INTERNATIONAL CIVIL AVIATION ORGANIZATION

**AFI PLANNING AND IMPLEMENTATION REGIONAL GROUP
EIGHTEENTH MEETING (APIRG/18)
Kampala, Uganda (27 – 30 March 2012)**

Agenda Item 3: Performance Framework for Regional Air Navigation Planning and Implementation
3.4 Communications, Navigation and Surveillance (CNS)

COMMUNICATIONS SYSTEMS

(Presented by the Secretariat)

SUMMARY
This working paper presents the report of the Fourth Meeting of APIRG Communications, Navigation and Surveillance Sub-group (CNS/SG/4, Dakar, Senegal, 25-29 July 2011) on Communications, for consideration by APIRG/18.
Action by the meeting is at paragraph 3.
REFERENCES : • ICAO SP AFI RAN 2008, Report (Doc 9930) • APIRG/17, Report • CNS/SG/4, Report Note: References can be downloaded from www.icao.int
Related ICAO Strategic Objective(s): C

1. INTRODUCTION

1.1 The Fourth Meeting of the APIRG Communications, Navigation and Surveillance Sub-group (CNS/SG/4) was held in Dakar, Senegal from 25 to 29 July 2011. It was attended by sixty one (61) delegates from twenty four (24) Contracting States and three (3) international Organizations.

1.2 **Appendix A** contains the draft conclusions and draft decisions formulated by CNS/SG/4.

1.3 WP/24 of this meeting addresses the CNS/SG/4 review of deficiencies in the field of communications.

2. DISCUSSION

AERONAUTICAL FIXED SERVICE (AFS)

AFS implementation status and performance

2.1 The meeting noted that States had implemented the requirements for AFS communications as contained in the AFI Air Navigation Plan (ANP), FASID Tables CNS 1A (AFTN Rationalized Plan) and CNS 1D (ATS/DS Plan), using digital technology. However, some of the required AFTN circuits (such as Addis-Ababa/Asmara, Addis-Ababa/Djibouti) and ATS/DS circuits (such as Addis-Ababa/Asmara, Bujumbura/Kinshasa, Djibouti/Hargeisa, Kigali /Kinshasa) were yet to be implemented. *(See Appendix A, Draft conclusion 4/01).*

AFTN circuit availability

2.2 The meeting noted that the implementation of aeronautical satellite telecommunications networks had significantly improved AFTN circuits' availability in the Region. However, availability rates remained below the *specified minimum of 97% stated in the AFI Air Navigation Plan (AFI/7 Recommendation 9/3) in some cases*, thus preventing normal distribution of messages related to flight planning and coordination between ATS units, aeronautical information services (AIS), operational meteorological information (OPMET) and search and rescue (SAR), with a negative impact on air transport operations safety and efficiency.

AFTN Transit Time Statistics

2.3 The meeting noted from reports made available to the Secretariat that the transit times prescribed in the AFI Regional Air Navigation Plan (ANP) were not met in many cases. In order to facilitate a thorough analysis of the root causes and identification of appropriate remedial action, States responsible for the operation of AFTN circuits were reminded to monitor transit time statistics on the 23rd day of each third month (January, April, July and October) of each year, and exchange them with correspondents, other administrations and ICAO Regional Offices.

AFTN Circuit Loading

2.4 The meeting emphasized the importance of carrying out performance evaluation of AFTN circuits on the basis of statistics collected for a period of minimum three days at the interval of six months from 23 to 25 April and October. It therefore requested AFTN centres and stations experiencing difficulties in taking character count due to system limitations to record circuits loading in accordance with the criteria specified in ICAO Doc. 8259 - *Manual on the Planning and Engineering of AFTN*.

Transmission speed

2.5 The meeting noted that all AFTN main circuits were operating at 9.6 kb/second or 19.2 kb/second, while some links had the potential for meeting 64 kb/second requirement specified for ATN backbone circuits.

Review of the report of the first meeting of the AFI AMHS Implementation Task Force

2.6 The meeting reviewed and endorsed the report of First Meeting of the AFI ATS Message Handling System Implementation Task Force (AFI AMHS/I/TF/1), which was held at the ICAO Eastern and Southern Regional office, United Nations Complex, Nairobi, Kenya from, 19 to 20 May 2011, back to back with a Regional Workshop on ATS Message Handling System which took place from 17 to 18 May 2011. The workshop was based on ICAO SARPs and Guidance Material contained in *Annex 10 to the Chicago Convention, Doc 9880, Part 2 – Manual on detailed technical specifications for the AN using ISO/OSI Standards and Protocols*.

2.7 The meeting noted that a number of States had already implemented AMHS on a national basis, pending guidelines for international AMHS links. It accordingly recommended that AFI States conclude bilateral and/or multilateral agreements using the model developed by the Task Force, and conduct trials to ensure interoperability between their AMHS systems. It also requested the Secretariat to conduct a regional survey on AMHS implementation. The entire report on AFI AMHS/I/TF/1 is accessible on the ICAO public website *(http://www.icao.int)*.

2.8 The meeting endorsed a draft AFI AMHS Implementation Strategy developed by the Task Force, as shown at **Appendix B** to this working paper, subject to further amendments to be made (as necessary) by the Secretary, based on the data to be provided by States through the recommended regional survey. *(See Appendix A, Draft conclusion 4/10).*

2.9 The meeting identified further work to be carried out by the Task Force, including the development of an AFI AMHS Manual based on the EUR AMHS Manual (Version 6.0), and of a regional AMHS implementation plan. Accordingly, the meeting agreed to amend the terms of reference, composition and programme of the AFI AMHS Implementation Task Force as shown in **Appendix C** to this working paper.

2.10 The meeting recalled State letter AN 4/49.1-09/34 of 14 April 2009, providing States with the procedures established for global coordination of AHMS information. States were therefore requested to designate representatives to register as users of the ATS Messaging Management Centre (AMC), and ensure that the designated users are duly trained on AMC web-based platform before they are actually allowed to enter data in *http://www.eurocontrol.int/amc*, and communicate to the ICAO Regional Offices the relevant details to the AMC users to facilitate their accreditation enabling them to access the AMC.

Aeronautical Telecommunication Network (ATN) Planning - Draft AFI ATN Routing Architecture Plan

2.11 The meeting recalled that, in 2005, APIRG/15 meeting had reviewed a draft AFI ATN Routing Architecture Plan, which provides technical guidance on the planning and implementation of the transition to the ATN for ground-ground communications within the ICAO AFI Region. The Draft AFI ATN Architecture Plan was circulated for comments, and was supported by States. Thereafter, further work carried out by the AFI Aeronautical VSAT Networks Managers formulated amendment proposals, based on the existing infrastructure. The proposed changes are reflected in the finalized Draft AFI ATN Architecture Plan shown at **Appendix D** to this working paper. *(Draft conclusion 4/11).*

Missing flight plans

2.12 The CNS Sub-group discussed the outstanding issue of missing flight plans in the AFI Region, in coordination with the ATM/AIM/SAR Sub-group. Mindful on the inherent safety risks, the two Sub-groups requested the Secretariat to coordinate a three-day regional survey from 15 to 17 August 2011, covering operational and technical aspects of flight plan processing. *(See Appendix A, Draft conclusion 13 and 14).*

Aeronautical Mobile Service (AMS)

Very High Frequency Communications (VHF)

2.13 The meeting noted significant improvement in VHF radio extension coverage in most FIRs. However, possibilities of further extending VHF radio coverage were limited in many areas where implementation of remote stations is not practicable.

Controller-Pilot Data Link Communications (CPDLC)

2.14 The meeting noted that operational controller-pilot data link communications (CPDLC) were being implemented by States and Organizations in their managed FIRs[1], in order to mitigate the geographical challenges limiting VHF radio coverage extension in some areas, as well as limitations inherent to HF radio communications. It recalled that the requirement for AFI ACCs was introduced in the Regional Air Navigation Plan (ICAO Doc 7474) by APIRG/13 in 2001, to support en-route operations, as well as APIRG Conclusion 17/25 reiterating this requirement.

Required Communication Performance (RCP)

2.15 The meeting discussed the concept of required communication performance (RCP) developed by ICAO in Doc. 9869, and its implementation in the AFI Region. RCP is a performance specification designed to serve as one possible safety net in airspace planning, to ensure that infrastructural, operational and technological components blend the aircraft systems and the ground systems to deliver a safe, reliable and repeatable service. The meeting reiterated APIRG Conclusion 17/26 requesting ICAO to support the implementation of the RCP concept through regional seminars and workshops.

Global Operational Data Link Document (GOLD)

2.16 The meeting was updated on developments concerning the Global Operational Data Link Document (GOLD), aimed to facilitate global harmonization of existing data link operations and resolve regional and/or State differences impacting seamless operations. It includes required communication performance (RCP) and surveillance specifications, based on RTCA DO-306/EUROCAE ED-122, and guidelines on post-implementation monitoring and corrective action to address a number of issues with satellite data communication services.

2.17 The meeting noted that the GOLD was finalized, and adopted by APANPIRG, NAT SPG and SAT groups[2]. It therefore recommended its adoption by APIRG to replace the current FANS 1/A Manual (FOM) endorsed by APIRG/16 (Conclusion 4/15).

Review of the Report of the Second Meeting of the AFI Frequency Management Group (AFI/FMG/2)

2.18 The meeting reviewed the Report of the Second Meeting of the AFI Frequency Management Group which took place in Dakar, Senegal, from 18 to 19 April 2011, as presented by the Secretariat and the Rapporteur (ASECNA). After considering the terms of reference of the FMG as defined by APIRG/17, and the relevant activities of ICAO Aeronautical Communication Panel Working Group F, the FMG assessed progress made in the implementation of the conclusions and decisions from its first meeting (AFI/FMG/1)[3] and from APIRG/17 meeting. The Group also reviewed the ITU WRC-2012 on-going global and regional preparatory activities, including the work of ICAO ACP, ICAO workshop (December 2010), ITU Conference Preparatory Meeting (CPM/2) and ATU Preparatory Meeting (February 2011). The entire report of AFI/FMG/2 can be downloaded from the ICAO public website (*www.icao.int/esaf*, *www.icao.int/wacaf*).

2.19 The CNS Sub-group endorsed the terms of reference of the AFI/FMG Rapporteur, as well as an action plan for the AFI/FMG whose tasks include specific issues to be addressed by States and Administrations:

[1] In 2011, CPDLC procedures were operational/planned in Antananarivo, Brazzaville, Dakar Terrestrial, Dakar Oceanic, Johannesburg, Mauritius, Ndjamena, Niamey, Sal Oceanic, and Seychelles.

[2] *The U.S. FAA recognizes the GOLD in its Advisory Circular (AC) 20-140A - Guidelines for Design Approval of Aircraft Data Link Communication Systems Supporting Air Traffic Services (ATS), and AC 120-70B - Operational Authorization Process for Use of Data Link Communication System.*

[3] *The First Meeting of the AFI Frequency Management Group (AFI/FMG) was held in Dakar, Senegal, in September 2009.*

- Monitor and report to APIRG the status of available capacity in the various aviation frequency bands;
- Review ICAO SARPs and Guidance Material;
- Coordinate activities in aeronautical frequency planning and protection of the aeronautical spectrum;
- Maintain AFI COM Lists by providing the relevant data;
- Support to ICAO position for the ITU WRC-2012 through national and regional initiatives.

2.20 The AFI FMG terms of reference, composition and future work programme are provided at **Appendix E1** to this working paper, together with the Group's action plan. The terms of reference of the Group's Rapporteur are also shown at **Appendix E2**. *(See Appendix A, Draft conclusion 4/18)*

Review of ICAO position, including updates and preparations for the ITU-WRC -2012

2.21 The meeting was informed that the ICAO Council, at the 3rd meeting of its 193rd Session on 15 June 2011, had approved updates to the ICAO position on the International Telecommunication Union (ITU) World Radiocommunication Conference (2012) (WRC-12) issues of critical concern to aviation. It recalled the original ICAO position that was sent to ICAO Contracting States under cover of State letter E 3/5-09/61 dated 30 June 2009, and that this letter had mentioned that prior to WRC-12 new developments resulting from studies under way in ICAO and ITU might require the submission of additional material to the conference. The approved updates contain that additional material based on the latest results of ICAO and ITU studies.

2.22 The meeting's attention was drawn to the fact that the ICAO position would be submitted to the ITU WRC-12 as an information paper. As such, active support from States was deemed to be the only means to ensure that the results of the WRC-12 reflect civil aviation's need for spectrum (ICAO Assembly Resolution A36-25 refers).

2.23 The meeting encouraged States/organizations to participate in the ICAO Regional Frequency Spectrum Workshop in preparation for ITU WRC-12, and the 25th Meeting of the Aeronautical Communication Panel Working Group F (ACP-WG/F/25) to be held in Dakar from 6 to 14 October 2011.

Need for a CNS technology roadmap

2.24 The meeting noted that at its 37th Session, the ICAO Assembly instructed the Council to organize a Twelfth Air Navigation Conference in 2012 (AN-Conf/12), to develop longer-term planning for ICAO based on an update of the Global Air Navigation Plan (GANP). (AN-Conf/12), and that the Conference would particularly develop communications, navigation, surveillance, avionics and aeronautical information roadmaps.

2.25 The meeting therefore agreed that the work programme of the CNS Sub-group should include the development of regional roadmaps to be derived from the ICAO global roadmaps. These roadmaps would ensure compatibility between air navigation systems.

2.26 The meeting also requested States to promote collaborative decision- making and partnership within the aviation industry for developing and implementing integrated solutions for CNS infrastructure components, according to identified priorities; and called on AFCAC, ICAO and other relevant institutions to facilitate the funding arrangements necessary for integrated programmes aimed at enhancing the regional infrastructure, including human resource aspects, based on the CNS technology roadmaps.

Global survey on aircraft equipage

2.27 With respect to avionics, the meeting was presented with the results from a global survey conducted by IATA in 2010, covering 218 airline fleets and more than 6000 aircraft.

2.28 The meeting emphasized the importance of having such comprehensive information on aircraft equipage for the purpose of air navigation system planning and implementation; and requested AFI States to provide the ICAO Regional Offices with detailed information concerning the level of equipage and capabilities of their registered aircraft. *(See Appendix A, Draft conclusions 4/19 and 4/20).*

Review of the future Work Programme and Composition of the CNS Sub-group

2.29 Under this Agenda Item, the CNS Sub-group reviewed and updated its work programme and composition as shown in **Appendix F** to this working paper. *(See Appendix A, Draft conclusion 4/21).*

Review of the conclusions and decisions of the Sixteenth Informal Meeting on the improvement of air traffic services over the South Atlantic (SAT/16) pertaining to CNS

2.30 The meeting was presented with the results of SAT/16 meeting of relevance to the APIRG CNS Sub-group. It particularly noted that SAT member States and Organizations had developed efficient cooperative initiatives aimed to ensure a coordinated implementation of CNS systems (AMHS, GNSS, SSR and ADS-C /CPDLC) through memoranda of understanding aimed to ensure their interoperability and interconnectivity, and recommended that AFI States participating in SAT activities should promote such initiatives in the AFI Region.

Planning and implementation guidelines for communications, navigation and surveillance (CNS) systems

2.31 The meeting reviewed the strategies for the implementation of the Global Plan Initiatives (GPIs) on CNS systems as described in the Global Air Navigation Plan (Doc 9750), and adopted these strategies for the AFI Region. **Appendix G** to this working paper provides a detailed description of the adopted strategies.

3. CONCLUSION

3.1 The meeting is invited to:

a) Note the report of the Fourth Meeting of the APIRG Communications, Navigation and Surveillance Sub-group on Communications as presented in this working paper;

b) Note that the CNS/SG/4 Draft Conclusions 4/13 and 4/14 and Decision 4/11 shown at **Appendix A** to this working paper, have already been implemented;

c) Adopt CNS/SG/4 Draft Conclusions 4/01, 4/10, 4/15, 4/18, 4/19, 4/20 and Draft Decision 4/20 shown at **Appendix A** to this working paper; and

d) Adopt the Draft AFI ATN Routing Architecture Plan shown at **Appendix D** to this working paper.

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APPENDIX A

DRAFT CONCLUSIONS AND DRAFT DECISONS

DRAFT CONC./DEC. NO.	TITLE/TEXT
Agenda Item 4 - Aeronautical Fixed Service (AFS)	
Draft Conclusion 4/01	**Need for ICAO assistance in the resolution of AFS deficiencies** That the ICAO Regional Offices should explore all avenues to assist the States concerned in restoring/implementing non-operational AFS circuits based on AFI Air Navigation Plan requirements.
Draft Conclusion 4/10	**AFI AMHS Implementation Strategy** That the AHMS Strategy shown at **Appendix B** *to this working paper* be adopted for the AFI Region.
Draft Decision 4/11	**AFI ATN Architecture Plan** That the Secretariat: 1) circulate to AFI States and Organizations the draft AFI ATN Architecture Plan shown at **Appendix D** *to this working paper*, for their final comments by 30 September 2011; and 2) accordingly finalize the draft AFI ATN Architecture for adoption by APIRG/18..
Draft Conclusion 4/13	**Need for further investigations on the lack of flight plans** That, considering the high priority to be accorded to the issue of lack of flight plans, AFI Air Traffic Service Units (ATSUs) report and conduct investigations on missing flight plans during the period from 15 to 17 August 2011. The results of their investigations should be compiled using the form attached to the report, and communicated to the relevant ICAO Regional Offices.
Draft Conclusion 4/14	**Investigations on the loss of AFTN messages in the AFI Region** That in order to further analyze and mitigate the loss of AFTN messages, including flight plan messages in the region, AFI AFTN centres carry out a three-day survey on AFTN performance from 15 to 17 August 2011 (inclusive), using the forms and model messages to be circulated by the Secretariat. In so doing, they should: 1) use the AFTN addresses of their correspondent ATSUs in the AFI Region; 2) provide availability of the AFTN circuit(s) involved, based on the implemented routing configuration; and 3) provide transit times.
Agenda Item 5 - Aeronautical Mobile Service (AMS)	
Draft Conclusion 4/15	**Adoption of the Global Operational Data Link Document (GOLD)** That in order to ensure regional and global harmonization of data link operations, the Global Operational Data Link Document (GOLD) be adopted for the AFI Region, and replace the previous FANS 1/A Operations Manual. Note: South Africa coordinates the maintenance of the GOLD for the AFI Region.
Agenda Item 8 - Aeronautical Radio Frequency Spectrum issues	

DRAFT CONC./DEC. NO.	TITLE/TEXT
Draft Conclusion 4/18	**Implementation of AFI FMG Action Plan** That AFI States and Organizations implement the Action Plan proposed by the AFI Frequency Management Group as shown at **Appendix E** *to this working paper*.
Agenda Item 9 - ICAO 37th Assembly (2010) and Twelfth Air Navigation Conference (AN/Conf/12, 2012) – CNS related issues	
Draft Conclusion 4/19	**Importance of the information on aircraft equipage in air navigation system planning and implementation** That, when making their decisions with respect to the planning and implementation of air navigation systems, AFI States take due account of available and reliable data and forecast on aircraft level of equipage and capabilities.
Draft Conclusion 4/20	**AFI States' registered aircraft equipage and capabilities** That, AFI States should support surveys conducted on aircraft equipage and capabilities by providing the ICAO Regional Offices with detailed information concerning their registered aircraft.
Agenda Item 10 - Future work programme and composition of the CNS/SG	
Draft Decision 4/21	**Future work programme for the CNS Sub-group** That the future work programme and composition of the CNS Sub-group be amended as shown at **Appendix F** *to this working paper*.

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APPENDIX B

STRATEGY FOR IMPLEMENTATION OF THE ATS MESSAGE HANDLING SYSTEM (AMHS) IN THE AFI REGION

TABLE OF CONTENT

1. Introduction 11
2. Object of the document 11
3. Background 11
3.1 OVERVIEW OF AMHS 12
3.2 Technical provision 13
3.3 Requirements for the Network 13
3.4 STATUS OF AMHS implementation Activities 13
4. IMPLEMENTATION TIMEFRAME 14
5. STRATEGY FOR IMPLEMENTATION OF THE ATSMHS IN THE AFI REGION 15

1. Introduction

The ATS Message Handling System (AMHS), which has been defined in the ICAO Aeronautical Telecommunication Network (ATN) standards, is intended to be a replacement for the current legacy Aeronautical Fixed Telecommunications Network (AFTN).

In order to assist States /Organizations on the matters relating to the implementation of ATS Messages Handling System (AMHS) in the AFI region and to ensure a uniform, smooth and harmonious implementation and regional interoperability, the AMHS/I/TF was requested to develop a Draft AFI AMHS Implementation Strategy.

2. Object of the document

This document presents the draft AFI strategy to guide States and/or Organizations in implementation of AMHS within the AFI Region as required by the terms of reference of the AFI AMHS/I/TF meeting, Nairobi, Kenya, 20-21 May 2011. The document contains:

- A background about the states of AMHS implementation in AFI and other Regions
- an AFI implementation strategy

3. Background

The exchange of ATS messages, as part of the Aeronautical Fixed Service (AFS) defined in ICAO Annex 10 Volume II is an essential function to the safety of air navigation and to the regular, efficient and economical operation of ATS provision. The Aeronautical Fixed Telecommunications Network (AFTN/CIDIN) has so far provided an effective store-and-forward messaging service for the conveyance of text messages, using character-oriented procedures. However, with regard to the future requirements in the exchange of ATS messages and the technological evolution, AFTN/CIDIN technology is now becoming obsolete, and is not sufficiently flexible to support messaging functions found in modern messaging systems (such as transfer of binary information and data folders).

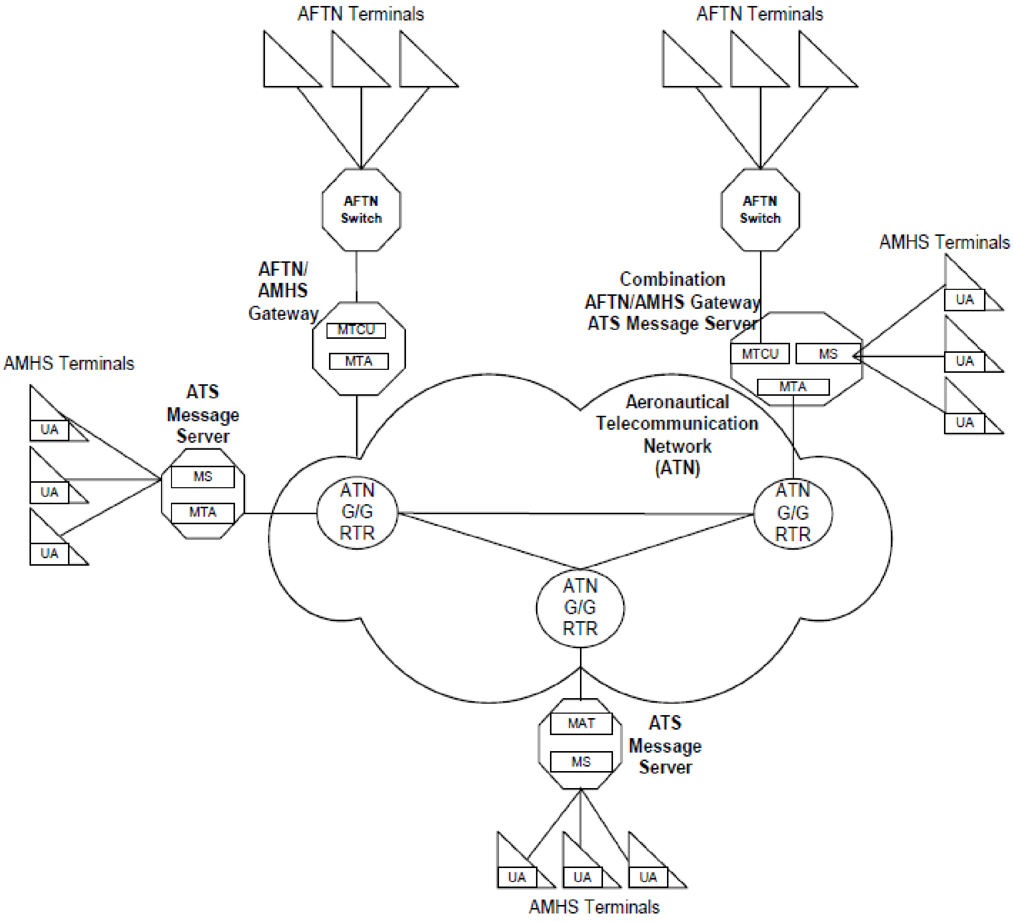
With a view to meet the critical requirements of the aviation community for enhancing its ground data communications by means of up to date technology, ICAO has specified that the Aeronautical Telecommunications Network (ATN) may replace the existing networks based on AFTN. The Aeronautical Telecommunication Network (ATN) will enable seamless communications between ground users (e.g. ANSPs, Airlines) and aircraft.

The most recent development with regard to messaging in the ATS environment is the ATS Message Handling System (AMHS). The AMHS is a natural evolution from AFTN/CIDIN and replaces the telegraphic style of working with a modern Message Handling System based on international Standards. The AMHS, being an ATN application utilizes the infrastructure of the ATN network; however this is not a prerequisite for the initial deployment of AMHS.

The AMHS is designed according to the International Telecommunication Union's (ITU) X.400 messaging standard which provides the core messaging framework similar to modern day email messages for the use of exchanging messages between Air Traffic Service users over the ATN. As an X.400-based system, the AMHS is specified in such a way that messages can be transferred from the sender to the recipient by passing reliably through intermediate AMHS systems. The AMHS system at the originating station, when it first receives a newly submitted message, must determine the AMHS system that will receive the AMHS message. This may be:

- the destination AMHS,
- a relay AMHS, or
- the AFTN.

3.1 OVERVIEW OF AMHS



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

- the Message Transfer Agent (MTA) which performs the function of the message switch,
- the User Agent (UA) which performs the user access to the MTA and provides an appropriate user interface,
- the Message Store (MS) which provides the intermediary storage between MTA and UA and is usually co-located with the MTA, and
- the Access Unit (AU) which provides for intercommunication with other Messaging.

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

- the ATS message server (MTA)
- the ATS message user agent (UA)
- the AFTN/AMHS gateway.

3.2 Technical provisions

The provisions pertaining to AMHS, such as SARPs, technical manuals and /or specifications and general guidance material are now available and the Industry has so far developed systems to provide AMHS along these guidelines. The following ICAO documents constitute the main references:

- Annex 10, Volume II, Chapter 4
- Annex 10, Volume III, Part I, Chapter 3
- Doc 9880 Part IIB
- Manual for the ATN using IPS Standards and Protocols (Doc 9896)
- Doc 9705

3.3 Requirements for the Network

The performance network to support the AMHS is very important to ensure a reliable AMHS service. From the ICAO SARPS, AMHS could be implemented using ISO or IPS protocols. There are already national AMHS implementations in place, based on the TCP/IP protocol suite. In addition, ANSPs have the necessary TCP/IP expertise on hand from various national applications. The broad market of TCP/IP products would facilitate rapid implementation with reasonable costs.

In the AFI Region, the States adopted to implement the AMHS under ATN/IPS as the ground-ground network in line with several ICAO Regions. Today, the majority of the links of current AFTN circuits are configured at 9600 kbps.
The implementation of the AMHS requires more bandwidth because of the overhead of the protocol. The network speed in areas of high traffic density is 64 kbps with at least 32 kbps in general. The AFI strategy will thus have to take into account the necessity of increasing the network capacity through the implementation of a successful ATN network.
This increased capacity will necessarily have an associated cost and may require the upgrade of the network infrastructures.

3.4 Status of AMHS implementation Activities

At present, there are many initiatives and activities aiming at a rapid implementation and operation of the ATS Message Handling System (AMHS). At the level of ICAO, Regional working groups are tasked with the development of guidelines and the coordination of implementation. Regional AMHS workshops are conducted to facilitate coordination between States and exchange of information with manufacturers. In addition, trials and operational implementations are underway.

The 17th APIRG meeting, Ouagadougou, Burkina Faso, 2-6 August 2010 per conclusion 17/17 set up a Task Force to coordinate and plan for the implementation of AMHS in the AFI

Region; and the SAT/16 meeting Recife, 02-06 May 2011 per conclusion 16/13 calls States to participate in the forthcoming regional Seminars and workshops organized by ICAO to support the implementation of AMHS regional Plans requirements.
Today, some AFI States have already installed AMHS systems, conducted trials and demonstrations for implementation of AMHS and have taken actions for the introduction of AMHS operationally on a national basis. It is therefore necessary to develop a regional strategy, in order to conduct a standardized and harmonized implementation process within the AFI Region.

4. AFI AMHS IMPLEMENTATION TIMEFRAME

The implementation of the AMHS will follow several stages. Currently, only a very few states within the AFI region have AMHS infrastructures and the necessary network capacities. The AFI strategy should therefore take into account the experience gained from the equipped countries and progress studies conducted.

2011 –2013 Experimentation
During this period, pioneer and new States will continue to install AMHS systems. The experimentations and testing of interoperability will be expedited. This phase will allow the constraints related to the implementation and especially to the interconnections to be determined.

2011 - 2015 Validation of the architecture ATN – Upgrade of the network capacities
The harmonization and the increase of the network capabilities are necessary for the implementation of the AMHS. Several projects related to satellite VSAT networks of the AFI region are currently on going and in particular the audit of the AFISNET network which will involve some modifications to the network.

During the current phase, the ATN architecture will be validated and the increase of the capabilities of the various connections will be completed. These modifications can involve the modifications of the network infrastructure;
Due to the financial resources which it could require, the priority will be given to the main links establishing the ATN Backbone, which will allow to conduct effectively the experiments and to validate the ATN backbone.

During this period, the priority will be given to the systems of extremity AMHS in case of replacement of AFTN switches.

This deadline takes into account the necessary time for the validation of the ATN and AMHS architectures as well as the planning and the mobilization of the necessary financing.

From 2015 - Deployment in the main centers
In 2015, it can be considered that the ATN backbone and the network capabilities are quite completed.

The systems of extremity ATN / AMHS will then be deployed in the main centers with an AMHS/AFTN Gateway if required.

From 2017 General Deployment

From 2017 onwards, all the End Systems of the network will have to be AMHS compatible. Various end-system such as the automated systems for the management of ATS data will be updated and the exchange l of ATS messages through the AMHS.

5. STRATEGY FOR IMPLEMENTATION OF THE AMHS IN THE AFI REGION

Considering the initiatives related to the AMHS implementation in the AFI region and the AMHS implementation activities progress in the other ICAO regions and in Industry, the AFI States/Organizations should take into consideration the following strategy to implement AMHS in the AFI region.

Considering:

1) The requirements for a reliable, secured and homogenous ground-to-ground Aeronautical Telecommunication Network to support the ATS Message Handling System (AMHS);

2) The availability of ICAO SARPs and technical manuals for the ATN/AMHS, the availability of equipment and readiness of vendors to support the AMHS ground-to-ground communications;

3) The availability of AMHS Transition and Implementation guidance materials required to assist States to ensure harmonization of procedures and protocols and thereby assure interoperability within the region;

4) The need for States using the currently AFTN systems for communication with other States and Regions to migrate gradually and harmoniously to the AMHS system by replacing the aging AFTN switches with ATS Message Transfer Agents (MTA);

5) The efforts of AFI States to take over and implement ATN/ AMHS; and

6) The need to support States to ensure a uniform, smooth and harmonious implementation;

The general strategy for the implementation of AMHS infrastructure in the AFI Region is as follows:

a) Deploy a backbone network of ATN/IPS to provide a reliable infrastructure to initially support ground-to-ground applications (AMHS, AIDC…);

b) Use the TCP/IP communication protocol for the initial implementation of ATS Message Handling Systems, as a transition mechanism to enable AMHS operations to commence ahead of eventual full SARPs compliance;

c) The backbone States to implement in the short term a interoperable AMHS infrastructure and to conduct trials and studies on bilateral and multilateral basis in AFI region and on inter-regional basis to validate the operational implementation of AMHS and AMHS/AFTN Gateway;

d) The BBIS states with interface to other regions that adopt TCP/IP or, should establish connection based on bilateral agreement;

e) The none backbone States, to implement gradually AMHS when replacing their aging current AFTN systems and to connect to backbone States using the ATN/ IPS protocols and the appropriate security provision ;

In order to achieve the above strategy the following is required of states and organization in the AFI Region:

a) States shall provide implementation in compliance with Annex 10 SARPS and ICAO Manuals, and with the Plans, Policies and AMHS Transition and Implementation guidance Materials adopted by APIRG;

b) Backbone States shall upgrade their network capability and later migrate to an IP sub-network capability for interconnection with other Backbone States and Non-backbone States.

c) States shall work co-operatively to assist each other on a multinational basis to implement the ATN and AMHS in an expeditious and coordinated manner and to ensure system inter-operability; and

d) States shall organize training of personnel to provide necessary capability to maintain and operate the ground-to-ground ATN/AMHS infrastructure and applications.

Strategy implementation plan

	Short Term 2011-2013	Mid-Term 2014-2017	Long Term2018-2023
APIRG Technical Provision	Development of AFI Technical Provisions	Implementation based on the AFI Technical Provisions	
Telecommunications Infrastructure	Upgrade of ANSP VSAT Networks and Validation of the AMHS Topology	Integration of AFI VSAT Network and Implementation of the AMHS Topology	Full Operational Implementation of AMHS Backbone and Applications
Implementation of AMHS	Operation of the existing AFTN System and Progressive Implementation of AMHS Systems on National or Regional Basis	Implementation Of AMHS Systems at all main AFTN Centers and Trials on Inter-Regional Links	Completed Transition of all the AFTN Centers and Full Operational Implementation
Operational Deployment	AMHS Trials on National/Regional basis	Pursue of Trials on Regional basis and Operational Implementation	Full AMHS Operational Implementation

Conclusion

The implementation of the ATN / AMHS requires the commitment of all the actors as was reaffirmed during the first meeting of the AMHS TASKFORCE. It will require the implementation of new systems of extremity ATN as well as the availability of an ATN network combining capabilities and adequate performances.

--END---

APPENDIX C

TERMS OF REFERENCE, WORK PROGRAMME AND COMPOSITION OF THE AFI ATS MESSAGE HANDLING SYSTEM IMPLEMENTATION TASK FORCE (AFI AMHS/I/TF)

1-TERMS OF REFERENCE

1) Conduct a comprehensive review of ICAO Standards and Recommended Practices (SARPs) pertaining to the Air Traffic Services Message Handling Service (ATSMHS) application as specified in Annex 10 – *Aeronautical Telecommunications* - Volume II and Volume III, and guidance material contained in ICAO *Manual on detailed specifications for the Aeronautical Telecommunication Network (ATN) using ISO/OSI standards and protocols* (Doc.9880), *Global Air Navigation Plan* (Doc 9750) and other relevant provisions;

2) Collect and analyze information on the status of AFI ANSPs ATS Message Handling Systems plans, including ongoing upgrades to existing systems and;

3) On the basis of the above, develop a coordinated AFI transition strategy and plan with associated timelines to enable the streamlined coordinated implementation of AMHS.

Considerations

In addressing its terms of reference, the Task Force should consider, *inter alia,* the following aspects:

1) AFI AMHS systems should be:

    a. implemented in accordance with ICAO SARPs and technical specifications, and
    b. interoperable with systems implemented by other ICAO Regions.
    c.

2) Personnel training for operational migration from AFTN to AMHS;

3) AFS network backbone capabilities;

4) Systems that transition early will need to be capable of handling both AMHS and AFTN messages;

5) Establishment of an Information Management system to track implementation timelines; and

6) Impacts to users (compliance to new flight plan format, availability of qualified personnel, etc).

2-WORK PROGRAMME

Task No.	Global Plan Initiative	Subject	Target date
1	GPI-22	**Conduct of a Regional Survey on:** 1. AFS circuits specifications (circuit type, modulation rate, protocol, ITU code, VSAT network) 2. AMHS implementation status (implementations, plans, levels of service, protocols, implementation challenges, level of knowledge on AMHS and ATN, etc.) *Team Leader: Secretariat* *Team members: All Task Force Core members* *References:* • *APIRG/15 Report* • *ICAO Annex 10 (Vol. 2 and Vol.3)* • *ICAO Doc 9880*	CNS/SG/5 2013
2	GPI-22	**Draft AFI AMHS Implementation Plan** 1. Draft AFI ATN Architecture 2. Draft AFI ATN Network Service Access Point Addressing Plan 3. Draft AFI AMHS Implementation Plan a. AFI FASID CNS1B Table b. AFI FASID CNS1C Table *Team Leader: Rwanda* *Team members: Angola, Ethiopia, Kenya, Mozambique, Rwanda, Sudan, Zimbabwe and ASECNA* *References:* • *Report of the Second Meeting of AFI ATN Planning Task Force* • *AFI Air Navigation Plan, FASID (CNS)* • *ICAO Annex 10 (Vol. 2 and Vol.3)*	CNS/SG/5 2013
3	GPI-22	**Draft AFI AMHS Manual** 1. Introduction 2. AFI AMHS Requirements 3. AFI ATS Messaging Service Profile 4. System implementation - Guidelines for system requirements 5. AMHS management 6. Tests and validation of systems 7. Operational procedures and recommendations 8. Miscellaneous 9. Appendices *Team Leader: South Africa (ATNS)* *Team members: Somalia (CACAS), South Africa, Tanzania, Uganda and ASECNA* *References:* • *ICAO EUR AMHS Manual (Doc 020)* • *ICAO Annex 10 (Vol. 2 and Vol.3)*	CNS/SG/5 2013

Task No.	Global Plan Initiative	Subject	Target date
		• *ICAO Doc 9880*	

3-COMPOSITION

Core members: *Algeria, Angola, Botswana, Egypt, Ethiopia, Ghana, Kenya, Malawi, Niger, Nigeria, Rwanda, Senegal, South Africa (ATNS), Sudan, Tanzania, Tunisia, Uganda, Zimbabwe, ASECNA, IFATSEA and Roberts FIR.*

Other members: *All AFI States and Air Navigation Service Providers (ANSPs) with implemented and planned AMHS systems.*

Note: *Members should nominate suitable experts involved in aeronautical telecommunications operations and systems engineering.*

-END-

APPENDIX D

AFI

ATN ROUTING ARCHITECTURE PLAN

(DRAFT)

EXECUTIVE SUMMARY

This document provides technical guidance on the Planning and Implementing the transition to the Aeronautical Telecommunication Network (ATN) for ground communication within the ICAO AFI Region.

The routing architecture is based upon the need for a ground-ground infrastructure to eventually replace the existing AFTN infrastructure. For this reason, the routing architecture uses the existing AFTN infrastructure as a guideline for the positioning of ATN equipment.

The routing architecture is designed primarily for the ground-ground environment. It is intended that this architecture will be suitable as the routing architecture for the introduction of the air-ground communication requirements.

INTRODUCTION

This document presents an initial plan for the routing architecture within the AFI Region.

Terms used

Aeronautical Fixed Telecommunication Network (AFTN): a low-speed network providing the majority of ground-ground data communication services within the ICAO realm. This term is defined in ICAO Annex 10.

Boundary Intermediate Systems (BIS): a router that supports IDRP and routes PDUs to more than one routing domain. This term is defined in ICAO Doc. 9705.

Backbone Boundary Intermediate Systems (BBIS): a router that primarily routes PDUs between routing domains and does not support End Systems.

Note: This definition is similar to that found in ICAO Doc. 9705 and is meant to be consistent with that definition. This definition is made on the assumption that this version of the routing architecture is limited to the ground-ground infrastructure.

End Boundary Intermediate Systems (EBIS): a router that primarily routes PDUs between routing domains and connected End Systems.

End Systems (ES): an ATN system that supports one or more applications and that is a source and/or destination for PDUs.

Inter-Regional Boundary Intermediate Systems (IRBIS): a router that routes PDUs between systems (both End Systems and Boundary Intermediate Systems) within the Region with routers outside of the Region. These routers are the entry points into the Region and exit points from the Region for PDUs.

Network Service Access Point (NSAP) (address): a 20-octet value that uniquely identifies an interface between the Transport Layer and the Network Layer. In the ATN it provides the address of transport entity providing ATN Internet services.

Acronyms used

AFTN	-	Aeronautical Fixed Telecommunication Network
BIS	-	Boundary Intermediate Systems
BBIS	-	Backbone Boundary Intermediate Systems
CLNP	-	Connectionless Network Protocol

EBIS - End Boundary Intermediate Systems
ES - End System
IDRP - Inter-Domain Routing Protocol
IS - Intermediate System
PDU - Protocol Data Unit

ROUTING DOMAIN FUNDAMENTALS

The ATN consists of a set of End-Systems (ESs) and a set of Intermediate Systems (ISs). ESs are the source and destination of all data and are where the applications reside. ISs are better known as routers and relay PDUs from one system to another.

The ISs and ESs are organized into *Routing Domains*. Routing Domains are used to define sets of ystems (that typically operate together) into clusters. These clusters have two major properties:

- they are controlled by a single administration/organization, and
- a significant amount of the traffic is internal to the cluster.

The single most important characteristic is that they are controlled by a single administration or organization. This characteristic is manifested in technical terms by mutual trust between all routers in a routing domain. Routing protocols are based on the fact that the information exchanged between *intra*-domain routers can be trusted. No special reliability or trust is required to accept information about advertised routes.

The second characteristic, most traffic is internal to a routing domain, is more an artifact of proper network engineering.

Routing domains are established through the NSAP addressing conventions established for the ATN in Doc. 9705, Sub-Volume 5. All systems with NSAP addresses defined with the same address prefix are by definition in the same routing domain.

Intra-Domain Routing

Intra-domain routing is the routing of PDUs from the source to destination where both are in the same domain. Intra-domain routing implies one or more ISs capable of routing PDUs across the domain. Examples of intra-domain routing would be CLNP-capable routers exchanging PDUs between two Local Area Networks.

Since the ATN is specified across State boundaries, there are no SARPs requirements for intra-domain routing. The choice and configuration of internal routers is a local matter.

Inter-Domain Routing

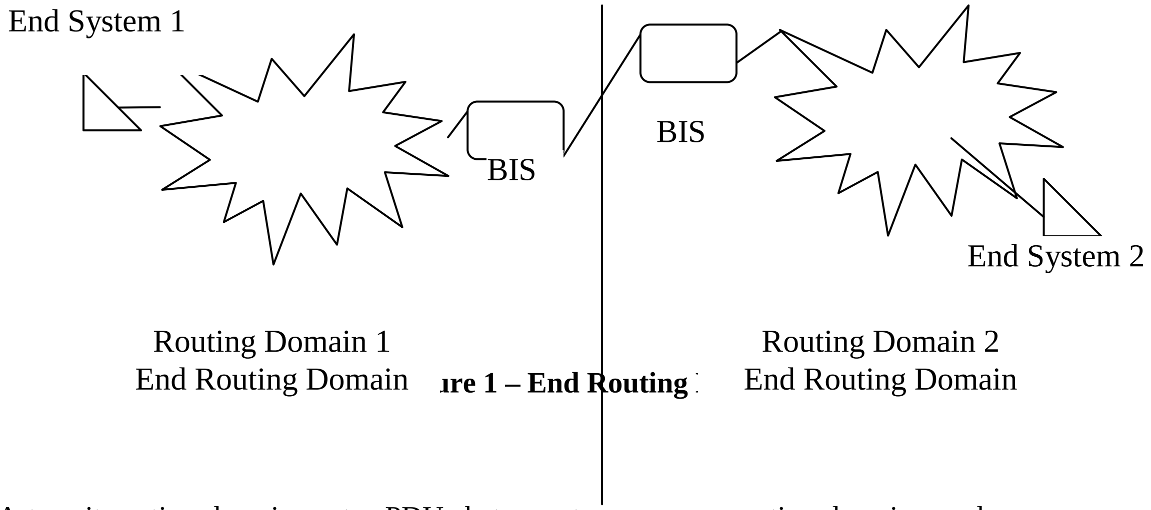
The central definition of routing in the ATN is concerned with inter-domain routing. This is a particularly difficult problem since by the very nature of inter-domain routing, the information received cannot be fully trusted.

Inter-domain routing is based upon the mutual distrust of the received routing information. First, reliability mechanisms must be built-in to ensure the reliable transfer of the information. Second, the received information must be filtered to ensure that it meets the suitability constraints of the received system (in other words, can it be believed.)

After receiving the routing information, the inter-domain router must build routing tables based upon its internal policy about routing its data.

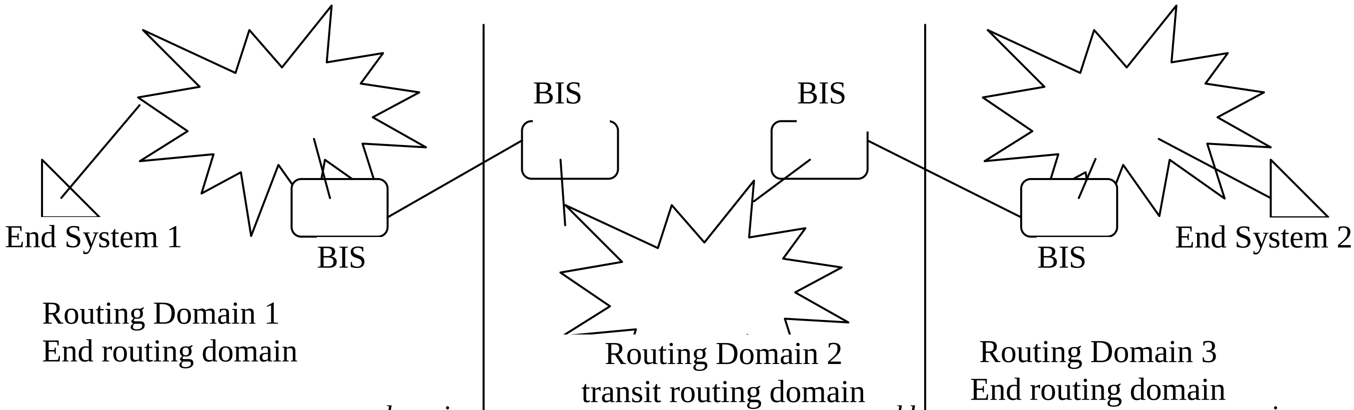
Types of Routing Domains

There are two basic types of routing domains: end routing domains, and transit routing domains.
An end routing domain routes PDUs to and from end-systems within its routing domain. Figure 1 shows an end routing domain.



ıre 1 – End Routing

A transit routing domain routes PDUs between two or more routing domains, and may as an option also act as an end routing domain. An example of a transit domain is where a set of backbone routers is configured in their own routing domain with all of the end systems in end routing domains attached to the backbone.



Note: A transit routing domain may or ... ckb ... in may consist of BISs none of which are backbone routers.

Figure 2 – Transit Routing Domains

Routing Domain Construction

Based on the above, a routing domain consists of at least one inter-domain router.
Note: There must be at least one BIS. There is no requirement for any other equipment.
Routing domains are elements of the physical structure of the ATN.

ROUTER FUNDAMENTALS

All routers discussed within this document are ICAO Doc. 9880 compliant Boundary Intermediate Systems (BISs).

Note: Individual States may elect to use other routers that do not comply with the ATN IDRP requirements as found in ICAO Doc. 9880 within the limits of their own States. These router are internal State issues and outside the scope of this document.

Boundary Intermediate System Overview

Boundary Intermediate Systems comprise the interfaces between networks, and in particular, between different routing domains. The term "Boundary Intermediate System" can often be replaced with the more common term "router".

An important consideration in developing the routing architecture is the different roles that routers take within the ATN environment.

Router Types

There will be two primary types of BISs employed within the Region:

- Backbone BISs (BBISs), and
- End BISs (EBISs).

Backbone BISs

A BBIS is a router that primarily routes PDUs between routing domains. These routers are typically higher performance routers that aid in the efficient flow of data between domains. BBISs may have End-Systems connected to them, but often are limited to only router-to-router connections.

BBISs can be further subdivided into Inter-regional BBISs and Regional BBISs. Inter-regional Backbone BBISs are those backbone routers that connect to BBISs in other regions.

Regional BBISs are backbone routers that only connect to routers within the Region.

Note 1: A single high performance router may act as both a Regional BBIS and an Inter-regional BBIS based upon meeting the requirements for performance and reliability.

Note 2: For completeness of the routing architecture, it must be mentioned that the routers out-side of the Region to which Inter-regional Backbone BISs attach are, in fact, Inter-regional Backbone BISs in the other Region.

Note 3: The interconnection of backbone BISs typically require higher capacity communication lines based on the consolidation of traffic through those backbone routers. Even though the architecture takes into account existing AFTN infrastructure facilities, the need to upgrade the communication facilities as traffic through the backbone increases may be necessary.

Note 4: It is possible for some States to provide transit routing from their routing domains to the routing domains of other States using BISs that are not backbone routers.

End BISs

End BISs are connected to one or more BBISs and provide routing services to a single routing domain. Further, End BISs do not act as a transit router for passing PDUs between other routing domains.

AFI REGIONAL ROUTING ARCHITECTURE

The AFI Regional routing architecture is based upon several concepts:

1. from a routing domain point of view, the Region can be considered an "autonomous" area, that is, there is a difference between routers located within the Region and outside the Region.
2. routing domains and confederations of routing domains may be applied to areas within the Region.
3. States will make their own implementation and transition decisions.

The routing architecture can be divided into several distinct parts:

- the definition of the backbone routing structure for passing information between routing domains within the Region;

- the definition of the routing structure for passing information from this Region to other Regions;
- the definition of the routing structure between routing domains not on the backbone; and
- the definition of the routing structure for use in end-routing domains.

The first component is the definition of the backbone routing structure that supports the exchange of data within the Region. This part defines the interconnection of the major communication facilities in the Region and how they cooperate to link all of the systems in the Region.

The second part is needed to define how data will be routed between the systems within the Region with those systems outside the Region. More importantly, the structure describes how all global ATN systems are accessible from systems in the Region.

The third component is the definition of the structure that allows end routing domains to exchange data across the backbone to another end routing domain. This part defines how the end routing domains connect through the backbone.

The fourth component defines the routing structure that is used within an end routing domain. This part defines how the individual routing domains may be used to pass data.

Regional Backbone

The definition of a Regional Backbone is based upon the efficiencies that may be realized by concentrating the ATN traffic at major communication centres and using the economy of scale in passing this information between major communication centres.

The rationale for defining Regional backbone sites is based upon existing VSAT networks in the AFI Region and the flow of both AFTN traffic and possible future air-ground ATN traffic.
Within the Region there exist four VSAT networks (AFISNET, CAFSAT, NAFISAT and SADC) that can be used to simplify the definition of the backbone architecture.

However, it must be understood that the expected growth in communication traffic over the ATN could quickly exceed the capabilities of the existing communication infrastructure. Planning for the increased traffic loads will be needed as soon as ATN traffic begins to flow.

The architecture and communication requirements define a routing plan that incorporates alternate routing and communication paths so that no single router or communication failure can isolate major parts of the Region.
The initial AFI BBISs sites are defined in the following table by identifying those communication centres that are participating in more than one VSAT network as shown at **Attachment A**. Additional backbone sites will need to be identified in the future for increased reliability of the interconnections between the networks. This is done in subsequent paragraphs.

Item	ATN backbone router site	State
1	Antananarivo	Madagascar
2	Dakar	Senegal
3	Dar es Salaam	Tanzania
4	Johannesburg	South Africa
5	Kinshasa	Dem. Rep. of Congo
6	Luanda	Angola
7	Mauritius	Mauritius
8	N'djamena	Chad

Table 4.1 - Definition of initial AFI ATN Backbone router sites

At each ATN Backbone site, there should be at least one BBIS. States that are to be invited to committing to operate backbone routers are identified in the table above.

AFI Backbone router requirements

The definition of BBIS and the location of these routers may be affected by the requirements for backbone routers. A backbone router must meet several performance and reliability requirements:

- Availability
- Reliability
- Capacity; and
- Alternate routing.

Availability

A backbone router must provide a high-level of availability (24 hours a day, 7 days a week).

Reliability

A backbone router must be very reliable system that may require redundant hardware or more than one router per site.

Capacity

As a communication concentrator site, a backbone router must be capable of supporting significantly more traffic than other ATN routers.

Alternate routing

Based upon the need for continuity of service, backbone routers will require multiple communication links with a minimum of two and preferably three or more backbone routers to guarantee alternate routing paths in case of link or router failure.

Routing policies

States providing Regional BBISs must be capable of supporting routing policies that allow for Regional transit traffic and for dynamic re-routing of traffic based upon loading or link/router failures.

Inter-Regional Backbone

The second component of the AFI Regional Routing Architecture is the definition and potential location of Inter-Regional Backbone Routers. The manner in which this architecture was developed was to ensure that the use of the existing communication infrastructure is possible to the greatest degree. The use of the existing communication infrastructure should reduce the overall cost of transitioning to the ATN.

To re-state from the previous section, the Inter-Regional BBISs provide communication from routers within the AFI Region to routers in other regions. These Inter-Regional BBISs provide vital communications across regions and therefore need to have redundant communication paths and high availability. (Note: This can be accomplished through multiple routers at different locations.)

Within the current AFTN network environment, the following locations have been identified to initially serve centres outside the AFI Region:

Entry/Exit Centre	Region served
Addis Ababa	Middle East
Algiers	Europe
Casablanca	Europe

Cairo	Europe, Middle East
Dakar	South America
Johannesburg	Asia/Pacific, South America
Nairobi	Asia
Tunis	Europe

Table 4.2 - Centres with circuits to other Inter- Regional Backbones

For the transition to the ATN, connectivity to the other Regions should be a priority. This is especially important as other Regions begin the transition to the ATN and begin deploying ATN BISs.

Long Term Implementation

The transition to a fully implemented ATN requires that connectivity amongst the ICAO regions be robust. That is, there is the need to ensure alternate paths and reliable communication. Table 4.2 presents a minimal Inter-Regional Backbone that provides a minimum of 2 circuits to other ICAO regions that communicate directly with the AFI Region. For longer term implementation of the ATN, it would be advisable to have 3 circuits to each Region.

Initial Implementation

Note: Information is needed on the plans of States in implementing ATN.

The initial implementation of the ATN, outside of the AFI Region, will most likely be in North America, Europe and Asia/Pacific. Therefore, initial transition planning in AFI may focus on Europe and Asia/Pacific.

For connecting to Europe, there should be four (4) Inter-Regional BBISs. For example, the following locations would be candidates for such routers: Algiers, Cairo, Casablanca and Tunis.

Note: The locations presented above are examples of possible router sites. The selection of actual locations will be based on implementation schedules and circuit availabilities.

For connecting to the Middle East, Inter-Regional BBISs may be located at the locations of the existing AFTN centres, Cairo and Addis Ababa. However, these routers would not be needed until such time as ATN traffic is destined for that Region and the location of the routers would be determined at that time.

For connecting to the ASIA/PAC, Inter-Regional BBISs may be located at the locations of the existing AFTN centres, Johannesburg and Nairobi. However, these routers would not be needed until such time as ATN traffic is destined for that Region and the location of the routers would be determined at that time.

For connecting to the SAM Region, Inter-Regional BBISs may be located at the locations of the existing AFTN centres, Dakar and Johannesburg. However, these routers would not be needed until such time as ATN traffic is destined for that Region and the location of the routers would be determined at that time. In the future, Luanda could be added for interface with the SAM Region.

Routing between Backbone Routers and Routing Domains

The third component of the AFI ATN routing architecture is the definition of the routing structure between end routing domains within the AFI Region through the regional ATN backbone. This is done by linking routing domains within the coverage area of each VSAT network to the ATN backbone sites on the same network. In this process additional backbones are identified.

Based upon the exiting VSAT network coverage areas, sub-regions are defined for routing efficiencies. These sub-regions are used to concentrate traffic. The goal of this architecture is to use the existing communication infrastructure and the facilities available at existing AFTN centres to the maximum degree possible.

Within the AFISNET area, six major routing domains can be identified:

- ASECNA member States, which could form a routing confederation
- Ghana
- Nigeria
- Roberts FIR
- Sal FIR; and
- Sao Tome and Principe.

Within the ASECNA ensemble, two additional backbones could be located at Brazzaville and Niamey to concentrate traffic as in the current AFTN.

In the Ghana domain, Accra is being linked to Sao Tome by VSAT for VHF extension. This facility could be used in the future to link the Sao Tome domain to the ATN. Thus Accra BIS will be a transit router for Sao Tome. For added reliability, Lagos BIS should transit through Accra, while Kano BIS is linked to N'djamena and Niamey.

In the SADC VSAT coverage area, each State constitutes a routing domain that will be linked to the Johannesburg BBIS.

In the NAFISAT coverage area, each State also constitutes a routing domain. The additional BBIS identified is at Khartoum. Each routing domain has at least two links to the ATN. The BB locations are defined in Table 4.3. The table is organized with one site identified as a potential backbone router site identified above. This site is listed first and in bold text. The remainder of the sites in each sub-region follows.

Note: The identified backbone router sites are only examples. Actual backbone router sites will be determined by implementation schedules and States' willingness to implement backbone routers.

Location (State) of BB (including amendments by AFI Aeronautical VSAT Networks Managers)
Addis Ababa (Ethiopia) Sub-Regional sites: None Other BBIS sites: Khartoum, Nairobi, Jeddah Other Regions: MID
Accra (Ghana) Sub-Regional sites: None Other BBIS sites: Dakar, Niamey Other Regions: None
Algiers (Algeria) Sub-Regional sites: None Other BBIS sites: Casablanca, Tunis, Niamey Other Regions: EUR
Antananarivo (Madagascar) Sub-Regional sites: SADC:Johannesburg Other BBIS sites: Mauritius Other Regions: None
Brazzaville (Congo) Sub-Regional Sites: NAFISAT:Nairobi, SADC:Kinshasa, Luanda Other BBIS sites: Dakar, Niamey, N'djamena Other Regions: None
Cairo (Egypt) Sub-Regional Sites: Tunis

Location (State) of BB (including amendments by AFI Aeronautical VSAT Networks Managers)
Other BBIS sites: Khartoum Other Regions: EUR, MID
Casablanca (Morocco) Sub-Regional Sites: EUR:Lisbon Other BBIS sites: Algiers, Dakar Other Regions: EUR
Dakar (Senegal) Sub-Regional Sites: CAFSAT: Recife,Las Palmas, SADC:Johannesburg Other BBIS sites: Casablanca, Niamey, Accra, Brazzaville, Conakry Other Regions: SAM
Dar es Salaam (Tanzania) Sub-Regional Sites: NAFISAT:Nairobi Other BBIS sites: Kinshasa, Johannesburg Other Regions: None
Ezeiza (Argentina) Sub-Regional sites: SADC:Johannesburg Other BBIS sites: None Other Regions: AFI
Jeddah (Saudi Arabia) Sub-Regional Sites: NAFISAT:Addis Ababa,Khartoum Other BBIS sites: None Other Regions: AFI
Johannesburg (South Africa) Sub-Regional Sites: AFISNET:Dakar,Antatanarivo, CAFSAT:Ezeiza Other BBIS sites: Luanda, Kinshasa, Dar es Salaam, Plaisance Other Regions: SAM, ASIA/PAC
Kano (Nigeria) Sub-Regional Sites: None Other BBIS sites: Niamey, N'djamena Other Regions: None
Khartoum (Sudan) Sub-Regional sites: NAFISAT:N'djamena, SADC:Kinshasa Other BBIS sites: Cairo, Jeddah, Addis Ababa, Nairobi Other Regions: MID
Kinshasa (Democratic Republic of Congo) Sub-Regional sites: AFISNET:Brazzaville,N'djamena, NAFISAT:Khartoum Other BBIS sites: Dar es Salaam, Johannesburg Other Regions: None
Las Palmas (Gran Canaria) Sub-Regional sites: AFISNET:Dakar Other BBIS sites: Lisbon, Recife Other Regions: SAM, EUR
Lisbon (Portugal) Sub-Regional sites: CAFSAT:Casablanca Other BBIS sites: Las Palmas Other Regions: AFI
Luanda (Luanda) Sub-Regional sites: CAFSAT:Recife, AFISNET:Brazzaville Other BBIS sites: Johannesburg Other Regions: SAM
Nairobi (Kenya) Sub-Regional Sites: AFISNET:Brazzaville, SADC:Plaisance,Dar es Salaam

Location (State) of BB (including amendments by AFI Aeronautical VSAT Networks Managers)
Other BBIS sites: Khartoum, Addis Ababa Other Regions: ASIA/PAC
N'djamena (Chad) Sub-regional sites: NAFISAT:Khartoum, SADC:Kinshasa Other BBIS sites: Niamey, Brazzaville, Kano Other Regions: None
Niamey (Niger) Sub-Regional Sites: None Other BBI sites: Dakar, Algiers, N'djamena, Kano, Brazzaville, Accra, Conakry Other Regions: None
Plaisance (Mauritius) Sub-Regional sites: NAFISAT:Nairobi Other BBIS sites: Antananarivo, Johannesburg Other Regions: None
Recife (Brazil) Sub-Regional sites: AFISNET:Dakar, SADC:Luanda Other BBIS sites: Las Palmas Other Regions: AFI
Roberts (Guinea) Sub-Regional sites: None Other BBIS sites: Dakar, Niamey Other Regions: None
Tunis (Tunisia) Sub-regional sites: NAFISAT:Cairo Other BBIS sites: Algiers Other Regions: EUR

Table 4.3 – Definition of Geographic Location of BB Sites

Routing within end domains

The fourth component of the AFI routing architecture is the definition of routing within end domains.

Routing Domains

Each State is expected to have one or more routing domains. Where a State chooses not to implement an ATN BIS, it may choose to incorporate its systems into a routing domain of another State.

The AFI ATN Backbone will consist of routers from the selected States. Each of these routers will be part of its State's routing domain.

Note: This means that the backbone will not be configured with its own routing domain.

Routing to the backbone and between backbone routers will be controlled through IDRP policies. Each State will be responsible for the designation of routing policies for its End Systems and End BISs. Individual States will also be responsible for establishing routing policies for routing to its designated BBIS.

The use of routing confederations is for further study. It should be noted that the establishment of routing confederations within the AFI Region could simplify considerably the routing architecture since a routing confederation can be viewed externally as a single routing domain.

End BISs

It is assumed that naming and addressing (and routing domain definition) will be done on a Regional basis. Further, for areas within the Region that may utilize an End BIS serving more than one State, the naming structure will be based on the Regional NSAP format defined in Doc. 9880. Further, States may choose to either implement the Regional (or Sub-Regional) NSAP format or the State NSAP format based on whether it installs a BIS.

AFI Regional Routing Architecture

Summarizing the information presented above, the AFI Regional Backbone network will consist of at least one BBIS router in each of the sub-regions identified above. The actual location of the routers will be based upon implementation schedules and the choices of States.

The Inter-Regional BBISs may be configured to provide both Regional routing services and Extra-Regional routing services. However, these routers must be engineered with sufficient performance capabilities to provide such services.

The chart at **Attachment B** shows the configuration of the AFI routing architecture.

Transition Issues

This area needs further work. Information about plans of the States is required.

ATN Transition

Based upon the previous sections, the implementation of the ATN within the AFI Region may require considerable planning for the transition of the AFTN.

Initial Regional Implementation

The very beginning of ATN implementation will be bilateral testing between States. For this scenario, each State will need at a minimum:

- an ATN-compliant router,
- a means for managing the router,
- an ATN application, and
- a circuit connecting the States.

States involved in bilateral ATN trials should consider the use of the trial infrastructure in expanding the ATN throughout the Region.

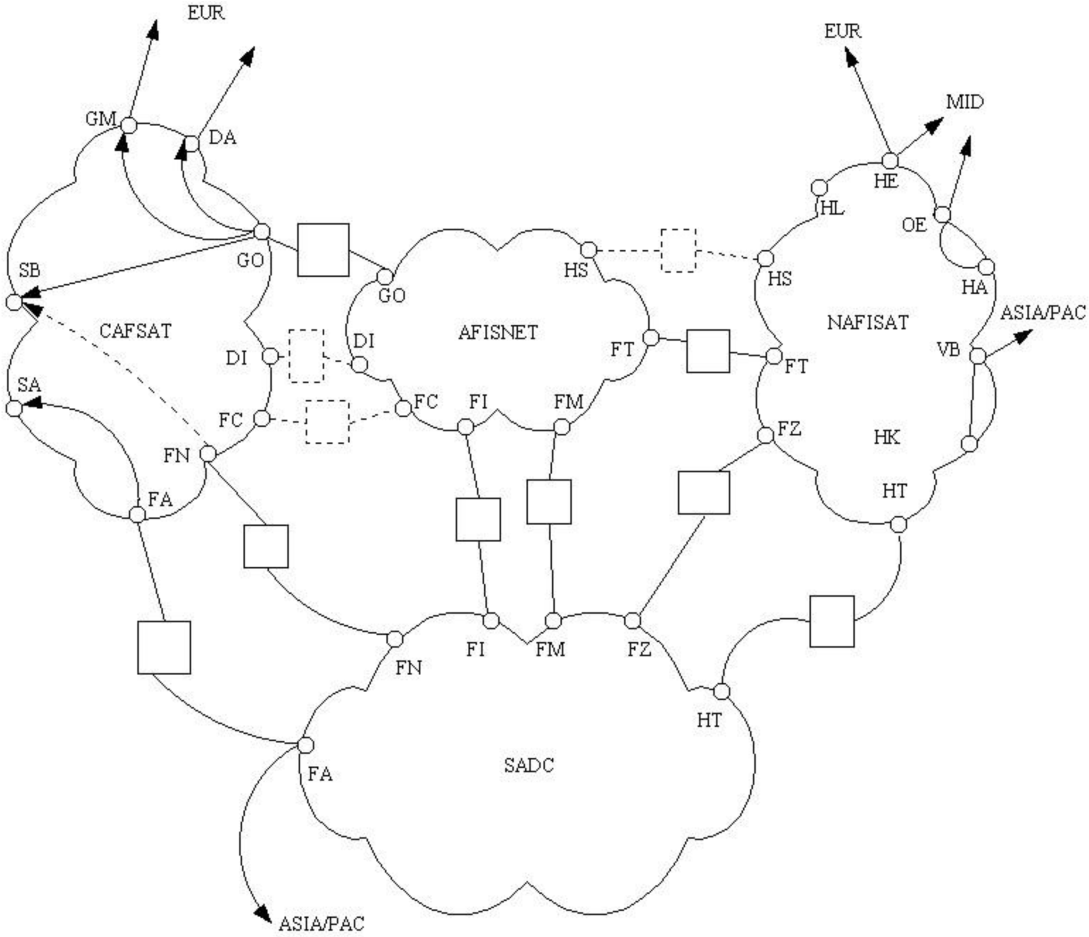
Regional ATN Implementation

At a certain time, sufficient bilateral trials will be underway to permit a region-wide ATN network based upon the plan presented above. As each State implements the ATN applications and network infrastructure, it will be added to the Regional infrastructure according to this plan.

-END-

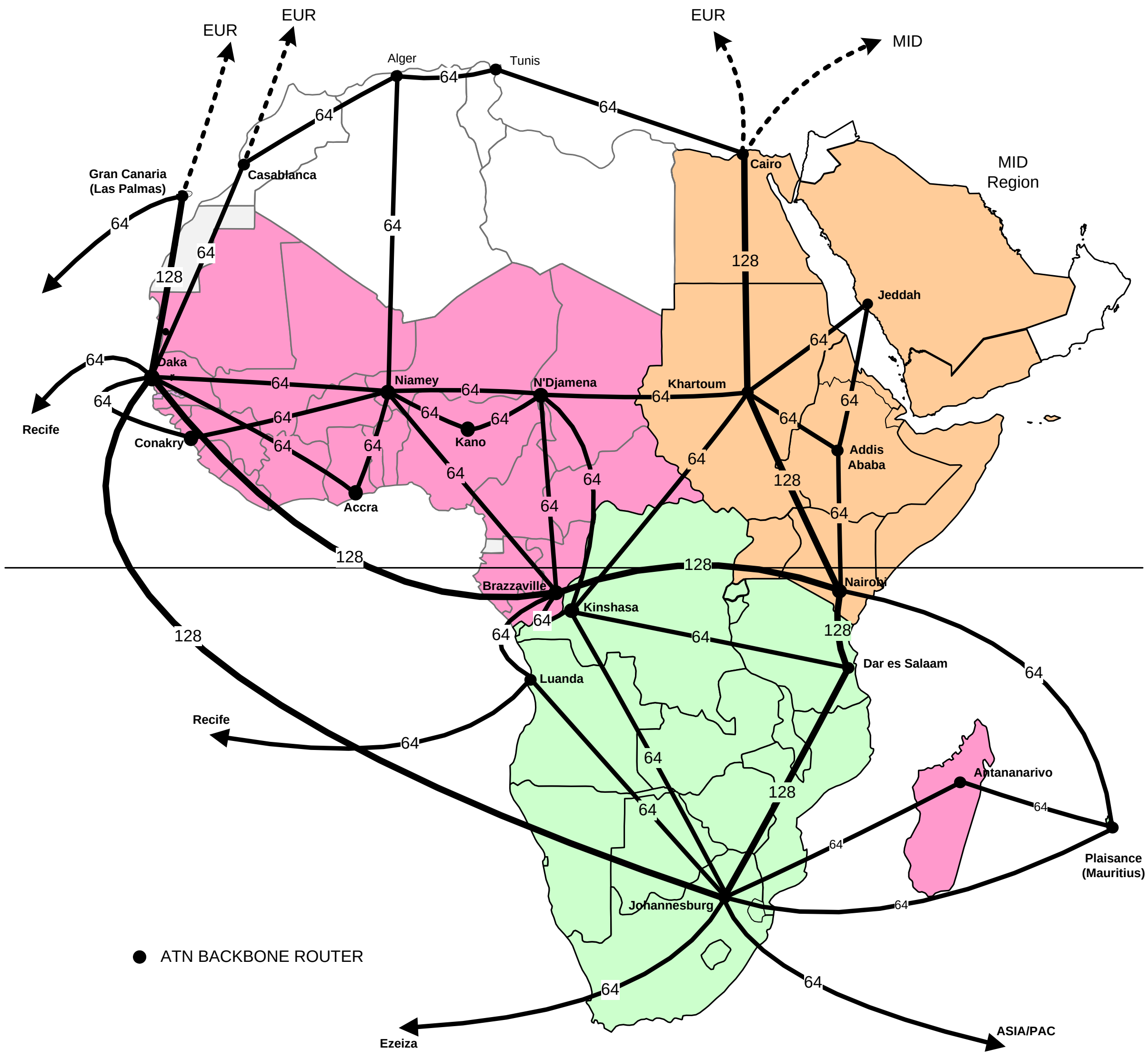
Attachment A

INDENTIFICATION OF BACKBONE ROUTER SITES



Attachment B

ATN BACKBONE



AFI ATN BACKBONE INTERCONNECTIVITY

APPENDIX E1

AFI Frequency Management Group (FMG) Action Plan

Action	By	deadline	Status of implementation
Development of the Terms of Reference for the Rapporteur of the AFI Frequency Management Group	Secretariat	30/06/2011	Completed
Allocation of necessary resources to ensure that the designated Officer is available to participate in all activities of relevance to his/her mandate	ASECNA	Continuous	Completed in 2011 and 2012 through hosting of AFI FMG/2 and WRC-12 preparatory workshop, as well as attendance at WRC-12.
Establishment of national regulatory provisions to protect the use of Fixed Satellite Service (FSS) for the provision of aeronautical telecommunications services	States/ICAO	31/12/2012	Follow up action to be taken on implementation of Recommendation 724 (WRC-07)
Development of a model of a national coordination framework to facilitate efficient dialogue between appropriate authorities and resolution of issues related to the provision, the optimum operation and protection of aeronautical telecommunications spectrum,	States/ICAO	31/12/2013	
Survey on AFI States policies and regulations pertaining to aeronautical telecommunications, and determination of areas of required assistance by AFI /FMG	ICAO	31/12/2011	Survey conducted. Data awaited from States
Coordination of trials on HF Propagation forecast with all States within the same frequencies allotment areas defined in AFI FASID Chart CNS 2.	States/ANSPs	31/12/2012	AMS Survey conducted in 2012, in coordination with IATA
Organization of regional workshops/seminars on the RCP concept (Doc 9869) as called for by APIRG Conclusion 17/26 to facilitate its implementation by AFI	ICAO	31/12/2013	
Review and update AFI database COM Lists	States/ICAO	31/12/2012	AFI COM Lists No.1, 2 and 3 are being updated in coordination with States
Finalization and maintenance of the Frequency Assignment Planning Software	States/ICAO	31/12/2012	Software under evaluation by ICAO Regional Offices
Coordination between States and stakeholders for the development of regional strategies,	States/ICAO	31/12/2013	
Specifications and criteria for software integrity	Rapporteur	31/12/2013	

Action	By	deadline	Status of implementation
validation	Cameroon, Ghana, Morocco, Rwanda and South Africa		

APPENDIX E2

Draft Terms of Reference for the Rapporteur of the AFI Frequency Management Group (AFI FMG)

A. Terms of Reference

The Rapporteur of the AFI Frequency Management Group (AFI/FMG) nominated among the members of the Group is tasked to coordinate the activities of the Group. He develops his activities in the frame of the Action Plan driven from the outcomes of the meetings of the Group in particular through:

1. The follow up of the implementation of AFI/FMG Conclusion and Decisions that need coordinated activities on frequency spectrum management within AFI region;
2. The promotion of AFI Civil Aviation position to the AFI institutions involved in frequency spectrum management (African Telecommunication Union (ATU); African Broadcasting Union-ABU, Regional Direction of International Telecommunication Union (ITU)…)
3. The Report to the ICAO Aeronautical Communication Panel bodies (AC Panel and AC Working Group F) on the current developing activities on frequency spectrum management in AFI Region;
4. The coordination with the similar Rapporteur on frequency management Group nominated in the neighboring ICAO regions
5. The provision to the report to APIRG/CNSG of the status of implementation of APIRGB Conclusions and Decisions pertaining to AFI/FMG activities.
6. Any other activities that could enhance the development of the optimum usage and ensure the protection of Aeronautical Frequency Spectrum.

B. General List of actions

In the short and near term the main activities of the Rapporteur of AFI Frequency management Group can be listed as follows:

1. Ensure the complete collection of COM List
2. Ensure the follow up of the usage of the frequency planning software with feedback from AFI FMG Members
3. Participate to the analysis of the results of the surveys by users (ANSPs forecast on HF, IATA survey on VHF Coverage, Interferences mitigation issues…);

C. Participation to meetings dealing with Aeronautical Frequency Spectrum

To develop efficiently his assigned tasks, the Rapporteur of AFI Frequency Management Group should be provided with the adequate resources aiming to ensuring his participation to the mayor events that could be of interest of the Group mandate.
In the other hand the Rapporteur should endeavor to ensure a relevant yearly planning of his activities allowing him to attend these meetings:;

The following meetings are activities with great relevance to AFI/FMG:

a) African Telecommunication Union Meeting for the preparation of WRCs;
b) ACP Working Group F meetings
c) CPM meetings
d) WRC meeting
e) Regional Seminar/Workshops on frequency spectrum management.

APPENDIX F

TERMS OF REFERENCE, FUTURE WORK PROGRAMME AND COMPOSITION OF THE COMMUNICATIONS, NAVIGATION AND SURVEILLANCE SUB-GROUP (CNS/SG)

1. TERMS OF REFERENCE

a) Ensure the continuing and coherent development of the AFI Regional Air Navigation Plan in the fields of aeronautical communications, navigation and surveillance (CNS), including the development of CNS elements of the AFI CNS/ATM Implementation Plan in the light of new developments, in harmony with the ICAO Global Air Navigation Plan (Doc 9750) and the plans for adjacent regions;

b) Identify, review and monitor deficiencies that impede or affect the provision of efficient aeronautical telecommunications and recommend appropriate corrective action;

c) Prepare, as necessary, CNS/ATM cost/benefit analyses for the implementation options of C, N an S elements; and

d) Study, as necessary, institutional arrangements for the implementation of C, N and S systems in the AFI Region.

2. WORK PROGRAMME

Item	Global Plan Initiatives	Task description	Priority	Target date
		Communications		
1.	GPI-22	Follow up and monitor the implementation of VHF coverage in the AFI region in accordance with AFI/7 Rec. 5/12.	A	APIRG/19
2.	GPI-22	Update the AFI AFTN routing directory	A	APIRG/19
3.	GPI-22	In coordination with the ATM/AIM/SAR Sub-group, participate in the development of a communication infrastructure to support an AFI Central AIS Database (AFI CAD)	A	Continuing
4.	GPI-17	Monitor the development, and coordinate the implementation of guidance material for service level agreements between air navigations service providers and ATN service providers	A	APIRG/19
5.	GPI-17	Review and update, if needed, the ICAO Register of AMHS managing domains and addressing information pertaining to AFI.	A	Continuing
		Navigation		
6.	GPI-21	Analyze and review the Report of the AFI GNSS Implementation Task Force.	A	Continuing
7.	GPI-21	Follow up and monitor the implementation of Phase 1 of the AFI GNSS Strategy.	A	Continuing
		Surveillance		
8.	GPI -9	Analyze and review CNS aspects of the report of the Aeronautical Surveillance Implementation Task Force.	A	APIRG/19
		Communications, Navigation and Surveillance – General matters		
9.	GPI -9 GPI-17 GPI-	Analyze, review and monitor the implementation and operation of aeronautical communications, navigation and surveillance	A	Continuing

Item	Global Plan Initiatives	Task description	Priority	Target date
	21 GPI-22	(CNS) systems, identify CNS deficiencies and propose measures for their elimination, as required		
10.	GPI -9 GPI-17 GPI-21 GPI-22	Give further consideration, as necessary, to the concept of multinational ICAO AFI air navigation facility/service addressed in the AFI/7 Report under Agenda Item 14 (AFI/7, Conclusion 10/6c).	C	Continuing
11.	GPI -9 GPI-17 GPI-21 GPI-22	In co-ordination with the ATS/AIS/SAR Sub-group, continue the evolutionary and harmonized development of the AFI CNS/ATM Systems Implementation Plan (AFI/7 Concl. 13/1).	A	Continuing
12.	GPI -9 GPI-17 GPI-21 GPI-22	In co-ordination with the ATS/AIS/SAR Sub-group, develop, as necessary, comprehensive business cases for competing CNS/ATM elements implementation options for the routing areas.	B	Continuing
13.	GPI -9 GPI-17 GPI-21 GPI-22	Co-ordinate plans developed by States, international organizations, airlines and industry for the implementation of the regional CNS/ATM systems implementation plan; and monitor CNS/ATM systems research and development, trials and demonstrations within the AFI Region and information from other regions.	B	Continuing
14.	GPI -9 GPI-17 GPI-21 GPI-22	Coordinate the implementation of ICAO Global Plan Initiatives pertaining to CNS and develop associated regional performance objectives.	A	Continuous
		Aeronautical Spectrum		
15.	GPI-23	Coordinate regional activities aimed at promoting ICAO position for ITU-WRC meetings, and improving aeronautical spectrum management and control in the Region.	A	Continuing
16	GPI-23	Review the report of the AFI Frequency Management Group	A	APIRG/19

Priority:

A: High priority tasks on which work should be speeded up;
B: Medium priority tasks, on which work should be undertaken as soon as possible, but without detriment to priority A tasks; and
C: Lesser priority tasks, on which work should be undertaken as time and resources permit, but without detriment to priority A and B tasks.

3. COMPOSITION:

Algeria, Angola, Cameroon, Congo, Côte d'Ivoire, D.R. of Congo, Egypt, Eritrea, Ethiopia, Gambia, Ghana, Guinea, Kenya, Malawi, Mali, Mauritius, Morocco, Niger, Nigeria, Senegal, South Africa, Spain, Sudan, Tanzania, Tunisia, Zambia, ACAC, ASECNA, IATA, and IFALPA.

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Appendix G

Description of strategies for the implementation of the ICAO Global Plan initiatives pertaining to Communications, Navigation and Surveillance (CNS)

(Global Air Navigation Plan, Doc 9750)

1. COMMUNICATION INFRASTRUCTURE (GPI-22)

Description of strategy

1.1. ATM depends extensively and increasingly on the availability of real-time or near real-time, relevant, accurate, accredited and quality-assured information to make informed decisions. The timely availability of appropriate aeronautical mobile and fixed communication capabilities (voice and data) to accommodate ATM requirements and to provide the adequate capacity and quality of service requirements is essential. The aeronautical communication network infrastructure should accommodate the growing need for information collection and exchange within a transparent network in which all stakeholders can participate.

1.2. The gradual introduction of performance-based SARPs and system-level and functional requirements will allow the increased use of commercially available voice and data telecommunication technologies and services. In the framework of this strategy, States should, to the maximum extent possible, take advantage of appropriate technologies, services and products offered by the telecommunication industry.

1.3. Considering the fundamental role of communications in enabling aviation, the common objective is to seek the most efficient communication network service providing the desired services with the required performance and interoperability required for aviation safety levels at minimum cost.

2. DATA LINK APPLICATIONS (GPI-17)

Description of strategy

2.1. The implementation of less complex data link services (e.g. pre-departure clearance, oceanic clearance, D-ATIS, automatic position reporting) can bring immediate efficiency benefits to the provision of ATS. Transition to the use of data link communications for more complex safety-related uses that take advantage of a wide variety of CPDLC messages, including ATC clearances, is already being successfully implemented.

2.2. Use of CPDLC and implementation of other data link applications can bring significant advantages over voice communication for both pilots and controllers in terms of workload and safety. In particular, they can provide efficient linkages between ground and airborne systems, improved handling and transfer of data, reduced channel congestion, reduced communication errors, interoperable communication media and reduced workload. The reduction of workload per flight translates into capacity increases and enhanced safety.

2.3. Communication data link and data link surveillance technologies and applications should be selected and harmonized for seamless and interoperable global operations. ADS-C, ADS-B and CPDLC are in service in various regions of the world but lack global harmonization. Current regional initiatives, including utilizing unique message subsets and CPDLC procedures, hinder efficient development and acceptance for global aircraft operations. Existing and emerging technologies should be implemented in a harmonized global manner in the near term to support long-term goals. Harmonization will define global equipage requirements and therefore minimize user investment.

2.4. FANS-1/A and aeronautical telecommunication network (ATN) applications support similar functionality, but with different avionics requirements. Many internationally-operated aircraft are equipped with FANS-1/A avionics initially to take advantage of data link services offered in certain oceanic and remote regions. FANS-1/A equipage on international business aviation aircraft is underway and is expected to increase.

3. NAVIGATION SYSTEMS (GPI-21)

Description of strategy

3.1. Airspace users need a globally interoperable navigational infrastructure that delivers benefits in safety, efficiency and capacity. Aircraft navigation should be straightforward and conducted to the highest level of accuracy supported by the infrastructure.

3.2. To meet those needs, the progressive introduction of performance-based navigation must be supported by an appropriate navigation infrastructure consisting of an appropriate combination of global navigation satellite systems (GNSS), self-contained navigation systems (inertial navigation system) and conventional ground-based navigation aids.

3.3. GNSS provides standardized positioning information to the aircraft systems to support precise navigation globally. One global navigation system will help support a standardization of procedures and cockpit displays coupled with a minimum set of avionics, maintenance and training requirements. Thus, the ultimate goal is a transition to GNSS that would eliminate the requirement for ground-based aids, although the vulnerability of GNSS to interference may require the retention of some ground aids in specific areas.

3.4. GNSS-centered performance-based navigation enables a seamless, harmonized and cost-effective navigational service from departure to final approach that will provide benefits in safety, efficiency and capacity.

3.5. GNSS implementation will be carried out in an evolutionary manner, allowing gradual system improvements to be introduced. Near-term applications of GNSS are intended to enable the early introduction of satellite-based area navigation without any infrastructure investment, using the core satellite constellations and integrated multisensory airborne systems. The use of these systems already allows for increased reliability of non-precision approach operations at some airports.

3.6. Medium/longer-term applications will make use of existing and future satellite navigation systems with some type of augmentation or combination of augmentations required for operation in a particular phase of flight.

4. WORLD GEODETIC SYSTEM – 1984 (GPI-20)

Description of strategy

4.1. The geographical coordinates used across various States in the world to determine the position of runways, obstacles, aerodromes, navigation aids and ATS routes are based on a wide variety of local geodetic reference systems. With the introduction of RNAV, the problem of having geographical coordinates referenced to local geodetic datums is more evident and has clearly shown the need for a universal geodetic reference system. ICAO, to address this issue, adopted in 1994 the World Geodetic System — 1984 (WGS-84) as a common horizontal geodetic reference system for air navigation with an applicability date of 1 January 1998.

4.2. Fundamental to the implementation of GNSS is the use of a common geographical reference system. ICAO adopted the WGS-84 Geodetic Reference System as that datum, and many States have implemented or are implementing the system. Failure to implement, or a decision to use an alternative reference system, will create a seam in ATM service and will delay the full realization of GNSS benefits. Completion of the implementation of the WGS-84 Geodetic Reference System is a prerequisite for a number of ATM enhancements, including GNSS.

5. SITUTIONAL AWARENESS (GPI-9)

Description of strategy

5.1. The further implementation of enhanced surveillance techniques (ADS-C or ADS-B) will

allow reductions in separation minima and an enhancement of safety, increase in capacity, and improved flight efficiency, all on a cost-effective basis. These benefits may be achieved by bringing surveillance to areas where there is no primary or secondary radar, when cost-benefit models warrant it. In airspaces where radar is used, enhanced surveillance can bring further reductions in aircraft separation minima and improve, in high traffic density areas, the quality of surveillance information both on the ground and in the air, thereby increasing safety levels. The implementation of sets of quality-assured electronic terrain and obstacle data necessary to support the ground proximity warning systems with forward-looking terrain avoidance function as well as a minimum safe altitude warning (MSAW) system will benefit safety substantially.

5.2. Implementation of surveillance systems for surface movement at aerodromes where weather conditions and capacity warrant will also enhance safety and efficiency while implementation of cockpit display of traffic information and associated procedures will enable pilot participation in the ATM system and improve safety through greater situational awareness.

5.3. In remote and oceanic airspace where ADS-C is used, FANS capabilities exist on many air transport aircraft and could be added to business aircraft. ADS-B can be used to enhance traffic surveillance in domestic airspace. In this respect, it should be noted that the 1090 extended squitter is available and should be accepted as the global choice for the ADS-B data link.

5.4. At terminal areas and at aerodromes surrounded by significant terrain and obstacles, the availability of quality-assured terrain and obstacle databases containing digital sets of data representing terrain surface in the form of continuous elevation values and digital sets of obstacle data of features, having vertical significance in relation to adjacent and surrounding features considered hazardous to air navigation, will improve situational awareness and contribute to the overall reduction of the number of controlled flight into terrain related accidents.

6. AERONAUTICAL RADIO SPECTRUM (GPI-23)

Description of strategy

6.1. States need to address all regulatory aspects on aeronautical matters on the agendas for International Telecommunication Network (ITU) World Radiocommunication Conferences (WRC). Particular attention is drawn to the need to maintain the current spectrum allocations to aeronautical services.

6.2. The radio spectrum is a scarce natural resource with finite capacity for which demand from all users (aeronautical and non-aeronautical) is constantly increasing. Thus the ICAO strategy on aeronautical radio spectrum aims at long-term protection of adequate aeronautical spectrum for all radio communication, surveillance and radio navigation systems. The process of international coordination taking place in the ITU obliges all spectrum users (i.e. aeronautical and non aeronautical) to continually defend and justify spectrum requirements. Civil aviation operations are expanding globally creating pressure on the already stressed and limited available aeronautical spectrum.

6.3. The framework of this initiative involves the support and dissemination by States of the ICAO quantified and qualified policy statements of requirements for aeronautical radio frequency spectrum agendas for ITU World Radiocommunication Conferences (WRC). This is necessary to maintain the current spectrum allocations to aeronautical services and ensure the continuing availability of adequate aeronautical radio spectrum and ultimately the viability of existing and new air navigation services globally.

-END-