Not used	Not used	Not used	Not allotted	Not used	Not used
130.1000	130.100	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.1000	130.105	Not used	Not used	Not used	Not allotted	Not used	Not used
130.1083	130.110	Not used	Not used	Not used	Not allotted	Not used	Not used
130.1167	130.115	Not used	Not used	Not used	Not allotted	Not used	Not used
130.1250	130.125	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.1250	130.130	Not used	Not used	Not used	Not allotted	Not used	Not used
130.1333	130.135	Not used	Not used	Not used	Not allotted	Not used	Not used
130.1417	130.140	Not used	Not used	Not used	Not allotted	Not used	Not used
130.1500	130.150	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.1500	130.155	Not used	Not used	Not used	Not allotted	Not used	Not used
130.1583	130.160	Not used	Not used	Not used	Not allotted	Not used	Not used
130.1667	130.165	Not used	Not used	Not used	Not allotted	Not used	Not used
130.1750	130.175	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.1750	130.180	Not used	Not used	Not used	Not allotted	Not used	Not used
130.1833	130.185	Not used	Not used	Not used	Not allotted	Not used	Not used
130.1917	130.190	Not used	Not used	Not used	Not allotted	Not used	Not used
130.2000	130.200	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.2000	130.205	Not used	Not used	Not used	Not allotted	Not used	Not used
130.2083	130.210	Not used	Not used	Not used	Not allotted	Not used	Not used
130.2167	130.215	Not used	Not used	Not used	Not allotted	Not used	Not used
130.2250	130.225	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.2250	130.230	Not used	Not used	Not used	Not allotted	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
130.2333	130.235	Not used	Not used	Not used	Not allotted	Not used	Not used
130.2417	130.240	Not used	Not used	Not used	Not allotted	Not used	Not used
130.2500	130.250	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.2500	130.255	Not used	Not used	Not used	Not allotted	Not used	Not used
130.2583	130.260	Not used	Not used	Not used	Not allotted	Not used	Not used
130.2667	130.265	Not used	Not used	Not used	Not allotted	Not used	Not used
130.2750	130.275	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.2750	130.280	Not used	Not used	Not used	Not allotted	Not used	Not used
130.2833	130.285	Not used	Not used	Not used	Not allotted	Not used	Not used
130.2917	130.290	Not used	Not used	Not used	Not allotted	Not used	Not used
130.3000	130.300	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.3000	130.305	Not used	Not used	Not used	Not allotted	Not used	Not used
130.3083	130.310	Not used	Not used	Not used	Not allotted	Not used	Not used
130.3167	130.315	Not used	Not used	Not used	Not allotted	Not used	Not used
130.3250	130.325	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.3250	130.330	Not used	Not used	Not used	Not allotted	Not used	Not used
130.3333	130.335	Not used	Not used	Not used	Not allotted	Not used	Not used
130.3417	130.340	Not used	Not used	Not used	Not allotted	Not used	Not used
130.3500	130.350	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.3500	130.355	Not used	Not used	Not used	Not allotted	Not used	Not used
130.3583	130.360	Not used	Not used	Not used	Not allotted	Not used	Not used
130.3667	130.365	Not used	Not used	Not used	Not allotted	Not used	Not used
130.3750	130.375	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.3750	130.380	Not used	Not used	Not used	Not allotted	Not used	Not used
130.3833	130.385	Not used	Not used	Not used	Not allotted	Not used	Not used
130.3917	130.390	Not used	Not used	Not used	Not allotted	Not used	Not used
130.4000	130.400	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.4000	130.405	Not used	Not used	Not used	Not allotted	Not used	Not used
130.4083	130.410	Not used	Not used	Not used	Not allotted	Not used	Not used
130.4167	130.415	Not used	Not used	Not used	Not allotted	Not used	Not used
130.4250	130.425	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.4250	130.430	Not used	Not used	Not used	Not allotted	Not used	Not used
130.4333	130.435	Not used	Not used	Not used	Not allotted	Not used	Not used
130.4417	130.440	Not used	Not used	Not used	Not allotted	Not used	Not used
130.4500	130.450	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.4500	130.455	Not used	Not used	Not used	Not allotted	Not used	Not used
130.4583	130.460	Not used	Not used	Not used	Not allotted	Not used	Not used
130.4667	130.465	Not used	Not used	Not used	Not allotted	Not used	Not used
130.4750	130.475	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.4750	130.480	Not used	Not used	Not used	Not allotted	Not used	Not used
130.4833	130.485	Not used	Not used	Not used	Not allotted	Not used	Not used
130.4917	130.490	Not used	Not used	Not used	Not allotted	Not used	Not used
130.5000	130.500	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.5000	130.505	Not used	Not used	Not used	Not allotted	Not used	Not used
130.5083	130.510	Not used	Not used	Not used	Not allotted	Not used	Not used
130.5167	130.515	Not used	Not used	Not used	Not allotted	Not used	Not used
130.5250	130.525	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.5250	130.530	Not used	Not used	Not used	Not allotted	Not used	Not used
130.5333	130.535	Not used	Not used	Not used	Not allotted	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
130.5417	130.540	Not used	Not used	Not used	Not allotted	Not used	Not used
130.5500	130.550	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.5500	130.555	Not used	Not used	Not used	Not allotted	Not used	Not used
130.5583	130.560	Not used	Not used	Not used	Not allotted	Not used	Not used
130.5667	130.565	Not used	Not used	Not used	Not allotted	Not used	Not used
130.5750	130.575	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.5750	130.580	Not used	Not used	Not used	Not allotted	Not used	Not used
130.5833	130.585	Not used	Not used	Not used	Not allotted	Not used	Not used
130.5917	130.590	Not used	Not used	Not used	Not allotted	Not used	Not used
130.6000	130.600	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.6000	130.605	Not used	Not used	Not used	Not allotted	Not used	Not used
130.6083	130.610	Not used	Not used	Not used	Not allotted	Not used	Not used
130.6167	130.615	Not used	Not used	Not used	Not allotted	Not used	Not used
130.6250	130.625	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.6250	130.630	Not used	Not used	Not used	Not allotted	Not used	Not used
130.6333	130.635	Not used	Not used	Not used	Not allotted	Not used	Not used
130.6417	130.640	Not used	Not used	Not used	Not allotted	Not used	Not used
130.6500	130.650	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.6500	130.655	Not used	Not used	Not used	Not allotted	Not used	Not used
130.6583	130.660	Not used	Not used	Not used	Not allotted	Not used	Not used
130.6667	130.665	Not used	Not used	Not used	Not allotted	Not used	Not used
130.6750	130.675	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.6750	130.680	Not used	Not used	Not used	Not allotted	Not used	Not used
130.6833	130.685	Not used	Not used	Not used	Not allotted	Not used	Not used
130.6917	130.690	Not used	Not used	Not used	Not allotted	Not used	Not used
130.7000	130.700	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.7000	130.705	Not used	Not used	Not used	Not allotted	Not used	Not used
130.7083	130.710	Not used	Not used	Not used	Not allotted	Not used	Not used
130.7167	130.715	Not used	Not used	Not used	Not allotted	Not used	Not used
130.7250	130.725	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.7250	130.730	Not used	Not used	Not used	Not allotted	Not used	Not used
130.7333	130.735	Not used	Not used	Not used	Not allotted	Not used	Not used
130.7417	130.740	Not used	Not used	Not used	Not allotted	Not used	Not used
130.7500	130.750	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.7500	130.755	Not used	Not used	Not used	Not allotted	Not used	Not used
130.7583	130.760	Not used	Not used	Not used	Not allotted	Not used	Not used
130.7667	130.765	Not used	Not used	Not used	Not allotted	Not used	Not used
130.7750	130.775	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.7750	130.780	Not used	Not used	Not used	Not allotted	Not used	Not used
130.7833	130.785	Not used	Not used	Not used	Not allotted	Not used	Not used
130.7917	130.790	Not used	Not used	Not used	Not allotted	Not used	Not used
130.8000	130.800	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.8000	130.805	Not used	Not used	Not used	Not allotted	Not used	Not used
130.8083	130.810	Not used	Not used	Not used	Not allotted	Not used	Not used
130.8167	130.815	Not used	Not used	Not used	Not allotted	Not used	Not used
130.8250	130.825	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.8250	130.830	Not used	Not used	Not used	Not allotted	Not used	Not used
130.8333	130.835	Not used	Not used	Not used	Not allotted	Not used	Not used
130.8417	130.840	Not used	Not used	Not used	Not allotted	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
130.8500	130.850	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.8500	130.855	Not used	Not used	Not used	Not allotted	Not used	Not used
130.8583	130.860	Not used	Not used	Not used	Not allotted	Not used	Not used
130.8667	130.865	Not used	Not used	Not used	Not allotted	Not used	Not used
130.8750	130.875	Not allotted	AOC	AOC	Not allotted	AOC	AOC
130.8750	130.880	Not used	Not used	Not used	Not allotted	Not used	Not used
130.8833	130.885	Not used	Not used	Not used	Not allotted	Not used	Not used
130.8917	130.890	Not used	Not used	Not used	Not allotted	Not used	Not used
130.9000	130.900	ACC-U	AOC	AOC	APP, ACC-L	AOC	AOC
130.9000	130.905	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
130.9083	130.910	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
130.9167	130.915	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
130.9250	130.925	ACC-U	AOC	AOC	APP, ACC-L	AOC	AOC
130.9250	130.930	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
130.9333	130.935	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
130.9417	130.940	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
130.9500	130.950	ACC-U	AOC	AOC	APP, ACC-L	AOC	AOC
130.9500	130.955	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
130.9583	130.960	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
130.9667	130.965	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
130.9750	130.975	ACC-U	AOC	AOC	APP, ACC-L	AOC	AOC
130.9750	130.980	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
130.9833	130.985	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
130.9917	130.990	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.0000	131.000	Not allotted	AOC	AOC	APP, ACC-L	AOC	AOC
131.0000	131.005	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.0083	131.010	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.0167	131.015	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.0250	131.025	Not allotted	AOC	AOC	APP, ACC-L	AOC	AOC
131.0250	131.030	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.0333	131.035	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.0417	131.040	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.0500	131.050	Not allotted	AOC	AOC	APP, ACC-L	AOC	AOC
131.0500	131.055	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.0583	131.060	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.0667	131.065	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.0750	131.075	Not allotted	AOC	AOC	APP, ACC-L	AOC	AOC
131.0750	131.080	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.0833	131.085	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.0917	131.090	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.1000	131.100	FIS-L	AOC	AOC	APP, ACC-L	AOC	AOC
131.1000	131.105	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.1083	131.110	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.1167	131.115	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.1250	131.125	FIS-L	AOC	AOC	APP, ACC-L	AOC	AOC
131.1250	131.130	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.1333	131.135	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.1417	131.140	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.1500	131.150	FIS-L	AOC	AOC	APP, ACC-L	AOC	AOC

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
131.1500	131.155	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.1583	131.160	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.1667	131.165	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.1750	131.175	FIS-L	AOC	AOC	APP, ACC-L	AOC	AOC
131.1750	131.180	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.1833	131.185	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.1917	131.190	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.2000	131.200	ACC-L	AOC	AOC	APP, ACC-L	AOC	AOC
131.2000	131.205	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.2083	131.210	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.2167	131.215	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.2250	131.225	ACC-L	AOC	AOC	APP, ACC-L	AOC	AOC
131.2250	131.230	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.2333	131.235	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.2417	131.240	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.2500	131.250	ACC-L	AOC	AOC	APP, ACC-L	AOC	AOC
131.2500	131.255	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.2583	131.260	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.2667	131.265	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.2750	131.275	ACC-L	AOC	AOC	APP, ACC-L	AOC	AOC
131.2750	131.280	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.2833	131.285	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.2917	131.290	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.3000	131.300	FIS-U (GPS)	AOC	AOC	APP, ACC-L	AOC	AOC
131.3000	131.305	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.3083	131.310	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.3167	131.315	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.3250	131.325	FIS-U (GPS)	AOC	AOC	APP, ACC-L	AOC	AOC
131.3250	131.330	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.3333	131.335	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.3417	131.340	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.3500	131.350	FIS-U (GPS)	AOC	AOC	APP, ACC-L	AOC	AOC
131.3500	131.355	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.3583	131.360	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.3667	131.365	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.3750	131.375	FIS-U (GPS)	AOC	AOC	APP, ACC-L	AOC	AOC
131.3750	131.380	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.3833	131.385	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.3917	131.390	Not used	Not used	Not used	APP, ACC-L	Not used	Not used
131.4000	131.400	AOC	AOC	AOC	AOC	AOC	AOC
131.4000	131.405	Not used	Not used	Not used	AOC	Not used	Not used
131.4083	131.410	Not used	Not used	Not used	AOC	Not used	Not used
131.4167	131.415	Not used	Not used	Not used	AOC	Not used	Not used
131.4250	131.425	AOC	AOC	AOC	AOC	AOC	AOC
131.4250	131.430	Not used	Not used	Not used	AOC	Not used	Not used
131.4333	131.435	Not used	Not used	Not used	AOC	Not used	Not used
131.4417	131.440	Not used	Not used	Not used	AOC	Not used	Not used
131.4500	131.450	AOC	AOC	AOC	AOC	AOC	AOC
131.4500	131.455	Not used	Not used	Not used	AOC	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
131.4583	131.460	Not used	Not used	Not used	AOC	Not used	Not used
131.4667	131.465	Not used	Not used	Not used	AOC	Not used	Not used
131.4750	131.475	AOC	AOC	AOC	AOC	AOC	AOC
131.4750	131.480	Not used	Not used	Not used	AOC	Not used	Not used
131.4833	131.485	Not used	Not used	Not used	AOC	Not used	Not used
131.4917	131.490	Not used	Not used	Not used	AOC	Not used	Not used
131.5000	131.500	AOC	AOC	AOC	AOC	AOC	AOC
131.5000	131.505	Not used	Not used	Not used	Blocked	Not used	Not used
131.5083	131.510	Not used	Not used	Not used	Blocked	Not used	Not used
131.5167	131.515	Not used	Not used	Not used	Blocked	Not used	Not used
131.5250	131.525	AOC	AOC	AOC	AOC	AOC	AOC
131.5250	131.530	Not used	Not used	Not used	Blocked	Not used	Not used
131.5333	131.535	Not used	Not used	Not used	Blocked	Not used	Not used
131.5417	131.540	Not used	Not used	Not used	Blocked	Not used	Not used
131.5500	131.550	AOC	AOC	AOC	AOC	AOC	AOC
131.5500	131.555	Not used	Not used	Not used	AOC	Not used	Not used
131.5583	131.560	Not used	Not used	Not used	AOC	Not used	Not used
131.5667	131.565	Not used	Not used	Not used	AOC	Not used	Not used
131.5750	131.575	AOC	AOC	AOC	AOC	AOC	AOC
131.5750	131.580	Not used	Not used	Not used	AOC	Not used	Not used
131.5833	131.585	Not used	Not used	Not used	AOC	Not used	Not used
131.5917	131.590	Not used	Not used	Not used	AOC	Not used	Not used
131.6000	131.600	AOC	AOC	AOC	AOC	AOC	AOC
131.6000	131.605	Not used	Not used	Not used	AOC	Not used	Not used
131.6083	131.610	Not used	Not used	Not used	AOC	Not used	Not used
131.6167	131.615	Not used	Not used	Not used	AOC	Not used	Not used
131.6250	131.625	AOC	AOC	AOC	AOC	AOC	AOC
131.6250	131.630	Not used	Not used	Not used	AOC	Not used	Not used
131.6333	131.635	Not used	Not used	Not used	AOC	Not used	Not used
131.6417	131.640	Not used	Not used	Not used	AOC	Not used	Not used
131.6500	131.650	AOC	AOC	AOC	AOC	AOC	AOC
131.6500	131.655	Not used	Not used	Not used	AOC	Not used	Not used
131.6583	131.660	Not used	Not used	Not used	AOC	Not used	Not used
131.6667	131.665	Not used	Not used	Not used	AOC	Not used	Not used
131.6750	131.675	AOC	AOC	AOC	AOC	AOC	AOC
131.6750	131.680	Not used	Not used	Not used	AOC	Not used	Not used
131.6833	131.685	Not used	Not used	Not used	AOC	Not used	Not used
131.6917	131.690	Not used	Not used	Not used	AOC	Not used	Not used
131.7000	131.700	AOC	AOC	AOC	AOC	AOC	AOC
131.7000	131.705	Not used	Not used	Not used	Blocked	Not used	Not used
131.7083	131.710	Not used	Not used	Not used	Blocked	Not used	Not used
131.7167	131.715	Not used	Not used	Not used	Blocked	Not used	Not used
131.7250	131.725	AOC	AOC	AOC	AOC	AOC	AOC
131.7250	131.730	Not used	Not used	Not used	Blocked	Not used	Not used
131.7333	131.735	Not used	Not used	Not used	Blocked	Not used	Not used
131.7417	131.740	Not used	Not used	Not used	Blocked	Not used	Not used
131.7500	131.750	AOC	AOC	AOC	AOC	AOC	AOC
131.7500	131.755	Not used	Not used	Not used	Blocked	Not used	Not used
131.7583	131.760	Not used	Not used	Not used	Blocked	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
131.7667	131.765	Not used	Not used	Not used	Blocked	Not used	Not used
131.7750	131.775	AOC	AOC	AOC	AOC	AOC	AOC
131.7750	131.780	Not used	Not used	Not used	Blocked	Not used	Not used
131.7833	131.785	Not used	Not used	Not used	Blocked	Not used	Not used
131.7917	131.790	Not used	Not used	Not used	Blocked	Not used	Not used
131.8000	131.800	AOC	AOC	AOC	AOC	AOC	AOC
131.8000	131.805	Not used	Not used	Not used	Blocked	Not used	Not used
131.8083	131.810	Not used	Not used	Not used	Blocked	Not used	Not used
131.8167	131.815	Not used	Not used	Not used	Blocked	Not used	Not used
131.8250	131.825	AOC	AOC	AOC	AOC	AOC	AOC
131.8250	131.830	Not used	Not used	Not used	Blocked	Not used	Not used
131.8333	131.835	Not used	Not used	Not used	Blocked	Not used	Not used
131.8417	131.840	Not used	Not used	Not used	Blocked	Not used	Not used
131.8500	131.850	AOC	AOC	AOC	AOC	AOC	AOC
131.8500	131.855	Not used	Not used	Not used	AOC	Not used	Not used
131.8583	131.860	Not used	Not used	Not used	AOC	Not used	Not used
131.8667	131.865	Not used	Not used	Not used	AOC	Not used	Not used
131.8750	131.875	AOC	AOC	AOC	AOC	AOC	AOC
131.8750	131.880	Not used	Not used	Not used	AOC	Not used	Not used
131.8833	131.885	Not used	Not used	Not used	AOC	Not used	Not used
131.8917	131.890	Not used	Not used	Not used	AOC	Not used	Not used
131.9000	131.900	AOC	AOC	AOC	AOC	AOC	AOC
131.9000	131.905	Not used	Not used	Not used	AOC	Not used	Not used
131.9083	131.910	Not used	Not used	Not used	AOC	Not used	Not used
131.9167	131.915	Not used	Not used	Not used	AOC	Not used	Not used
131.9250	131.925	AOC	AOC	AOC	AOC	AOC	AOC
131.9250	131.930	Not used	Not used	Not used	AOC	Not used	Not used
131.9333	131.935	Not used	Not used	Not used	AOC	Not used	Not used
131.9417	131.940	Not used	Not used	Not used	AOC	Not used	Not used
131.9500	131.950	AOC	AOC	AOC	AOC	AOC	AOC
131.9500	131.955	Not used	Not used	Not used	AOC	Not used	Not used
131.9583	131.960	Not used	Not used	Not used	AOC	Not used	Not used
131.9667	131.965	Not used	Not used	Not used	AOC	Not used	Not used
131.9750	131.975	AOC	AOC	AOC	AOC	AOC	AOC
131.9750	131.980	Not used	Not used	Not used	AOC	Not used	Not used
131.9833	131.985	Not used	Not used	Not used	AOC	Not used	Not used
131.9917	131.990	Not used	Not used	Not used	AOC	Not used	Not used
132.0000	132.000	Not allotted	AOC	AOC	ACC-U	AOC	AOC
132.0000	132.005	Not used	Not used	Not used	ACC-U	Not used	Not used
132.0083	132.010	Not used	Not used	Not used	ACC-U	Not used	Not used
132.0167	132.015	Not used	Not used	Not used	ACC-U	Not used	Not used
132.0250	132.025	Not allotted	AOC	AOC	ACC-U	AOC	AOC
132.0250	132.030	Not used	Not used	Not used	ACC-U	Not used	Not used
132.0333	132.035	Not used	Not used	Not used	ACC-U	Not used	Not used
132.0417	132.040	Not used	Not used	Not used	ACC-U	Not used	Not used
132.0500	132.050	Not allotted	Not allotted	VOLMET, ATIS	ACC-U	Not allotted	VOLMET, ATIS
132.0500	132.055	Not used	Not used	Not used	ACC-U	Not used	Not used
132.0583	132.060	Not used	Not used	Not used	ACC-U	Not used	Not used
132.0667	132.065	Not used	Not used	Not used	ACC-U	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
132.0750	132.075	Not allotted	Not allotted	VOLMET, ATIS	ACC-U	Not allotted	VOLMET, ATIS
132.0750	132.080	Not used	Not used	Not used	ACC-U	Not used	Not used
132.0833	132.085	Not used	Not used	Not used	ACC-U	Not used	Not used
132.0917	132.090	Not used	Not used	Not used	ACC-U	Not used	Not used
132.1000	132.100	ACC-U	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.1000	132.105	Not used	Not used	Not used	ACC-U	Not used	Not used
132.1083	132.110	Not used	Not used	Not used	ACC-U	Not used	Not used
132.1167	132.115	Not used	Not used	Not used	ACC-U	Not used	Not used
132.1250	132.125	ACC-U	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.1250	132.130	Not used	Not used	Not used	ACC-U	Not used	Not used
132.1333	132.135	Not used	Not used	Not used	ACC-U	Not used	Not used
132.1417	132.140	Not used	Not used	Not used	ACC-U	Not used	Not used
132.1500	132.150	ACC-U	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.1500	132.155	Not used	Not used	Not used	ACC-U	Not used	Not used
132.1583	132.160	Not used	Not used	Not used	ACC-U	Not used	Not used
132.1667	132.165	Not used	Not used	Not used	ACC-U	Not used	Not used
132.1750	132.175	ACC-U	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.1750	132.180	Not used	Not used	Not used	ACC-U	Not used	Not used
132.1833	132.185	Not used	Not used	Not used	ACC-U	Not used	Not used
132.1917	132.190	Not used	Not used	Not used	ACC-U	Not used	Not used
132.2000	132.200	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.2000	132.205	Not used	Not used	Not used	ACC-U	Not used	Not used
132.2083	132.210	Not used	Not used	Not used	ACC-U	Not used	Not used
132.2167	132.215	Not used	Not used	Not used	ACC-U	Not used	Not used
132.2250	132.225	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.2250	132.230	Not used	Not used	Not used	ACC-U	Not used	Not used
132.2333	132.235	Not used	Not used	Not used	ACC-U	Not used	Not used
132.2417	132.240	Not used	Not used	Not used	ACC-U	Not used	Not used
132.2500	132.250	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.2500	132.255	Not used	Not used	Not used	ACC-U	Not used	Not used
132.2583	132.260	Not used	Not used	Not used	ACC-U	Not used	Not used
132.2667	132.265	Not used	Not used	Not used	ACC-U	Not used	Not used
132.2750	132.275	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.2750	132.280	Not used	Not used	Not used	ACC-U	Not used	Not used
132.2833	132.285	Not used	Not used	Not used	ACC-U	Not used	Not used
132.2917	132.290	Not used	Not used	Not used	ACC-U	Not used	Not used
132.3000	132.300	FIS-U (GPS)	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.3000	132.305	Not used	Not used	Not used	ACC-U	Not used	Not used
132.3083	132.310	Not used	Not used	Not used	ACC-U	Not used	Not used
132.3167	132.315	Not used	Not used	Not used	ACC-U	Not used	Not used
132.3250	132.325	FIS-U (GPS)	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.3250	132.330	Not used	Not used	Not used	ACC-U	Not used	Not used
132.3333	132.335	Not used	Not used	Not used	ACC-U	Not used	Not used
132.3417	132.340	Not used	Not used	Not used	ACC-U	Not used	Not used
132.3500	132.350	FIS-U (GPS)	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.3500	132.355	Not used	Not used	Not used	ACC-U	Not used	Not used
132.3583	132.360	Not used	Not used	Not used	ACC-U	Not used	Not used
132.3667	132.365	Not used	Not used	Not used	ACC-U	Not used	Not used
132.3750	132.375	FIS-U (GPS)	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
132.3750	132.380	Not used	Not used	Not used	ACC-U	Not used	Not used
132.3833	132.385	Not used	Not used	Not used	ACC-U	Not used	Not used
132.3917	132.390	Not used	Not used	Not used	ACC-U	Not used	Not used
132.4000	132.400	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.4000	132.405	Not used	Not used	Not used	ACC-U	Not used	Not used
132.4083	132.410	Not used	Not used	Not used	ACC-U	Not used	Not used
132.4167	132.415	Not used	Not used	Not used	ACC-U	Not used	Not used
132.4250	132.425	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.4250	132.430	Not used	Not used	Not used	ACC-U	Not used	Not used
132.4333	132.435	Not used	Not used	Not used	ACC-U	Not used	Not used
132.4417	132.440	Not used	Not used	Not used	ACC-U	Not used	Not used
132.4500	132.450	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.4500	132.455	Not used	Not used	Not used	ACC-U	Not used	Not used
132.4583	132.460	Not used	Not used	Not used	ACC-U	Not used	Not used
132.4667	132.465	Not used	Not used	Not used	ACC-U	Not used	Not used
132.4750	132.475	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.4750	132.480	Not used	Not used	Not used	ACC-U	Not used	Not used
132.4833	132.485	Not used	Not used	Not used	ACC-U	Not used	Not used
132.4917	132.490	Not used	Not used	Not used	ACC-U	Not used	Not used
132.5000	132.500	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.5000	132.505	Not used	Not used	Not used	ACC-U	Not used	Not used
132.5083	132.510	Not used	Not used	Not used	ACC-U	Not used	Not used
132.5167	132.515	Not used	Not used	Not used	ACC-U	Not used	Not used
132.5250	132.525	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.5250	132.530	Not used	Not used	Not used	ACC-U	Not used	Not used
132.5333	132.535	Not used	Not used	Not used	ACC-U	Not used	Not used
132.5417	132.540	Not used	Not used	Not used	ACC-U	Not used	Not used
132.5500	132.550	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.5500	132.555	Not used	Not used	Not used	ACC-U	Not used	Not used
132.5583	132.560	Not used	Not used	Not used	ACC-U	Not used	Not used
132.5667	132.565	Not used	Not used	Not used	ACC-U	Not used	Not used
132.5750	132.575	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.5750	132.580	Not used	Not used	Not used	ACC-U	Not used	Not used
132.5833	132.585	Not used	Not used	Not used	ACC-U	Not used	Not used
132.5917	132.590	Not used	Not used	Not used	ACC-U	Not used	Not used
132.6000	132.600	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.6000	132.605	Not used	Not used	Not used	ACC-U	Not used	Not used
132.6083	132.610	Not used	Not used	Not used	ACC-U	Not used	Not used
132.6167	132.615	Not used	Not used	Not used	ACC-U	Not used	Not used
132.6250	132.625	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.6250	132.630	Not used	Not used	Not used	ACC-U	Not used	Not used
132.6333	132.635	Not used	Not used	Not used	ACC-U	Not used	Not used
132.6417	132.640	Not used	Not used	Not used	ACC-U	Not used	Not used
132.6500	132.650	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.6500	132.655	Not used	Not used	Not used	ACC-U	Not used	Not used
132.6583	132.660	Not used	Not used	Not used	ACC-U	Not used	Not used
132.6667	132.665	Not used	Not used	Not used	ACC-U	Not used	Not used
132.6750	132.675	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.6750	132.680	Not used	Not used	Not used	ACC-U	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
132.6833	132.685	Not used	Not used	Not used	ACC-U	Not used	Not used
132.6917	132.690	Not used	Not used	Not used	ACC-U	Not used	Not used
132.7000	132.700	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.7000	132.705	Not used	Not used	Not used	ACC-U	Not used	Not used
132.7083	132.710	Not used	Not used	Not used	ACC-U	Not used	Not used
132.7167	132.715	Not used	Not used	Not used	ACC-U	Not used	Not used
132.7250	132.725	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.7250	132.730	Not used	Not used	Not used	ACC-U	Not used	Not used
132.7333	132.735	Not used	Not used	Not used	ACC-U	Not used	Not used
132.7417	132.740	Not used	Not used	Not used	ACC-U	Not used	Not used
132.7500	132.750	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.7500	132.755	Not used	Not used	Not used	ACC-U	Not used	Not used
132.7583	132.760	Not used	Not used	Not used	ACC-U	Not used	Not used
132.7667	132.765	Not used	Not used	Not used	ACC-U	Not used	Not used
132.7750	132.775	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.7750	132.780	Not used	Not used	Not used	ACC-U	Not used	Not used
132.7833	132.785	Not used	Not used	Not used	ACC-U	Not used	Not used
132.7917	132.790	Not used	Not used	Not used	ACC-U	Not used	Not used
132.8000	132.800	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.8000	132.805	Not used	Not used	Not used	ACC-U	Not used	Not used
132.8083	132.810	Not used	Not used	Not used	ACC-U	Not used	Not used
132.8167	132.815	Not used	Not used	Not used	ACC-U	Not used	Not used
132.8250	132.825	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.8250	132.830	Not used	Not used	Not used	ACC-U	Not used	Not used
132.8333	132.835	Not used	Not used	Not used	ACC-U	Not used	Not used
132.8417	132.840	Not used	Not used	Not used	ACC-U	Not used	Not used
132.8500	132.850	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.8500	132.855	Not used	Not used	Not used	ACC-U	Not used	Not used
132.8583	132.860	Not used	Not used	Not used	ACC-U	Not used	Not used
132.8667	132.865	Not used	Not used	Not used	ACC-U	Not used	Not used
132.8750	132.875	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.8750	132.880	Not used	Not used	Not used	ACC-U	Not used	Not used
132.8833	132.885	Not used	Not used	Not used	ACC-U	Not used	Not used
132.8917	132.890	Not used	Not used	Not used	ACC-U	Not used	Not used
132.9000	132.900	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.9000	132.905	Not used	Not used	Not used	ACC-U	Not used	Not used
132.9083	132.910	Not used	Not used	Not used	ACC-U	Not used	Not used
132.9167	132.915	Not used	Not used	Not used	ACC-U	Not used	Not used
132.9250	132.925	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.9250	132.930	Not used	Not used	Not used	ACC-U	Not used	Not used
132.9333	132.935	Not used	Not used	Not used	ACC-U	Not used	Not used
132.9417	132.940	Not used	Not used	Not used	ACC-U	Not used	Not used
132.9500	132.950	Not allotted	ACC-L, ACC-U	VOLMET, ATIS	ACC-U	ACC-L, ACC-U	VOLMET, ATIS
132.9500	132.955	Not used	Not used	Not used	ACC-U	Not used	Not used
132.9583	132.960	Not used	Not used	Not used	ACC-U	Not used	Not used
132.9667	132.965	Not used	Not used	Not used	ACC-U	Not used	Not used
132.9750	132.975	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
132.9750	132.980	Not used	Not used	Not used	ACC-U	Not used	Not used
132.9833	132.985	Not used	Not used	Not used	ACC-U	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
132.9917	132.990	Not used	Not used	Not used	ACC-U	Not used	Not used
133.0000	133.000	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.0000	133.005	Not used	Not used	Not used	ACC-U	Not used	Not used
133.0083	133.010	Not used	Not used	Not used	ACC-U	Not used	Not used
133.0167	133.015	Not used	Not used	Not used	ACC-U	Not used	Not used
133.0250	133.025	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.0250	133.030	Not used	Not used	Not used	ACC-U	Not used	Not used
133.0333	133.035	Not used	Not used	Not used	ACC-U	Not used	Not used
133.0417	133.040	Not used	Not used	Not used	ACC-U	Not used	Not used
133.0500	133.050	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.0500	133.055	Not used	Not used	Not used	ACC-U	Not used	Not used
133.0583	133.060	Not used	Not used	Not used	ACC-U	Not used	Not used
133.0667	133.065	Not used	Not used	Not used	ACC-U	Not used	Not used
133.0750	133.075	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.0750	133.080	Not used	Not used	Not used	ACC-U	Not used	Not used
133.0833	133.085	Not used	Not used	Not used	ACC-U	Not used	Not used
133.0917	133.090	Not used	Not used	Not used	ACC-U	Not used	Not used
133.1000	133.100	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.1000	133.105	Not used	Not used	Not used	ACC-U	Not used	Not used
133.1083	133.110	Not used	Not used	Not used	ACC-U	Not used	Not used
133.1167	133.115	Not used	Not used	Not used	ACC-U	Not used	Not used
133.1250	133.125	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.1250	133.130	Not used	Not used	Not used	ACC-U	Not used	Not used
133.1333	133.135	Not used	Not used	Not used	ACC-U	Not used	Not used
133.1417	133.140	Not used	Not used	Not used	ACC-U	Not used	Not used
133.1500	133.150	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.1500	133.155	Not used	Not used	Not used	ACC-U	Not used	Not used
133.1583	133.160	Not used	Not used	Not used	ACC-U	Not used	Not used
133.1667	133.165	Not used	Not used	Not used	ACC-U	Not used	Not used
133.1750	133.175	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.1750	133.180	Not used	Not used	Not used	ACC-U	Not used	Not used
133.1833	133.185	Not used	Not used	Not used	ACC-U	Not used	Not used
133.1917	133.190	Not used	Not used	Not used	ACC-U	Not used	Not used
133.2000	133.200	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.2000	133.205	Not used	Not used	Not used	ACC-U	Not used	Not used
133.2083	133.210	Not used	Not used	Not used	ACC-U	Not used	Not used
133.2167	133.215	Not used	Not used	Not used	ACC-U	Not used	Not used
133.2250	133.225	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.2250	133.230	Not used	Not used	Not used	ACC-U	Not used	Not used
133.2333	133.235	Not used	Not used	Not used	ACC-U	Not used	Not used
133.2417	133.240	Not used	Not used	Not used	ACC-U	Not used	Not used
133.2500	133.250	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.2500	133.255	Not used	Not used	Not used	ACC-U	Not used	Not used
133.2583	133.260	Not used	Not used	Not used	ACC-U	Not used	Not used
133.2667	133.265	Not used	Not used	Not used	ACC-U	Not used	Not used
133.2750	133.275	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.2750	133.280	Not used	Not used	Not used	ACC-U	Not used	Not used
133.2833	133.285	Not used	Not used	Not used	ACC-U	Not used	Not used
133.2917	133.290	Not used	Not used	Not used	ACC-U	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
133.3000	133.300	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.3000	133.305	Not used	Not used	Not used	ACC-U	Not used	Not used
133.3083	133.310	Not used	Not used	Not used	ACC-U	Not used	Not used
133.3167	133.315	Not used	Not used	Not used	ACC-U	Not used	Not used
133.3250	133.325	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.3250	133.330	Not used	Not used	Not used	ACC-U	Not used	Not used
133.3333	133.335	Not used	Not used	Not used	ACC-U	Not used	Not used
133.3417	133.340	Not used	Not used	Not used	ACC-U	Not used	Not used
133.3500	133.350	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.3500	133.355	Not used	Not used	Not used	ACC-U	Not used	Not used
133.3583	133.360	Not used	Not used	Not used	ACC-U	Not used	Not used
133.3667	133.365	Not used	Not used	Not used	ACC-U	Not used	Not used
133.3750	133.375	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.3750	133.380	Not used	Not used	Not used	ACC-U	Not used	Not used
133.3833	133.385	Not used	Not used	Not used	ACC-U	Not used	Not used
133.3917	133.390	Not used	Not used	Not used	ACC-U	Not used	Not used
133.4000	133.400	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.4000	133.405	Not used	Not used	Not used	ACC-U	Not used	Not used
133.4083	133.410	Not used	Not used	Not used	ACC-U	Not used	Not used
133.4167	133.415	Not used	Not used	Not used	ACC-U	Not used	Not used
133.4250	133.425	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.4250	133.430	Not used	Not used	Not used	ACC-U	Not used	Not used
133.4333	133.435	Not used	Not used	Not used	ACC-U	Not used	Not used
133.4417	133.440	Not used	Not used	Not used	ACC-U	Not used	Not used
133.4500	133.450	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.4500	133.455	Not used	Not used	Not used	ACC-U	Not used	Not used
133.4583	133.460	Not used	Not used	Not used	ACC-U	Not used	Not used
133.4667	133.465	Not used	Not used	Not used	ACC-U	Not used	Not used
133.4750	133.475	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.4750	133.480	Not used	Not used	Not used	ACC-U	Not used	Not used
133.4833	133.485	Not used	Not used	Not used	ACC-U	Not used	Not used
133.4917	133.490	Not used	Not used	Not used	ACC-U	Not used	Not used
133.5000	133.500	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.5000	133.505	Not used	Not used	Not used	ACC-U	Not used	Not used
133.5083	133.510	Not used	Not used	Not used	ACC-U	Not used	Not used
133.5167	133.515	Not used	Not used	Not used	ACC-U	Not used	Not used
133.5250	133.525	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.5250	133.530	Not used	Not used	Not used	ACC-U	Not used	Not used
133.5333	133.535	Not used	Not used	Not used	ACC-U	Not used	Not used
133.5417	133.540	Not used	Not used	Not used	ACC-U	Not used	Not used
133.5500	133.550	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.5500	133.555	Not used	Not used	Not used	ACC-U	Not used	Not used
133.5583	133.560	Not used	Not used	Not used	ACC-U	Not used	Not used
133.5667	133.565	Not used	Not used	Not used	ACC-U	Not used	Not used
133.5750	133.575	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.5750	133.580	Not used	Not used	Not used	ACC-U	Not used	Not used
133.5833	133.585	Not used	Not used	Not used	ACC-U	Not used	Not used
133.5917	133.590	Not used	Not used	Not used	ACC-U	Not used	Not used
133.6000	133.600	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
133.6000	133.605	Not used	Not used	Not used	ACC-U	Not used	Not used
133.6083	133.610	Not used	Not used	Not used	ACC-U	Not used	Not used
133.6167	133.615	Not used	Not used	Not used	ACC-U	Not used	Not used
133.6250	133.625	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.6250	133.630	Not used	Not used	Not used	ACC-U	Not used	Not used
133.6333	133.635	Not used	Not used	Not used	ACC-U	Not used	Not used
133.6417	133.640	Not used	Not used	Not used	ACC-U	Not used	Not used
133.6500	133.650	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.6500	133.655	Not used	Not used	Not used	ACC-U	Not used	Not used
133.6583	133.660	Not used	Not used	Not used	ACC-U	Not used	Not used
133.6667	133.665	Not used	Not used	Not used	ACC-U	Not used	Not used
133.6750	133.675	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.6750	133.680	Not used	Not used	Not used	ACC-U	Not used	Not used
133.6833	133.685	Not used	Not used	Not used	ACC-U	Not used	Not used
133.6917	133.690	Not used	Not used	Not used	ACC-U	Not used	Not used
133.7000	133.700	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.7000	133.705	Not used	Not used	Not used	ACC-U	Not used	Not used
133.7083	133.710	Not used	Not used	Not used	ACC-U	Not used	Not used
133.7167	133.715	Not used	Not used	Not used	ACC-U	Not used	Not used
133.7250	133.725	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.7250	133.730	Not used	Not used	Not used	ACC-U	Not used	Not used
133.7333	133.735	Not used	Not used	Not used	ACC-U	Not used	Not used
133.7417	133.740	Not used	Not used	Not used	ACC-U	Not used	Not used
133.7500	133.750	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.7500	133.755	Not used	Not used	Not used	ACC-U	Not used	Not used
133.7583	133.760	Not used	Not used	Not used	ACC-U	Not used	Not used
133.7667	133.765	Not used	Not used	Not used	ACC-U	Not used	Not used
133.7750	133.775	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.7750	133.780	Not used	Not used	Not used	ACC-U	Not used	Not used
133.7833	133.785	Not used	Not used	Not used	ACC-U	Not used	Not used
133.7917	133.790	Not used	Not used	Not used	ACC-U	Not used	Not used
133.8000	133.800	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.8000	133.805	Not used	Not used	Not used	ACC-U	Not used	Not used
133.8083	133.810	Not used	Not used	Not used	ACC-U	Not used	Not used
133.8167	133.815	Not used	Not used	Not used	ACC-U	Not used	Not used
133.8250	133.825	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.8250	133.830	Not used	Not used	Not used	ACC-U	Not used	Not used
133.8333	133.835	Not used	Not used	Not used	ACC-U	Not used	Not used
133.8417	133.840	Not used	Not used	Not used	ACC-U	Not used	Not used
133.8500	133.850	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.8500	133.855	Not used	Not used	Not used	ACC-U	Not used	Not used
133.8583	133.860	Not used	Not used	Not used	ACC-U	Not used	Not used
133.8667	133.865	Not used	Not used	Not used	ACC-U	Not used	Not used
133.8750	133.875	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.8750	133.880	Not used	Not used	Not used	ACC-U	Not used	Not used
133.8833	133.885	Not used	Not used	Not used	ACC-U	Not used	Not used
133.8917	133.890	Not used	Not used	Not used	ACC-U	Not used	Not used
133.9000	133.900	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.9000	133.905	Not used	Not used	Not used	ACC-U	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
133.9083	133.910	Not used	Not used	Not used	ACC-U	Not used	Not used
133.9167	133.915	Not used	Not used	Not used	ACC-U	Not used	Not used
133.9250	133.925	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.9250	133.930	Not used	Not used	Not used	ACC-U	Not used	Not used
133.9333	133.935	Not used	Not used	Not used	ACC-U	Not used	Not used
133.9417	133.940	Not used	Not used	Not used	ACC-U	Not used	Not used
133.9500	133.950	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.9500	133.955	Not used	Not used	Not used	ACC-U	Not used	Not used
133.9583	133.960	Not used	Not used	Not used	ACC-U	Not used	Not used
133.9667	133.965	Not used	Not used	Not used	ACC-U	Not used	Not used
133.9750	133.975	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
133.9750	133.980	Not used	Not used	Not used	ACC-U	Not used	Not used
133.9833	133.985	Not used	Not used	Not used	ACC-U	Not used	Not used
133.9917	133.990	Not used	Not used	Not used	ACC-U	Not used	Not used
134.0000	134.000	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
134.0000	134.005	Not used	Not used	Not used	ACC-U	Not used	Not used
134.0083	134.010	Not used	Not used	Not used	ACC-U	Not used	Not used
134.0167	134.015	Not used	Not used	Not used	ACC-U	Not used	Not used
134.0250	134.025	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
134.0250	134.030	Not used	Not used	Not used	ACC-U	Not used	Not used
134.0333	134.035	Not used	Not used	Not used	ACC-U	Not used	Not used
134.0417	134.040	Not used	Not used	Not used	ACC-U	Not used	Not used
134.0500	134.050	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
134.0500	134.055	Not used	Not used	Not used	ACC-U	Not used	Not used
134.0583	134.060	Not used	Not used	Not used	ACC-U	Not used	Not used
134.0667	134.065	Not used	Not used	Not used	ACC-U	Not used	Not used
134.0750	134.075	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
134.0750	134.080	Not used	Not used	Not used	ACC-U	Not used	Not used
134.0833	134.085	Not used	Not used	Not used	ACC-U	Not used	Not used
134.0917	134.090	Not used	Not used	Not used	ACC-U	Not used	Not used
134.1000	134.100	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
134.1000	134.105	Not used	Not used	Not used	ACC-U	Not used	Not used
134.1083	134.110	Not used	Not used	Not used	ACC-U	Not used	Not used
134.1167	134.115	Not used	Not used	Not used	ACC-U	Not used	Not used
134.1250	134.125	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
134.1250	134.130	Not used	Not used	Not used	ACC-U	Not used	Not used
134.1333	134.135	Not used	Not used	Not used	ACC-U	Not used	Not used
134.1417	134.140	Not used	Not used	Not used	ACC-U	Not used	Not used
134.1500	134.150	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
134.1500	134.155	Not used	Not used	Not used	ACC-U	Not used	Not used
134.1583	134.160	Not used	Not used	Not used	ACC-U	Not used	Not used
134.1667	134.165	Not used	Not used	Not used	ACC-U	Not used	Not used
134.1750	134.175	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
134.1750	134.180	Not used	Not used	Not used	ACC-U	Not used	Not used
134.1833	134.185	Not used	Not used	Not used	ACC-U	Not used	Not used
134.1917	134.190	Not used	Not used	Not used	ACC-U	Not used	Not used
134.2000	134.200	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
134.2000	134.205	Not used	Not used	Not used	ACC-U	Not used	Not used
134.2083	134.210	Not used	Not used	Not used	ACC-U	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
134.2167	134.215	Not used	Not used	Not used	ACC-U	Not used	Not used
134.2250	134.225	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
134.2250	134.230	Not used	Not used	Not used	ACC-U	Not used	Not used
134.2333	134.235	Not used	Not used	Not used	ACC-U	Not used	Not used
134.2417	134.240	Not used	Not used	Not used	ACC-U	Not used	Not used
134.2500	134.250	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
134.2500	134.255	Not used	Not used	Not used	ACC-U	Not used	Not used
134.2583	134.260	Not used	Not used	Not used	ACC-U	Not used	Not used
134.2667	134.265	Not used	Not used	Not used	ACC-U	Not used	Not used
134.2750	134.275	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
134.2750	134.280	Not used	Not used	Not used	ACC-U	Not used	Not used
134.2833	134.285	Not used	Not used	Not used	ACC-U	Not used	Not used
134.2917	134.290	Not used	Not used	Not used	ACC-U	Not used	Not used
134.3000	134.300	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
134.3000	134.305	Not used	Not used	Not used	ACC-U	Not used	Not used
134.3083	134.310	Not used	Not used	Not used	ACC-U	Not used	Not used
134.3167	134.315	Not used	Not used	Not used	ACC-U	Not used	Not used
134.3250	134.325	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
134.3250	134.330	Not used	Not used	Not used	ACC-U	Not used	Not used
134.3333	134.335	Not used	Not used	Not used	ACC-U	Not used	Not used
134.3417	134.340	Not used	Not used	Not used	ACC-U	Not used	Not used
134.3500	134.350	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
134.3500	134.355	Not used	Not used	Not used	ACC-U	Not used	Not used
134.3583	134.360	Not used	Not used	Not used	ACC-U	Not used	Not used
134.3667	134.365	Not used	Not used	Not used	ACC-U	Not used	Not used
134.3750	134.375	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
134.3750	134.380	Not used	Not used	Not used	ACC-U	Not used	Not used
134.3833	134.385	Not used	Not used	Not used	ACC-U	Not used	Not used
134.3917	134.390	Not used	Not used	Not used	ACC-U	Not used	Not used
134.4000	134.400	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
134.4000	134.405	Not used	Not used	Not used	ACC-U	Not used	Not used
134.4083	134.410	Not used	Not used	Not used	ACC-U	Not used	Not used
134.4167	134.415	Not used	Not used	Not used	ACC-U	Not used	Not used
134.4250	134.425	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
134.4250	134.430	Not used	Not used	Not used	ACC-U	Not used	Not used
134.4333	134.435	Not used	Not used	Not used	ACC-U	Not used	Not used
134.4417	134.440	Not used	Not used	Not used	ACC-U	Not used	Not used
134.4500	134.450	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
134.4500	134.455	Not used	Not used	Not used	ACC-U	Not used	Not used
134.4583	134.460	Not used	Not used	Not used	ACC-U	Not used	Not used
134.4667	134.465	Not used	Not used	Not used	ACC-U	Not used	Not used
134.4750	134.475	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
134.4750	134.480	Not used	Not used	Not used	ACC-U	Not used	Not used
134.4833	134.485	Not used	Not used	Not used	ACC-U	Not used	Not used
134.4917	134.490	Not used	Not used	Not used	ACC-U	Not used	Not used
134.5000	134.500	Not allotted	ACC-L, ACC-U	ACC	ACC-U	ACC-L, ACC-U	ACC
134.5000	134.505	Not used	Not used	Not used	ACC-U	Not used	Not used
134.5083	134.510	Not used	Not used	Not used	ACC-U	Not used	Not used
134.5167	134.515	Not used	Not used	Not used	ACC-U	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
134.5250	134.525	Not allotted	Not allotted	ACC	ACC-U	Not allotted	ACC
134.5250	134.530	Not used	Not used	Not used	ACC-U	Not used	Not used
134.5333	134.535	Not used	Not used	Not used	ACC-U	Not used	Not used
134.5417	134.540	Not used	Not used	Not used	ACC-U	Not used	Not used
134.5500	134.550	Not allotted	Not allotted	ACC	ACC-U	Not allotted	ACC
134.5500	134.555	Not used	Not used	Not used	ACC-U	Not used	Not used
134.5583	134.560	Not used	Not used	Not used	ACC-U	Not used	Not used
134.5667	134.565	Not used	Not used	Not used	ACC-U	Not used	Not used
134.5750	134.575	Not allotted	Not allotted	ACC	ACC-U	Not allotted	ACC
134.5750	134.580	Not used	Not used	Not used	ACC-U	Not used	Not used
134.5833	134.585	Not used	Not used	Not used	ACC-U	Not used	Not used
134.5917	134.590	Not used	Not used	Not used	ACC-U	Not used	Not used
134.6000	134.600	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
134.6000	134.605	Not used	Not used	Not used	ACC-U	Not used	Not used
134.6083	134.610	Not used	Not used	Not used	ACC-U	Not used	Not used
134.6167	134.615	Not used	Not used	Not used	ACC-U	Not used	Not used
134.6250	134.625	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
134.6250	134.630	Not used	Not used	Not used	ACC-U	Not used	Not used
134.6333	134.635	Not used	Not used	Not used	ACC-U	Not used	Not used
134.6417	134.640	Not used	Not used	Not used	ACC-U	Not used	Not used
134.6500	134.650	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
134.6500	134.655	Not used	Not used	Not used	ACC-U	Not used	Not used
134.6583	134.660	Not used	Not used	Not used	ACC-U	Not used	Not used
134.6667	134.665	Not used	Not used	Not used	ACC-U	Not used	Not used
134.6750	134.675	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
134.6750	134.680	Not used	Not used	Not used	ACC-U	Not used	Not used
134.6833	134.685	Not used	Not used	Not used	ACC-U	Not used	Not used
134.6917	134.690	Not used	Not used	Not used	ACC-U	Not used	Not used
134.7000	134.700	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
134.7000	134.705	Not used	Not used	Not used	ACC-U	Not used	Not used
134.7083	134.710	Not used	Not used	Not used	ACC-U	Not used	Not used
134.7167	134.715	Not used	Not used	Not used	ACC-U	Not used	Not used
134.7250	134.725	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
134.7250	134.730	Not used	Not used	Not used	ACC-U	Not used	Not used
134.7333	134.735	Not used	Not used	Not used	ACC-U	Not used	Not used
134.7417	134.740	Not used	Not used	Not used	ACC-U	Not used	Not used
134.7500	134.750	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
134.7500	134.755	Not used	Not used	Not used	ACC-U	Not used	Not used
134.7583	134.760	Not used	Not used	Not used	ACC-U	Not used	Not used
134.7667	134.765	Not used	Not used	Not used	ACC-U	Not used	Not used
134.7750	134.775	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
134.7750	134.780	Not used	Not used	Not used	ACC-U	Not used	Not used
134.7833	134.785	Not used	Not used	Not used	ACC-U	Not used	Not used
134.7917	134.790	Not used	Not used	Not used	ACC-U	Not used	Not used
134.8000	134.800	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
134.8000	134.805	Not used	Not used	Not used	ACC-U	Not used	Not used
134.8083	134.810	Not used	Not used	Not used	ACC-U	Not used	Not used
134.8167	134.815	Not used	Not used	Not used	ACC-U	Not used	Not used
134.8250	134.825	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
134.8250	134.830	Not used	Not used	Not used	ACC-U	Not used	Not used
134.8333	134.835	Not used	Not used	Not used	ACC-U	Not used	Not used
134.8417	134.840	Not used	Not used	Not used	ACC-U	Not used	Not used
134.8500	134.850	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
134.8500	134.855	Not used	Not used	Not used	ACC-U	Not used	Not used
134.8583	134.860	Not used	Not used	Not used	ACC-U	Not used	Not used
134.8667	134.865	Not used	Not used	Not used	ACC-U	Not used	Not used
134.8750	134.875	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
134.8750	134.880	Not used	Not used	Not used	ACC-U	Not used	Not used
134.8833	134.885	Not used	Not used	Not used	ACC-U	Not used	Not used
134.8917	134.890	Not used	Not used	Not used	ACC-U	Not used	Not used
134.9000	134.900	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
134.9000	134.905	Not used	Not used	Not used	ACC-U	Not used	Not used
134.9083	134.910	Not used	Not used	Not used	ACC-U	Not used	Not used
134.9167	134.915	Not used	Not used	Not used	ACC-U	Not used	Not used
134.9250	134.925	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
134.9250	134.930	Not used	Not used	Not used	ACC-U	Not used	Not used
134.9333	134.935	Not used	Not used	Not used	ACC-U	Not used	Not used
134.9417	134.940	Not used	Not used	Not used	ACC-U	Not used	Not used
134.9500	134.950	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
134.9500	134.955	Not used	Not used	Not used	ACC-U	Not used	Not used
134.9583	134.960	Not used	Not used	Not used	ACC-U	Not used	Not used
134.9667	134.965	Not used	Not used	Not used	ACC-U	Not used	Not used
134.9750	134.975	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
134.9750	134.980	Not used	Not used	Not used	ACC-U	Not used	Not used
134.9833	134.985	Not used	Not used	Not used	ACC-U	Not used	Not used
134.9917	134.990	Not used	Not used	Not used	ACC-U	Not used	Not used
135.0000	135.000	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.0000	135.005	Not used	Not used	Not used	ACC-U	Not used	Not used
135.0083	135.010	Not used	Not used	Not used	ACC-U	Not used	Not used
135.0167	135.015	Not used	Not used	Not used	ACC-U	Not used	Not used
135.0250	135.025	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.0250	135.030	Not used	Not used	Not used	ACC-U	Not used	Not used
135.0333	135.035	Not used	Not used	Not used	ACC-U	Not used	Not used
135.0417	135.040	Not used	Not used	Not used	ACC-U	Not used	Not used
135.0500	135.050	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.0500	135.055	Not used	Not used	Not used	ACC-U	Not used	Not used
135.0583	135.060	Not used	Not used	Not used	ACC-U	Not used	Not used
135.0667	135.065	Not used	Not used	Not used	ACC-U	Not used	Not used
135.0750	135.075	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.0750	135.080	Not used	Not used	Not used	ACC-U	Not used	Not used
135.0833	135.085	Not used	Not used	Not used	ACC-U	Not used	Not used
135.0917	135.090	Not used	Not used	Not used	ACC-U	Not used	Not used
135.1000	135.100	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.1000	135.105	Not used	Not used	Not used	ACC-U	Not used	Not used
135.1083	135.110	Not used	Not used	Not used	ACC-U	Not used	Not used
135.1167	135.115	Not used	Not used	Not used	ACC-U	Not used	Not used
135.1250	135.125	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.1250	135.130	Not used	Not used	Not used	ACC-U	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
135.1333	135.135	Not used	Not used	Not used	ACC-U	Not used	Not used
135.1417	135.140	Not used	Not used	Not used	ACC-U	Not used	Not used
135.1500	135.150	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.1500	135.155	Not used	Not used	Not used	ACC-U	Not used	Not used
135.1583	135.160	Not used	Not used	Not used	ACC-U	Not used	Not used
135.1667	135.165	Not used	Not used	Not used	ACC-U	Not used	Not used
135.1750	135.175	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.1750	135.180	Not used	Not used	Not used	ACC-U	Not used	Not used
135.1833	135.185	Not used	Not used	Not used	ACC-U	Not used	Not used
135.1917	135.190	Not used	Not used	Not used	ACC-U	Not used	Not used
135.2000	135.200	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.2000	135.205	Not used	Not used	Not used	ACC-U	Not used	Not used
135.2083	135.210	Not used	Not used	Not used	ACC-U	Not used	Not used
135.2167	135.215	Not used	Not used	Not used	ACC-U	Not used	Not used
135.2250	135.225	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.2250	135.230	Not used	Not used	Not used	ACC-U	Not used	Not used
135.2333	135.235	Not used	Not used	Not used	ACC-U	Not used	Not used
135.2417	135.240	Not used	Not used	Not used	ACC-U	Not used	Not used
135.2500	135.250	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.2500	135.255	Not used	Not used	Not used	ACC-U	Not used	Not used
135.2583	135.260	Not used	Not used	Not used	ACC-U	Not used	Not used
135.2667	135.265	Not used	Not used	Not used	ACC-U	Not used	Not used
135.2750	135.275	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.2750	135.280	Not used	Not used	Not used	ACC-U	Not used	Not used
135.2833	135.285	Not used	Not used	Not used	ACC-U	Not used	Not used
135.2917	135.290	Not used	Not used	Not used	ACC-U	Not used	Not used
135.3000	135.300	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.3000	135.305	Not used	Not used	Not used	ACC-U	Not used	Not used
135.3083	135.310	Not used	Not used	Not used	ACC-U	Not used	Not used
135.3167	135.315	Not used	Not used	Not used	ACC-U	Not used	Not used
135.3250	135.325	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.3250	135.330	Not used	Not used	Not used	ACC-U	Not used	Not used
135.3333	135.335	Not used	Not used	Not used	ACC-U	Not used	Not used
135.3417	135.340	Not used	Not used	Not used	ACC-U	Not used	Not used
135.3500	135.350	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.3500	135.355	Not used	Not used	Not used	ACC-U	Not used	Not used
135.3583	135.360	Not used	Not used	Not used	ACC-U	Not used	Not used
135.3667	135.365	Not used	Not used	Not used	ACC-U	Not used	Not used
135.3750	135.375	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.3750	135.380	Not used	Not used	Not used	ACC-U	Not used	Not used
135.3833	135.385	Not used	Not used	Not used	ACC-U	Not used	Not used
135.3917	135.390	Not used	Not used	Not used	ACC-U	Not used	Not used
135.4000	135.400	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.4000	135.405	Not used	Not used	Not used	ACC-U	Not used	Not used
135.4083	135.410	Not used	Not used	Not used	ACC-U	Not used	Not used
135.4167	135.415	Not used	Not used	Not used	ACC-U	Not used	Not used
135.4250	135.425	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.4250	135.430	Not used	Not used	Not used	ACC-U	Not used	Not used
135.4333	135.435	Not used	Not used	Not used	ACC-U	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
135.4417	135.440	Not used	Not used	Not used	ACC-U	Not used	Not used
135.4500	135.450	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.4500	135.455	Not used	Not used	Not used	ACC-U	Not used	Not used
135.4583	135.460	Not used	Not used	Not used	ACC-U	Not used	Not used
135.4667	135.465	Not used	Not used	Not used	ACC-U	Not used	Not used
135.4750	135.475	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.4750	135.480	Not used	Not used	Not used	ACC-U	Not used	Not used
135.4833	135.485	Not used	Not used	Not used	ACC-U	Not used	Not used
135.4917	135.490	Not used	Not used	Not used	ACC-U	Not used	Not used
135.5000	135.500	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.5000	135.505	Not used	Not used	Not used	ACC-U	Not used	Not used
135.5083	135.510	Not used	Not used	Not used	ACC-U	Not used	Not used
135.5167	135.515	Not used	Not used	Not used	ACC-U	Not used	Not used
135.5250	135.525	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.5250	135.530	Not used	Not used	Not used	ACC-U	Not used	Not used
135.5333	135.535	Not used	Not used	Not used	ACC-U	Not used	Not used
135.5417	135.540	Not used	Not used	Not used	ACC-U	Not used	Not used
135.5500	135.550	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.5500	135.555	Not used	Not used	Not used	ACC-U	Not used	Not used
135.5583	135.560	Not used	Not used	Not used	ACC-U	Not used	Not used
135.5667	135.565	Not used	Not used	Not used	ACC-U	Not used	Not used
135.5750	135.575	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.5750	135.580	Not used	Not used	Not used	ACC-U	Not used	Not used
135.5833	135.585	Not used	Not used	Not used	ACC-U	Not used	Not used
135.5917	135.590	Not used	Not used	Not used	ACC-U	Not used	Not used
135.6000	135.600	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.6000	135.605	Not used	Not used	Not used	ACC-U	Not used	Not used
135.6083	135.610	Not used	Not used	Not used	ACC-U	Not used	Not used
135.6167	135.615	Not used	Not used	Not used	ACC-U	Not used	Not used
135.6250	135.625	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.6250	135.630	Not used	Not used	Not used	ACC-U	Not used	Not used
135.6333	135.635	Not used	Not used	Not used	ACC-U	Not used	Not used
135.6417	135.640	Not used	Not used	Not used	ACC-U	Not used	Not used
135.6500	135.650	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.6500	135.655	Not used	Not used	Not used	ACC-U	Not used	Not used
135.6583	135.660	Not used	Not used	Not used	ACC-U	Not used	Not used
135.6667	135.665	Not used	Not used	Not used	ACC-U	Not used	Not used
135.6750	135.675	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.6750	135.680	Not used	Not used	Not used	ACC-U	Not used	Not used
135.6833	135.685	Not used	Not used	Not used	ACC-U	Not used	Not used
135.6917	135.690	Not used	Not used	Not used	ACC-U	Not used	Not used
135.7000	135.700	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.7000	135.705	Not used	Not used	Not used	ACC-U	Not used	Not used
135.7083	135.710	Not used	Not used	Not used	ACC-U	Not used	Not used
135.7167	135.715	Not used	Not used	Not used	ACC-U	Not used	Not used
135.7250	135.725	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.7250	135.730	Not used	Not used	Not used	ACC-U	Not used	Not used
135.7333	135.735	Not used	Not used	Not used	ACC-U	Not used	Not used
135.7417	135.740	Not used	Not used	Not used	ACC-U	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
135.7500	135.750	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.7500	135.755	Not used	Not used	Not used	ACC-U	Not used	Not used
135.7583	135.760	Not used	Not used	Not used	ACC-U	Not used	Not used
135.7667	135.765	Not used	Not used	Not used	ACC-U	Not used	Not used
135.7750	135.775	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.7750	135.780	Not used	Not used	Not used	ACC-U	Not used	Not used
135.7833	135.785	Not used	Not used	Not used	ACC-U	Not used	Not used
135.7917	135.790	Not used	Not used	Not used	ACC-U	Not used	Not used
135.8000	135.800	Not allotted	FIS-U (GPS)	ACC	ACC-U	FIS-U (GPS)	ACC
135.8000	135.805	Not used	Not used	Not used	ACC-U	Not used	Not used
135.8083	135.810	Not used	Not used	Not used	ACC-U	Not used	Not used
135.8167	135.815	Not used	Not used	Not used	ACC-U	Not used	Not used
135.8250	135.825	Not allotted	Not allotted	ACC	ACC-U	Not allotted	ACC
135.8250	135.830	Not used	Not used	Not used	ACC-U	Not used	Not used
135.8333	135.835	Not used	Not used	Not used	ACC-U	Not used	Not used
135.8417	135.840	Not used	Not used	Not used	ACC-U	Not used	Not used
135.8500	135.850	Not allotted	Not allotted	ACC	ACC-U	Not allotted	ACC
135.8500	135.855	Not used	Not used	Not used	ACC-U	Not used	Not used
135.8583	135.860	Not used	Not used	Not used	ACC-U	Not used	Not used
135.8667	135.865	Not used	Not used	Not used	ACC-U	Not used	Not used
135.8750	135.875	Not allotted	Not allotted	ACC	ACC-U	Not allotted	ACC
135.8750	135.880	Not used	Not used	Not used	ACC-U	Not used	Not used
135.8833	135.885	Not used	Not used	Not used	ACC-U	Not used	Not used
135.8917	135.890	Not used	Not used	Not used	ACC-U	Not used	Not used
135.9000	135.900	Not allotted	Not allotted	ACC	ACC-U	Not allotted	ACC
135.9000	135.905	Not used	Not used	Not used	ACC-U	Not used	Not used
135.9083	135.910	Not used	Not used	Not used	ACC-U	Not used	Not used
135.9167	135.915	Not used	Not used	Not used	ACC-U	Not used	Not used
135.9250	135.925	Not allotted	Not allotted	ACC	ACC-U	Not allotted	ACC
135.9250	135.930	Not used	Not used	Not used	ACC-U	Not used	Not used
135.9333	135.935	Not used	Not used	Not used	ACC-U	Not used	Not used
135.9417	135.940	Not used	Not used	Not used	ACC-U	Not used	Not used
135.9500	135.950	Not allotted	Not allotted	ACC	ACC-U	Not allotted	ACC
135.9500	135.955	Not used	Not used	Not used	ACC-U	Not used	Not used
135.9583	135.960	Not used	Not used	Not used	ACC-U	Not used	Not used
135.9667	135.965	Not used	Not used	Not used	ACC-U	Not used	Not used
135.9750	135.975	Not allotted	Not allotted	Not allotted	ACC-U	Not allotted	Not allotted
135.9750	135.980	Not used	Not used	Not used	ACC-U	Not used	Not used
135.9833	135.985	Not used	Not used	Not used	ACC-U	Not used	Not used
135.9917	135.990	Not used	Not used	Not used	ACC-U	Not used	Not used
136.0000	136.000	Not allotted	VDL	Not allotted	Not allotted	Not allotted	Not allotted
136.0000	136.005	Not used	Not used	Not used	Not allotted	Not used	Not used
136.0083	136.010	Not used	Not used	Not used	Not allotted	Not used	Not used
136.0167	136.015	Not used	Not used	Not used	Not allotted	Not used	Not used
136.0250	136.025	Not allotted	VDL	Not allotted	Not allotted	Not allotted	Not allotted
136.0250	136.030	Not used	Not used	Not used	Not allotted	Not used	Not used
136.0333	136.035	Not used	Not used	Not used	Not allotted	Not used	Not used
136.0417	136.040	Not used	Not used	Not used	Not allotted	Not used	Not used
136.0500	136.050	Not allotted	VDL	Not allotted	Not allotted	Not allotted	Not allotted

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
136.0500	136.055	Not used	Not used	Not used	Not allotted	Not used	Not used
136.0583	136.060	Not used	Not used	Not used	Not allotted	Not used	Not used
136.0667	136.065	Not used	Not used	Not used	Not allotted	Not used	Not used
136.0750	136.075	Not allotted	VDL	Not allotted	Not allotted	Not allotted	Not allotted
136.0750	136.080	Not used	Not used	Not used	Not allotted	Not used	Not used
136.0833	136.085	Not used	Not used	Not used	Not allotted	Not used	Not used
136.0917	136.090	Not used	Not used	Not used	Not allotted	Not used	Not used
136.1000	136.100	Not allotted	VDL	Not allotted	Not allotted	Not allotted	Not allotted
136.1000	136.105	Not used	Not used	Not used	Not allotted	Not used	Not used
136.1083	136.110	Not used	Not used	Not used	Not allotted	Not used	Not used
136.1167	136.115	Not used	Not used	Not used	Not allotted	Not used	Not used
136.1250	136.125	Not allotted	VDL	Not allotted	Not allotted	Not allotted	Not allotted
136.1250	136.130	Not used	Not used	Not used	Not allotted	Not used	Not used
136.1333	136.135	Not used	Not used	Not used	Not allotted	Not used	Not used
136.1417	136.140	Not used	Not used	Not used	Not allotted	Not used	Not used
136.1500	136.150	Not allotted	VDL	Not allotted	Not allotted	Not allotted	Not allotted
136.1500	136.155	Not used	Not used	Not used	Not allotted	Not used	Not used
136.1583	136.160	Not used	Not used	Not used	Not allotted	Not used	Not used
136.1667	136.165	Not used	Not used	Not used	Not allotted	Not used	Not used
136.1750	136.175	Not allotted	VDL	Not allotted	Not allotted	Not allotted	Not allotted
136.1750	136.180	Not used	Not used	Not used	Not allotted	Not used	Not used
136.1833	136.185	Not used	Not used	Not used	Not allotted	Not used	Not used
136.1917	136.190	Not used	Not used	Not used	Not allotted	Not used	Not used
136.2000	136.200	Not allotted	VDL	Not allotted	Not allotted	Not allotted	Not allotted
136.2000	136.205	Not used	Not used	Not used	Not allotted	Not used	Not used
136.2083	136.210	Not used	Not used	Not used	Not allotted	Not used	Not used
136.2167	136.215	Not used	Not used	Not used	Not allotted	Not used	Not used
136.2250	136.225	Not allotted	VDL	Not allotted	Not allotted	Not allotted	Not allotted
136.2250	136.230	Not used	Not used	Not used	Not allotted	Not used	Not used
136.2333	136.235	Not used	Not used	Not used	Not allotted	Not used	Not used
136.2417	136.240	Not used	Not used	Not used	Not allotted	Not used	Not used
136.2500	136.250	Not allotted	VDL	Not allotted	Not allotted	Not allotted	Not allotted
136.2500	136.255	Not used	Not used	Not used	Not allotted	Not used	Not used
136.2583	136.260	Not used	Not used	Not used	Not allotted	Not used	Not used
136.2667	136.265	Not used	Not used	Not used	Not allotted	Not used	Not used
136.2750	136.275	Not allotted	VDL	Not allotted	Not allotted	Not allotted	Not allotted
136.2750	136.280	Not used	Not used	Not used	Not allotted	Not used	Not used
136.2833	136.285	Not used	Not used	Not used	Not allotted	Not used	Not used
136.2917	136.290	Not used	Not used	Not used	Not allotted	Not used	Not used
136.3000	136.300	Not allotted	VDL	Not allotted	Not allotted	Not allotted	Not allotted
136.3000	136.305	Not used	Not used	Not used	Not allotted	Not used	Not used
136.3083	136.310	Not used	Not used	Not used	Not allotted	Not used	Not used
136.3167	136.315	Not used	Not used	Not used	Not allotted	Not used	Not used
136.3250	136.325	Not allotted	VDL	Not allotted	Not allotted	Not allotted	Not allotted
136.3250	136.330	Not used	Not used	Not used	Not allotted	Not used	Not used
136.3333	136.335	Not used	Not used	Not used	Not allotted	Not used	Not used
136.3417	136.340	Not used	Not used	Not used	Not allotted	Not used	Not used
136.3500	136.350	Not allotted	VDL	Not allotted	Not allotted	Not allotted	Not allotted
136.3500	136.355	Not used	Not used	Not used	Not allotted	Not used	Not used

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
136.3583	136.360	Not used	Not used	Not used	Not allotted	Not used	Not used
136.3667	136.365	Not used	Not used	Not used	Not allotted	Not used	Not used
136.3750	136.375	Not allotted	VDL	Not allotted	Not allotted	Not allotted	Not allotted
136.3750	136.380	Not used	Not used	Not used	Not allotted	Not used	Not used
136.3833	136.385	Not used	Not used	Not used	Not allotted	Not used	Not used
136.3917	136.390	Not used	Not used	Not used	Not allotted	Not used	Not used
136.4000	136.400	Not allotted	VDL	Not allotted	Not allotted	Not allotted	Not allotted
136.4000	136.405	Not used	Not used	Not used	Not allotted	Not used	Not used
136.4083	136.410	Not used	Not used	Not used	Not allotted	Not used	Not used
136.4167	136.415	Not used	Not used	Not used	Not allotted	Not used	Not used
136.4250	136.425	Not allotted	VDL	Not allotted	Not allotted	Not allotted	Not allotted
136.4250	136.430	Not used	Not used	Not used	Not allotted	Not used	Not used
136.4333	136.435	Not used	Not used	Not used	Not allotted	Not used	Not used
136.4417	136.440	Not used	Not used	Not used	Not allotted	Not used	Not used
136.4500	136.450	Not allotted	VDL	Not allotted	Not allotted	Not allotted	Not allotted
136.4500	136.455	Not used	Not used	Not used	Not allotted	Not used	Not used
136.4583	136.460	Not used	Not used	Not used	Not allotted	Not used	Not used
136.4667	136.465	Not used	Not used	Not used	Not allotted	Not used	Not used
136.4750	136.475	Not allotted	VDL	Not allotted	Not allotted	Not allotted	Not allotted
136.4750	136.480	Not used	Not used	Not used	Not allotted	Not used	Not used
136.4833	136.485	Not used	Not used	Not used	Not allotted	Not used	Not used
136.4917	136.490	Not used	Not used	Not used	Not allotted	Not used	Not used
136.5000	136.500	Not allotted	VDL	Not allotted	Not allotted	Not allotted	Not allotted
136.5000	136.505	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.5083	136.510	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.5167	136.515	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.5250	136.525	Not allotted	VDL	Not allotted	VDL	Not allotted	Not allotted
136.5250	136.530	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.5333	136.535	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.5417	136.540	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.5500	136.550	Not allotted	VDL	Not allotted	VDL	Not allotted	Not allotted
136.5500	136.555	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.5583	136.560	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.5667	136.565	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.5750	136.575	Not allotted	VDL	Not allotted	VDL	Not allotted	Not allotted
136.5750	136.580	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.5833	136.585	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.5917	136.590	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.6000	136.600	Not allotted	VDL	Not allotted	VDL	Not allotted	Not allotted
136.6000	136.605	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.6083	136.610	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.6167	136.615	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.6250	136.625	Not allotted	VDL	Not allotted	VDL	Not allotted	Not allotted
136.6250	136.630	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.6333	136.635	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.6417	136.640	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.6500	136.650	Not allotted	VDL	Not allotted	VDL	Not allotted	Not allotted
136.6500	136.655	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.6583	136.660	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
136.6667	136.665	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.6750	136.675	Not allotted	VDL	Not allotted	VDL	Not allotted	Not allotted
136.6750	136.680	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.6833	136.685	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.6917	136.690	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.7000	136.700	Not allotted	VDL	Not allotted	VDL	Not allotted	Not allotted
136.7000	136.705	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.7083	136.710	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.7167	136.715	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.7250	136.725	Not allotted	VDL	Not allotted	VDL	Not allotted	Not allotted
136.7250	136.730	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.7333	136.735	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.7417	136.740	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.7500	136.750	Not allotted	VDL	Not allotted	VDL	Not allotted	Not allotted
136.7500	136.755	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.7583	136.760	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.7667	136.765	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.7750	136.775	Not allotted	VDL	Not allotted	VDL	Not allotted	Not allotted
136.7750	136.780	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.7833	136.785	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.7917	136.790	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.8000	136.800	Not allotted	VDL	Not allotted	VDL	Not allotted	Not allotted
136.8000	136.805	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.8083	136.810	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.8167	136.815	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.8250	136.825	Not allotted	VDL	Not allotted	VDL	Not allotted	Not allotted
136.8250	136.830	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.8333	136.835	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.8417	136.840	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.8500	136.850	Not allotted	VDL	Not allotted	VDL	Not allotted	Not allotted
136.8500	136.855	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.8583	136.860	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.8667	136.865	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.8750	136.875	Not allotted	VDL	Not allotted	VDL	Not allotted	Not allotted
136.8750	136.880	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.8833	136.885	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.8917	136.890	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.9000	136.900	VDL	VDL	VDL	VDL	VDL	VDL
136.9000	136.905	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.9083	136.910	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.9167	136.915	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.9250	136.925	VDL	VDL	VDL	VDL	VDL	VDL
136.9250	136.930	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.9333	136.935	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.9417	136.940	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.9500	136.950	VDL	VDL	VDL	VDL	VDL	VDL
136.9500	136.955	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.9583	136.960	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.9667	136.965	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked

Frequency	Channel	AFI	APAC	CAR	EUR	MID	SAM
136.9750	136.975	VDL	VDL	VDL	VDL	VDL	VDL
136.9750	136.980	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.9833	136.985	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
136.9917	136.990	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked
137.0000	137.000	Blocked	Blocked	Blocked	Blocked	Blocked	Blocked

CNS/ATM Implementation Planning Matrix

(Updated in July 2011)

				Navigation*					
State/Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**En-route**	**Terminal**	**Approach**	**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
AFGHANISTAN									
AUSTRALIA	ATN tests were conducted. BIS Router and Backbone BIS Router and AMHS implemented.	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		A total of 29 UAP and 14 WAM stations are used to provide a 5 Nm separation service and operational. ADS-B mandate applies from 12/2013 at and above FL290. Mandates for additional flight level are considered for 2015 & 2017. WAM operating in Tasmania. Commissioned in 2010. WAM being installed in Sydney to provide 3 Nm separation service and PRM which is expected to be operational 2011. ADS-B data sharing with Indonesia operational since 2/2011.	FANS 1/A ADS-C implemented.	

				Navigation*					
State/Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**En-route**	**Terminal**	**Approach**	**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
AUSTRALIA (Cont'd)							ASMGCS using multilateration operational in Melbourne & Sydney in 2010. Brisbane and Perth being installed.		
BANGLADESH	BIS Router and AMHS planned for 2011.	AIDC between Dhaka and CTG, Dhaka and Sylhet planned for 2011.		Not yet planned	Not yet planned		Not yet planned	Not yet planned	
BHUTAN	ATN BIS Router and UA service 2011.					Procedures developed for NPA.			
BRUNEI DARUSSALAM	ATN BIS Router planned for 2012 and AMHS planned for 2012.								
CAMBODIA	BIS Router and AMHS planned for 2011.	Planned 2009	Planned 2009			Procedure developed for NPA.			

				Navigation*					
State/Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**En-route**	**Terminal**	**Approach**	**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
CHINA	ATN Router and AMHS deployed in 2008. Tripartite BBIS trial completed with Bangkok and Hong Kong, China in Jan. 2003. ATN trial with Hong Kong using XOT over internet conducted in 2006, Further trials planned in 2009. AMHS/ATN technical tests with Macau completed in 2009. ATN/AMHS tests with ROK completed in 2010. ATN/AMHS tests with India are on-going. ATN/AMHS tests with Hong Kong, China planned in 2011.	AIDC between some of ACCs within China has been implemented. AIDC between several other ACCs are being implemented. AIDC between Sanya and Hong Kong put in to operational use in Feb 2007. AIDC between Qingdao and Incheon planned for 2013.	Implemented to ATS Rout. L888 route, Trial on HF data link conducted for use in western China.	Implemented in certain airspace. L888, Y1 and Y2 routes.	RNAV (GNSS) implemented in certain airports. Beijing, Guangzhou, Tianjin.	Ali, Linzhi and Lhasa airports	5 UAT ADS-B sites are used for flight training of CAFUC. Chengdu-Jiuzhai project finished in 2008 with 2 ADS-B stations and additional site is planned to enhance the surveillance coverage. Chengdu - Lhasa route surveillance project completed with 5 ADS-B stations using 1090ES since 2010. Trials planned from May 2011. 1 ADS-B site installed in Sanya FIR since 2008. 3 additional ground stations planned, Trial planned for Jun, 2011.	FANS 1/A based ADS-C implemented. L888 route.	

				Navigation*					
State/Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**En-route**	**Terminal**	**Approach**	**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
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. Preliminary ATN/AMHS technical trials with China (Beijing) using VPN over Internet connection conducted in September 2006. Operational AMHS commissioned in July2009. ATN/AMHS circuit with Macao put into operational use in Dec. 2009. ATN/AMHS interoperability tests with other adjacent communications centres commenced in late 2009, viz Taibei (2009), Beijing (2010), Japan (2012) AMHS trial with Philippines in late 2010. ATN/AMHS into operation in end 2009.	AFTN-based AIDC with Sanya put into operational use in February 2007. AIDC trial with other adjacent ATS authorities for new ATC system to be commissioned by 2013. AIDC technical trial with Taibei conducted in 2010. AIDC technical trial with Philippines to be undertaken by end 2011.	FANS 1/A based CPDLC trials completed in 2002. VDL Mode-2 technical trial conducted in 2002. D-ATIS, D-VOLMET and 1-way PDC implemented in 2001. PDC service upgraded to 2-way data link in June 2008.	Implemented in certain airspace	Implemented in certain airspace	RNAV (GNSS) departure procedures implemented in July 2005. RNP AR APCH procedures for 07L/25R runways implemented in June 2010.	A larger-scale A-SMGCS covering the whole Hong Kong International Airport put into operational use in April 2009. Data collection/ analysis on aircraft ADS-B equipage in Hong Kong airspace conducted on quarterly basis since 2004. ADS-B trial using a dedicated ADS-B system completed in 2007. ADS-B out operations over PBN routes L642 and M771 at or above FL 290 within HK FIR are planned in December 2013 and within HK FIR at or above FL 290 in December 2014 ADS-B trial using ADS-B signal provided	FANS 1A trials for ADS-C completed in 2002.	

				Navigation*					
State/Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**En-route**	**Terminal**	**Approach**	**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
							by Mainland China to cover southern part of Hong Kong FIR commenced in 2010.		
MACAO, CHINA	ATN/AMHS interoperability test with Beijing commenced in March 2009. ATN/AMHS circuit with Hong Kong put into operational use in end Dec 2009.								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	The ATN BIS Router and AMHS to be implemented in 2011.	With neighboring ACCs to be implemented TBD		Implemented in certain ATS routes G711, B467		RNAV (GNSS) Non-precision approach to be implemented in 2011.	ADS-B has been used as back-up surveillance of SSR since 2008.		
FIJI	ATN BIS Router and AMHS implementation by 4th quarter 2010.	AFTN based AIDC implemented between Nadi, Brisbane, Auckland and Oakland.	Implemented and integrated with ATM systems to support FANS1/A equipped aircraft.	Implemented		Implemented	ADS- B /multilateration ground stations installed. Surveillance service will be provided starting from end of 2012	FANS 1/A ADS-C implemented.	

				Navigation*					
State/Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**En-route**	**Terminal**	**Approach**	**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
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	MUMBAI – SINGAPORE – BBIS – Circuit Implemented MUMBAI – PAKISTAN – BIS – Operational Trial Completed MUMBAI – CHINA – BBIS – Under operational trials MUMBAI – OMAN – BIS -Presently AFTN over TCP/IP MUMBAI – THAILAND – BBIS -Awaiting readiness from Thailand MUMBAI AMHS – Commissioned in APRIL 2011	AIDC with Dhaka /Muscat – TBD Mumbai/Karachi under trial operations	FANS-1 implemented at Kolkata, Chennai, Mumbai and Delhi.	SBAS (GAGAN project) likely to operational in the year 2013	PBN based SIDs & STARS implemented at Delhi, Mumbai, Chennai, Ahmadabad, Hyderabad and Kolkata		ASMGCS with MLAT commissioned at Delhi, Hyderabad and Bangalore Mumbai and Chennai ASMGCS installed	FANS 1/A ADS-C implemented at Kolkata, Chennai, Delhi and Mumbai.	

				Navigation*					
State/Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**En-route**	**Terminal**	**Approach**	**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
INDONESIA	ATN BIS Router and AMHS planned for trial in 2009. Trial with Singapore planned. ATNBIS Router and AMHS are still on going trial with Singapore planned to complete by 2012. (Part D: AMHS Commission)	Brisbane and Makassar in planned in June 2009. Makasar and Brisbane is still on going trial AIDC, planned operational in 2011	FANS-1/A. CPDLC in Ujung Pandang FIRs already trial start from 2008 and will be implemented in 2009. FANS-1/A CPDLC in Ujung Pandang FIRs is completely trial operational and will be full operational for designated route on September 2010.				30 Ground Station successfully installed. Since 2009, ATC Automation in MATSC has capabilities to support ADS-B application. ADS-B Task Force team established to develop planning and action concerning ADS-B Implementation within Indonesia FIR	FANS-1/A ADS-C trial planned at Jakarta and Ujung Pandang ACC in 2007. FANS-1/A ADS-C in Ujung Pandang FIRs is completely trial operational and will be full operational in September 2010.	
JAPAN	ATN BBIS router and AMHS installed at 2000. Connection tests with USA 2000 - 2004 and put into operational use in 2005. Connection test with Taibei 2008 - 2009. Connection tests with Australia, China, Hong Kong, Singapore, Republic of Korea, Europe and Russian Federation is TBD	AFTN based AIDC implemented with Oakland, Anchorage and Incheon. Planned between Fukoka ATMC and Taibei ACC for 2012.	FANS1/A system Implemented in Fukuoka FIR.	SBAS implemented RNAV5 implemented.	RNAV1 implemented	RNP Approach implemented	Two Multilateration Systems have been implemented at Narita and Haneda airports.	FANS 1/A. ADS-C implemented in Fukuoka FIR.	

				Navigation*					
State/Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**En-route**	**Terminal**	**Approach**	**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
KIRIBATI									
LAO PDR	ATN BIS Router and AMHS completed planned for implementation with Bangkok in 2010.	AIDC with Bangkok planned for 2010.		Implemented. Planned for 2011.					
MALAYSIA	ATN BIS Router completed 2007. AMHS planned in 2012.	AFTN AIDC planned with Bangkok ACC - TBD	On trial since July 2008. On 7 oceanic ATS routes i.e. P628, L510, L645, L627, N571, B466 and P574 within the Kuala Lumpur FIR.	Implemented for Oceanic Routes.	Basic RNAV implemented		Malaysia planned to start mandate ADS-B requirement in KL FIR in 2018 and ADS-B implementation on 2020. Implementation of ADS-B proposed in 2010 - 2015.	FANS 1/A ADS-C already implemented for Bay of Bengal area. Implemented since July 2008 on 7 oceanic ATS routes within KL FIR.	
MALDIVES	Implementation planned for 2012.	Planned for 2012.	FANS1/A installed, system on trial.	Planned for 2012	PBN based SIDS and STARS implemented.	RNP approach implemented at Male' International Airport.	Planned for 2013.	Implemented since 2008.	
MARSHALL ISLANDS						NPA implemented at Majuro Atoll.			
MICRONESIA (EDERATED STATES OF)									
Chuuk				Implemented					

				Navigation*					
State/Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**En-route**	**Terminal**	**Approach**	**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
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.		ADS-B trial in progress implementation planned for 2006.	FANS 1/A ADS-C implemented since August 1998.	
MYANMAR	Implementation of AMHS to be completed by the end of 2011.	The capability of ATM Automation system to support AIDC by 2011	Implemented since August 1998.				A plan to implement ADS-B by 2011	Implemented since August 1998.	
NAURU									
NEPAL	BIS Router and AMHS planned for 2011.	AFTN/AMHS based AIDC between KTM-CAL, KTM-BAN, KTM-LHASA planned for 2011.			GPS departure and approach has been developed for 8 airports and planned for implementation in 2008.		ADS-B feasibility study planned for 2007.		

				Navigation*					
State/Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**En-route**	**Terminal**	**Approach**	**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
NEW CALEDONIA							Three ADS-B ground stations commissioned in 2010 to cover international traffic at La tontouta airport serving Tontouta ACC & APP. It is used for Situation awareness and SAR.		
NEW ZEALAND	AMHS implementation planned for 2012 using IPS links.	AFTN based AIDC implemented between New Zealand, Australia, Fiji, Tahiti, Chile and USA.	FANS-1/A. Implemented	Will be implemented as required.	RNAV procedures being implemented as developed.	RNP AR APCH implemented at Queenstown (NZQN).	MLAT being used in Queenstown (NZQN) and Aukland (airport surface movements).	FANS 1/A Implemented	
PAKISTAN	ATN/AMHS considered as Phase II implemented since 2010.	Implemented between Karachi and Lahore ACCs Plan to implement AIDC with Mumbai and Muscat for December 2010	Implementation planned from 2005-2010.	Planned for 2005-2010.	RNAV arrival and departure procedure being developed.	NPA (RNP) procedure are being developed and under flight inspection.	Feasibility study for using ADS-B is in hand. One station was installed at ACC Karachi and evaluation is in progress.	Planned for 2005-2010.	Existing Radar system being upgraded.

				Navigation*					
State/Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**En-route**	**Terminal**	**Approach**	**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
PAPUA NEW GUINEA	Plans to create a newly duplicated digital communications line connecting with existing and new sites and replacing AFTN switch with a AMHS before 2015	Implemented with Australia in April 2011	Plans for new ATM system supporting CPDLC by 2015	Implemented	GNSS based RNAV procedures have been developed by for five airports.	GNSS NPA approach implemented at 22 aerodromes.	Legislation mandating ADS-B and guidelines for aircraft equipage and operational approval to be issued by 31/12/2011 with target mandatory date by mid-2015 and plans to provide ADS-B service above FL245 within Port Moresby FIR and also in specific higher traffic areas domestically.	Plans for new ATM system with ADS-C within UTA airspace by 2015	
PHILIPPINES	ATN G/G BIS Router/AMHS implemented in 2006. AMHS trials with Singapore by end 2012 and Hong Kong planned in 2012.	Planned for 2013.	CPDLC Planned for 2011. Trials on-going.	New ACC on test.	RNAV routes of MLA. MACTAN for FLT validation.		Two ground stations scheduled for implementation in 2013.	FANS 1/A ADS-C planned for 2013.	

				Navigation*					
State/Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**En-route**	**Terminal**	**Approach**	**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
REPUBLIC OF KOREA	ATN/AMHS circuit with China put into operational use in June 2011. ATN/AMHS test with Japan to be conducted	AFTN based AIDC implemented between ACC and Fukuoka ATMC. AIDC between Incheon and Qingdao to be implemented.	PDC & D-ATIS implemented 2003.	Two RNAV5 routes were implemented in 2011. More RNAV5/2 routes will be implemented gradually.	RNAV1 SID/STAR were partially implemented at GIMPO and INCHEON airports. More SIDs/STARs will be implemented gradually	RNP approaches with Baro were implemented at GIMPO airport in 2011. More RNP approaches with Baro will be implemented gradually	ADS-B implemented 2008 for SMC in Incheon International Airport.	FANS 1/A based ADS-C implemented since 2003 for contingency purpose.	
SINGAPORE	AMHS implemented. ATN Router trial with Malaysia completed in 2007 On-going ATN/AMHS trial with Indonesia and planned to complete by 2012. ATN/AMHS circuit with India put into operational use in Mar 2011. Coordinating with Thailand on ATN/AMHS trial in Q3-Q4 2011. Coordinating with UK on ATN/AMHS trial using VPN over internet in Q4 2011.	AFTN based AIDC to be implemented	Implemented since 1997. Integrated in the ATC system in 1999.		RNAV SIDS and STARS implemented in 2006.	NPA Procedure implemented in 2005.	The airport M-lat system was installed in 2007 and “far-range” ADS-B sensor was installed in 2009.	FANS 1/A ADS-C implemented since 1997. Integrated with ATC system in 1999.	

				Navigation*					
State/Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**En-route**	**Terminal**	**Approach**	**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
SRI LANKA	ATN BIS Router Planned for 2013. AMHS (Domestic) and AMHS/AFTN Gateway to be implemented by Oct. 2011.	Trials with Male' planned in 2013.	Implemented (FANS 1/A based)	14RNAV10 routes already established. 05 RNAV5 routes to be established in 2013. Upgrade airspace above FL225 to RNAV10 and introduce RNP4 routes in a phased manner within 2013-2016.	GNSS based RNAV-1 SIDS and STARS trials being conducted. To be implemented in a phased manner within 2013-2016.	Introduction of RNP APCH (with Baro-VNAV) in a phased manner with 2013-2016. GNSS based Precision Approaches planned beyond 2016.	ADS-B Trials planned for 2012 and implementation in 2013.	Implemented (FANS 1/A based) .	Information pertaining to Navigation are based on the PBN Implementa tion plan of Sri Lanka .
THAILAND	BBIS/BIS Routers already implemented. Target date for AMHS in Q2-2012. Coordinating with Singapore on ATN/AMHS trial in Q3-Q4 2011.	AFTN based AIDC planned for TBD. (as a part of new ATM system)	FANS-1/A Implemented.	Under implementation	Implemented at Phuket Airport	Implemented at Phuket	Multilateration implemented in 2006 at Suvarnbhumi Int'l. Airport. ADS-B is planned to be part of future surveillance infrastructure.	FANS 1/A ADS-C Implemented.	
TONGA	AMHS planned for 2008.					NPA planned for 2007.	Trial planned for 2012		CPDLC and ADS-C is not considered for lower airspace
UNITED STATES	AMHS implemented. (Salt Lake City & Atlanta)	AFTN based AIDC implemented.	FANS-1/A based CPDLC implemented.	Implemented	Implemented		Status as of March 31, 2011 81 Radio Stations under construction or in Final Design	Implemented	

				Navigation*					
State/Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**En-route**	**Terminal**	**Approach**	**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
							(77 in CONUS; 4 in AK) 342 Radio Stations constructed (313 in CONUS; 29 in Alaska) 326 Radio Stations Reporting on the SBS Network (297 in CONUS; 29 in AK) 275 Operational Radio Stations WAM implemented in areas of Colorado for 5nm separation services and coming to Juneau in 2011		
VANUATU									
VIET NAM	BIS Routers planned for 2009. ATN/AMHS trial in 2010 and operation in 2012.	AFTN based AIDC implemented in 2009. Trial for ATN based AIDC planned in 2010.	CPDLC operational trial conducted in early 2007.	For en-route TBD.	RNAV		TBD	FANS 1/A ADS-C operational trial conducted for oceanic area of Ho Chi Minh FIR since March 2002.	

* Navigation – Navigation including Performance Based Navigation (PBN), APV and precision approach

DRAFT TERMS OF REFERENCE

Ad Hoc Working Group on Review of Performance based
Communications and Surveillance Compliance Requirements

1. Define the issue: - the need to ensure that the required communications and surveillance standards are continuously in place to support a separation standard

2. Examine the current methods in place to ensure Communication and Surveillance standards are being met and develop compliance requirements if these are not being achieved:

   a. Strategic requirements
   b. Tactical requirements – technical – i.e. maximum time for com/aircraft systems failures/ATS provider failures

3. Examine methods to report non compliance:

   a. Strategic non compliance, and
   b. Tactical non compliance by:
      a. Service providers
      b. Aircraft
      c. ATS

4. Examine the education requirements to support Communication and Surveillance components of separation standards and the agreed compliance methodology.

5. Examine implementation procedures needed to support outcomes from 1-4.

6. Examine review techniques needed to ensure that TLS requirements for COM/SUR supported separation standards are being met.

7. This review should include CPDLC, ADS-C, HF and Sat Com Voice (SCV).

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Part IV

COMMUNICATIONS, NAVIGATION AND SURVEILLANCE (CNS)

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 communications, navigation and surveillance (CNS) 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 IV constitutes the stable guidance material considered to be the minimum necessary for effective planning of CNS 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 fulfil the requirements of the plan is contained in the ASIA/PAC Facilities and Services Implementation Document (FASID). During the transition and pending full implemen~~-~~tation 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 system-related requirements. Further, it is expected that some elements of 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 10 — *Aeronautical Telecommunications*, Volumes I, II, III, IV and V;

b) Annex 11 — *Air Traffic Services*; and

c) *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) on Agenda Items 10, 11 and 12.

5. The elements of the material referred to above are presented in the following paragraphs with appropriate cross-references to recommendations and/or conclusions of ASIA/PAC/3 and ~~regional planning groups~~Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG).

COMMUNICATIONS

General

6. The plan and details of the operational requirements for communications are contained in Tables CNS 1A, CNS 1B, CNS 1C, CNS 1D, CNS 1E, CNS 2, CNS 3, CNS 4A and CNS 4B, and associated charts in Part IV of the FASID.

Ground-ground communications

Aeronautical fixed service (AFS)

7. The aeronautical fixed service comprises of:

a) the aeronautical fixed telecommunication network (AFTN);

b) data communications subnetworks and associated systems supporting the ground-ground applications of the aeronautical telecommunication network (ATN), namely the ATS message handling services (ATS MHS) and ATS inter-facility data communications (AIDC);

c) ATS direct speech circuits; and

d) meteorological operation circuits, networks and broadcast systems.

Aeronautical fixed telecommunication network (AFTN)

8. States should ensure that telecommunication agencies engaged in providing aeronautical circuits be impressed of the need for:

a) high reliability terrestrial links connecting aeronautical facilities and common carrier terminals inclusive of priority restoration of service commensurate with the requirements of a safety service; and

b) rapid restoration of circuits in the event of breakdown.
[ASIA/PAC/3, Conc. 10/1]

9. States operating AFTN circuits which do not function satisfactorily 97 per cent of the time during which the circuit is scheduled to be in operation, should exchange monthly circuit performance charts on the form provided in Attachment A. Where a circuit consistently achieves 97 per cent reliability, the exchange of performance charts may cease. The circuit performance charts should be exchanged directly between the correspondent stations, with copies to the administrations concerned and to the ICAO Regional Office. States should also identify the causes for inadequate circuit performance and take necessary remedial measures.
[ASIA/PAC/3, Conc. 10/2]

10. States responsible for the operation of AFTN circuits which are not adequately meeting transit time requirements should record transit time statistics on the twenty-third day of each third month (January, April, July and October) of each year, in accordance with the existing practices, for the AFTN circuits and terminals under their jurisdiction which do not meet the specified transit time criteria. The data recorded should be exchanged directly between the correspondent stations, with copies to administrations concerned and to the ICAO Regional Office.
[ASIA/PAC/3, Conc.10/3]

10.1 States operating AFTN circuits may exchange circuit loading statistics only for those circuits where occupancy level exceed permissible levels specified in the Manual on Planning and Engineering of AFTN, Doc. 8259.
[APANPIRG/16, Conc. 16/28]

11. States operating AFTN circuits should:

a) record AFTN statistics on the form contained in Attachment B, from 23 to 25 April and October each year;

b) exchange the circuit loading data for each circuit with each correspondent station and provide a copy to the ICAO Regional Office; and

c) evaluate circuit loading and take appropriate remedial action when occupancy level exceeds permissible levels specified in the *Manual on the Planning and Engineering of the Aeronautical Fixed Telecommunications Network* (Doc 8259).
[ASIA/PAC/3, Conc. 10/4]

12. States concerned should take positive measures to ensure system reliability and provide adequate management and supervision of facilities to eliminate system failure, and to ensure data integrity and timely delivery of messages.
[ASIA/PAC/3, Conc. 10/5]

13. The AFTN entry/exit points:

a) between ASIA/PAC and AFI should be Brisbane and Mumbai;

b) between ASIA/PAC and EUR should be Bangkok, Singapore and Tokyo;

c) between ASIA/PAC and MID should be Karachi, Mumbai and Singapore;

d) between ASIA/PAC and NAM should be Brisbane, Nadi and Tokyo; and

e) between ASIA/PAC and CAR/SAM should be Brisbane.
[APANPIRG/11, Conc. 11/6]

Technical aspects of AFTN rationalization.

14. The ~~main~~ trunk circuits interconnecting main AFTN communication centres should be provided by landline teletypewriter (LTT) facilities, operate at a modulation rate commensurate with operational requirements, and employ International Alphabet Number 5 (IA-5) and character-oriented data link control procedures — system category B, or bit-oriented data link control procedures as defined in Annex 10, Volume III, Part I, Chapter 8.

15. Also, the ~~tributary~~ circuits ~~inter~~connecting tributary AFTN communication centres with main AFTN communi~~-~~cation centres, or with other tributary AFTN communication centres, or with AFTN stations should be provided with LTT facilities where available and feasible, preferably operating at a modulation rate commensurate with operational requirements, and employing IA-5 code and procedures and an appropriately controlled circuit protocol.
[ASIA/PAC AFS RPG/3, Rec. 3/1]

16. To support data communication requirements and to provide needed data integrity and minimal transit time, the CCITT X.25 protocol should be used between AFTN COM centres and main and tributary COM centres in the ASIA/PAC regions.
[APANPIRG/4, Conc. 4/27 and APANPIRG/7, Conc. 7/14]

16.1 States should continue using X.25 as recommended protocol to support implementation of ATN ground infrastructure in the short to medium term (5-10 years) and consider acquisition of sufficient spares for the service life of the equipment. States not implementing X.25 consider the use of emerging replacement technology.
[APANPIRG/15 in 2004, Conc.15/11]

17. States should consider implementing digital communication networks or circuits in a coordinated manner in order to meet current and future AFS communication requirements for data/voice communications and to facilitate the introduction of ATN.
[APANPIRG/11, Conc. 11/14]

17.1 States should consider the provision of an alternative communication links for critical AFS communications which are supported by a single VSAT system between States and for remote control air-ground (RCAG) VHF stations supported by a single VSAT link.
[APANPIRG/11, Conc.11/15]

17.2 States in the Bay of Bengal area are urged to implement AFS circuits using VSAT technology as a matter of high priority to enhance safety and efficiency of aircraft operations and to meet AFS communication requirements for data/voice communications.
[APANPIRG/13 Conc.13/13]

~~***ATN infrastructure transition and implementation***~~

18. Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG) in the further development of the ASIA/PAC communications, navigation and surveillance (CNS)/air traffic management (ATM) implementation plan, further determine plans for the integration of ground-ground communications systems necessary for the implementation of the aeronautical telecommunication network (ATN), taking into account the work of the aeronautical telecommunication network panel (ATNP) on this subject.
[ASIA/PAC RAN/3 Conclusion 11/8]

18.1 The ATN transition plan outlines the requirements to increase bandwidth and upgrade protocols for those trunk circuits that will support main data flow of traffic in the ASIA/PAC regions. The plan also provides target dates for implementation of boundary intermediate systems (BIS) and backbone BIS in the ASIA/PAC regions.
[APANPIRG/12, Conc. 12/14]

19. ATN development should be introduced in an evolutionary and cost-effective manner based on available ICAO SARPs and regional ATN technical and planning documents. ~~The ATN infrastructure transition is expected to be implemented in three phases as follows:~~ It is recommended that there will be three phases in the implementation of the ATN infrastructure

~~a) *Phase 1.* Upgrade of existing AFTN circuits where necessary to support the introduction of the ATN backbone BIS;~~
~~b) *Phase 2.* Implementation of the ATN regional backbone BIS; and~~
~~c) *Phase 3.* Implementation of supporting ATN BIS.~~

- Phase 1. Up-grade of existing subnetwork infrastructure to support the Backbone BISs (BBISs)
- Phase 2. Implementation of ATN Regional BBISs; and
- Phase 3. Implementation of supporting ATN BISs

[APANPIRG 12/14]

19.1 Considering the inclusion of ATN over IPS SARPs in ICAO Annex 10, Volume 3 and to support global harmonization of ATN implementation, States hosting BBIS be urged to implement ATN over IPS in addition to ATN over OSI and complete this implementation of Dual Stack ATN (ATN/OSI and ATN/IPS) by 2011.
[APANPIRG 19/20]

19.2 Permit non-backbone States, and States in other regions with connections to Asia/Pacific region, to connect their Message Transfer Agents (MTAs) to backbone States using either the OSI-based ATN Internet Communications Services (ICS) or the ATN IPS on a bilateral basis.
[APANPIRG 21/20]

20. States should consider establishment of gateways, where required, to allow inter-operation between AFTN and ATS MHS.

ATS direct speech circuits

~~*ATS direct speech communications.*~~

21. States concerned should assign a high priority to the establishment, in accordance with Annex 11, 3.6.1.1, of efficient direct-speech communications between ATS units serving adjacent areas in order to permit proper use of air-ground frequencies and further implementation of the air traffic control (ATC) service.
[ASIA/PAC/3, Conc. 5/21]

~~22. Voice switching centres should be provided at the following locations:~~

~~1)~~	~~Auckland~~	~~2)~~	~~Bangkok~~
~~3)~~	~~Beijing~~	~~4)~~	~~Mumbai~~
~~5)~~	~~Calcutta~~	~~6)~~	~~Guangzhou~~
~~7)~~	~~Jakarta~~	~~8)~~	~~Karachi~~
~~9)~~	~~Lahore~~	~~10)~~	~~Kuala Lumpur~~
~~11)~~	~~Chennai~~	~~12)~~	~~Nadi~~
~~13)~~	~~Tokyo~~	~~14)~~	~~Brisbane~~

~~[ASIA/PAC/3, Rec. 10/15]~~

~~23. Dissemination of World Area Forecast System (WAFS) products in the ASIA/PAC regions will be accomplished by satellite broadcast.~~
~~[ASIA/PAC/3, Rec. 10/19]~~

ATS inter-facility data communications (AIDC) circuits

24. States should consider implementing ~~the ATN application~~ AIDC in order to enable the exchange of ATS messages ~~for active flights~~ related to flight notification, flight coordination, transfer of control surveillance data and free (unstructured) text data for active flights.

24.1 Noting the continued prevalence of RVSM Large Height Deviation (LHD) occurrences resulting from ATC Unit-to-ATC Unit coordination errors, APANPIRG recommended that States work towards the implementation of compatible AIDC capabilities based on the Asia/Pacific AIDC ICD between ATC units as soon as possible
[APANPIRG/18, Conc.18/3]

24.2 States are urged to expedite implementation of AIDC between neighboring ATS facilities in accordance with the Regional Air Navigation Plan and the Asia/Pacific AIDC ICD.
[APANPIRG/19, Conc.19/19]

Support for Global ICD for AFTN AIDC

24.3 Recognizing the benefits to be gained from globally harmonized interface arrangements for AIDC, APANPIRG supports the work being undertaken by the United States to coordinate a global Interface Control Document for AFTN AIDC and invites the Asia/Pacific Regional Office to act as the regional point of contact for this work.
[APANPIRG/20, Conc.20/14]

Air/ground communications

Aeronautical mobile service and aeronautical mobile satellite service

Frequency utilization lists.

25. States in the ASIA/PAC regions should coordinate, as necessary, with the ICAO Regional Office all radio frequency assignments for both national and inter-national facilities in the190–526.50 kHz, 108–117.975 MHz, 960–1215 MHz and 117.975–137 MHz bands. The ICAO Regional Office, based on the information provided

for this purpose by the States, will issue Frequency Lists Nos. 1, 2 and 3 at periodic intervals.

[ASIA/PAC/3, Conc. 11/4, 11/5 and 12/9]

HF en-route communications

26. States should be urged to coordinate on a national basis with the appropriate interested authorities, a programme directed towards achieving the elimination of the interference currently being experienced on some of the frequencies allocated to the Aeronautical Mobile (R) Service in the ASIA/PAC regions. When reviewing methods for developing such a national programme, consideration should be given to the procedures in Article S15 of the ITU Radio Regulations.

27. In the case of an unidentified interfering station, States should notify the ICAO Regional Office concerned, utilizing the procedure and report form developed by the Fifth Session of the Communications Division (1954) and updated by the Communications Divisional Meeting (1978). The Harmful Interference Report Form is provided in Attachment C. However, in the case of persistent harmful interference to an aeronautical service which may affect safety, it should be immediately reported to ICAO and to the ITU, using the prescribed format, for appropriate action.
[ASIA/PAC/3, Conc. 11/6]

27.1 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.
[APANPIRG/17, Conc.17/32]

~~***Air-ground elements of ATN***~~

~~28. With the implementation of the air-ground applications of ATN, it is important to ensure that transit response times are kept to a minimum level so as not to affect the overall response time that it takes for traffic such as automatic dependent surveillance (ADS) reports and controller-pilot data link communications (CPDLC) messages to be delivered to their final destination. This also reflects the need to ensure that critical ground links within the ASIA/PAC regions are capable of handling this information efficiently.~~

~~29. One important factor with air-ground traffic is the generation of routing information caused by aircraft that will move between various ATN routing domains. As aircraft move through various coverage media and FIR boundaries, the ATN routing backbone will be notified of the changing routing data for each mobile aircraft in the region. To allow this routing information to be propagated within the region will require a minimum number of backbone routers to be implemented which protect all other ATN routers form being inundated with routing information.~~
~~[ASIA/PAC ATN transition plan]~~

Satellite Communication Service Performance

28. States and International Organizations be requested to liaise with satellite service providers to establish a mechanism to maintain and modernize the satellite communication infrastructure.
[APANPIRG/19, Conc.19/24]

29. 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.

[APANPIRG18, Conc.18/29]

NAVIGATION

General

30. The plan and details of operational requirements for radio navigation aids are contained in Table CNS 3 and associated charts in Part IV of the FASID.

31. States should continue to provide ICAO with information on their flight inspection activities for inclusion in the *ASIA/PAC Catalogue of Flight Inspection Units* and circulation to States in the ASIA/PAC regions and to the ASIA/PAC Air Navigation Planning and Implementation Regional Group (APANPIRG).
[ASIA/PAC/3, Conc. 12/8]

32. The development of the radio navigation aids plan, and its subsequent documentation in relevant air navigation plan (ANP) publications, defines the respective radio navigation aid requirements at each location without reference to discrete frequency assignments. The ICAO Regional Office will continue to maintain its frequency selection and co-ordination role, including the maintenance and promulgation of Frequency Lists Nos. 1 and 2 in a timely and periodic manner.
[ASIA/PAC/3, Conc. 12/9]

Radio navigation aid requirements

33. States that have not yet done so should install VHF omnidirectional radio range (VOR) supplemented by distance measuring equipment (DME) as the primary aid for en-route navigation and, except in specified circumstances, delete any parallel requirement for a non-directional radio beacon (NDB) from the ANP.
[ASIA/PAC/3, Rec. 5/22]

Agreement for sharing DME Infrastructure

33.1 In the interest of efficiency, States with DME coverage extending beyond their FIRs be requested to consider allowing neighboring States to develop PBN procedures utilizing these DMEs.
[APANPIRG/19, Conc.19/26]

Constant Descent Final Approach (CDFA) and Baro-VNAV

34. In order to reduce the likelihood of CFIT accidents, States be urged to review non-precisioin approach procedures with LNAV lines of minima to include CDFA profile and include the Baro-VNAV design in the current and new RNP APCH approaches and consequent LNAV/VNAV approach minima.
[APANPIRG/19, Conc.19/28]

RF interference on the protected DME frequency

35. States' civil aviation administrations be encouraged to work closely with the respective regulatory authorities and undertake all necessary action to ensure the DME and SSR service are not interfered by devices such as wireless CCTV cameras.

SURVEILLANCE

General

~~34. The plan and details of operational requirements for surveillance are contained in Table CNS 4A of Part IV of the FASID.~~

36. Surveillance systems for terminal and en-route ATC purposes should be installed, maintained and operated at international aerodromes and en-route area control centres whenever it is necessary to improve the safe and expeditious handling of air traffic and wherever the traffic density and associated complexity of operations, system delays, meteoro~~-~~logical conditions and/or transition from oceanic to continental airspace would justify these installations.
[ASIA/PAC/3, Rec. 5/28]

37. Where different systems are used for navigation and position determination within the same controlled airspace, the ground facilities involved should be collocated and/or orientated so as to provide compatible flight paths and to ensure, as far as practicable, a fully integrated ATC pattern.
[ASIA/PAC, Rec. 7/14]

38~~7~~. The ASIA/PAC regions are characterised by the use of:

a) secondary surveillance radar (SSR) Mode A, C and~~, in the near future,~~ Mode S in some terminal and high-density continental airspace;

b) ADS in some parts of the ASIA/PAC regions;

c) Automatic Dependent Surveillance – Broadcast (ADS-B); and

~~e~~d) the diminishing use of primary radar.

39~~8~~. ADS-C is ~~becoming~~ available over the oceanic and continental airspace of the ASIA/PAC regions. SSR (augmented as necessary with Mode S) will continue to be used in terminal areas and in some high density airspace.

Automatic Dependent Surveillance -Contract - (ADS-C)

~~***Coordination of activities related to the implementation of ADS***~~

~~39. The introduction of air-ground data links, together with sufficiently accurate and reliable aircraft navigation systems, presents the opportunity to provide surveillance services in areas lacking such services in the present infrastructure, in particular oceanic areas and other areas where the current systems prove difficult, uneconomic, or even impossible, to implement. ADS is a function for use by ATS in which aircraft automatically transmit, via a data link, data derived from on-board navigation systems. As a minimum, the data should include the four-dimensional position. Additional data may be provided as appropriate. The ADS data would be used by the automated ATC system to present information to the controller. In addition to areas which are at present devoid of traffic position information other than pilot-provided position reports, ADS will find beneficial application in other areas including high-density areas, where ADS may serve as an adjunct and/or backup for SSR and thereby reduce the need for primary radar. Also, in some circumstances, it may even substitute for secondary radar in the future. As with current surveillance systems, the full benefit of ADS requires supporting complementary two-way pilot-controller data and/or voice communication (voice for at least emergency and non-routine communication).~~

40. States should closely cooperate in the development of procedures for the implementation of ADS-C in the ASIA/PAC regions and participate to the extent possible in trials and demonstrations related to the implementation of ADS-C.
[ASIA/PAC/3, Conc. 14/21]

Automatic Dependent Surveillance – Broadcast (ADS-B)

41. Mode S Extended Squitter (1090 ES) be used as the data link for ADS-B radar like services in the ASIA/PAC Region in the near term [APANPIRG/14,Conc.14/20]

42. States are advised to use the following guidelines for the development of ADS-B implementation plan.

a) minimize capital and operating costs of ADS-B data facilities;

b) give priority to provide ADS-B coverage over major traffic flows and *those airspaces currently not covered by radar. ADS-B should have overlapping area with existing radar coverage.*

c) provide ADS-B coverage in areas within 150 NM from FIR boundaries;

d) suitable sites with power, shelter, access routes and data communication links shall be preferred; and

e) overlapping of ADS-B coverage is preferred.

f) Integrate ADS-B data with the ATM automation system wherever possible taking advantage of synergies with other means of surveillance (such as radar, ADS-C, flight plan tracks) ;

g) Mandate ADS-B OUT equipage on the aircraft operating in the airspaces, at the flight levels or area where currently no radar surveillance is available and where ADS-B based services are offered (served with ADS-B ground stations).

h) Expand the "mandate" to aircraft operating in other airspace when the ANSP is able to provide ADS-B based services in the airspace.

i) ADS-B Implementation is more effective when it is implemented regionally both on the ground and on the aircraft.

j) When considering the benefits of ADS-B

Implementation, it is necessary to consider the total benefits to all stakeholders (airline operators, passengers, efficiency of the ATM network, and society etc) and not only the benefit derived for airlines operators and air navigation services providers.
[APANPIRG/20, Conc. 20/53]

Exchange of ADS-B surveillance data with neighbours

43. States are encouraged to share ADS-B surveillance data with neighbouring States and to develop mechanisms to achieve this as ADS-B ground infrastructure requirements are being identified during the design phase
[APANPIRG/15 Conc.15/26]

Support provision of VHF radio voice communication associated with ADS-B data sharing between adjacent States

44. States are urged to consider following regional policy on supporting provision of direct controller pilot communication capability associated with ADS-B data sharing between adjacent FIRs of States.

"In order to provide radar like separation services using ADS-B, it is necessary for the controllers to have direct controller pilot communication (DCPC). In some cases, to achieve radar like separation services it may be necessary for the States to provide VHF radio voice communication services for use by adjacent States.
It is therefore recommended that States capable to do so support provision of VHF radio voice communication services to adjacent States when this is required to support the delivery of ADS-B based separation services. Cost of such service provision shall be agreed between the States concerned."
[APANPIRG/19, Conc.19/38]

Secondary surveillance radar (SSR)

Implementation of surveillance systems

45~~1~~. Implementation of surveillance systems should be pursued as an enhancement to ATS where so required and the use of SSR alone, in accordance with the procedures in the *Regional Supplementary Procedures* (Doc 7030), should be considered as a cost-effective alternative to primary surveillance radar.
[ASIA/PAC/3, Rec. 14/20]

Coordination for SSR Mode S Interrogator Identifier Code

46. In view of low density of SSR interrogator installations in the region, only Interrogator Identifier (and not Surveillance Identifiers) codes be used for SSRs Mode S in the areas of overlapping coverage.
[APANPIRG/19 Concl 19/40]

47. while implementing SSR Mode S, States should take into account following issues while assigning Interrogator Identifier codes for these installations:

- for planning the implementation of SSR Mode S interrogators, administrations should ensure that the interrogators with overlapping coverage are not operating with the same Interrogator Identifier (II) codes.
- where, the coverage of the interrogator extends beyond the boundaries of the State, The II code and PRF should be worked out in coordination with the ICAO Asia and Pacific Office and the neighboring States, and

- administrations should inform the ICAO Asia and Pacific Office about the assigned II codes and PRFs for these installations.

[APANPIRG/19, Conc.19/40]

48. Recognizing more Mode S Radar ground stations being introduced in the region, States in the Asia and Pacific Region are urged to have aircraft registered having Mode S transponder regularly inspected to ensure correct operation of the Mode S transponders.
[APANPIRG17, Conc.17/29]
