INTERNATIONAL CIVIL AVIATION ORGANIZATION

AFI PLANNING AND IMPLEMENTATION REGIONAL GROUP
SEVENTEENTH MEETING (APIRG/17)
(Burkina Faso, 2 to 6 August 2010)

Agenda Item 3.3: Communications, Navigation and Surveillance (CNS)
Review of the Report of CNS/SG/3 Sub-Group

Outcome of the eighteenth meeting of AFI Satellite Network Management Committee (SNMC/18) and related follow up activities

(Presented by the Secretariat)

SUMMARY

This paper presents the outcome of the eighteenth meeting of AFI Satellite Network Management Committee (SNMC/18) for review by APIRG.

Action by the meeting is at paragraph 3.

References :

[1] – SNMC/17 Report

[2] – SP AFI / RAN Report

[3]– APIRG/16 Report

Related ICAO Strategic Objectives: A, D &E

1. INTRODUCTION

1.1 The Eighteenth Meeting of the AFI Satellite Network Management Committee (SNMC/18) was held at the Splendid Hotel in Ouagadougou, Burkina Faso, from 01 to 04 June 2010, at the invitation of ASECNA.

1.2 This paper provides APIRG/17 with the outcome of SNMC/18) meeting. Appendix A hereto contains the SNMC/18) conclusions and decisions and Appendix B shows the conclusions and decisions of the Joint Technical Evaluation and re-engineering exercise conclusions as endorsed by the SNMC/18 meeting.

2. DISCUSSIONS

2.1 Follow up on SNMC/17 Conclusions

2.1.1 The meeting reviewed the status of implementation of the twelve (12) SNMC /17 Conclusions. It was noted that some conclusions have been partially implemented while others need to be implemented. The status of implementation of SNMC/17 conclusions is presented in Appendix B to SNMC/18 report and the meeting therefore made conclusion 18/01 in Appendix A to this Working Paper.

2.1.2 The meeting also discussed the issue of maintenance and operational Personnel exchange and training. It was noted that although some efforts have been made by stakeholders, namely: Ghana, Roberts and ASECNA, the rate of Personnel exchange and training remains low compared to the technical challenge experienced by such Personnel. The meeting found that it should be of benefit that member States build a common training programme based on the common components of AFISNET Stations.

2.1.3 The meeting also recognized that between two SNMC meetings the follow up of the status of implementation of the current conclusions is not formally planned. It was proposed that the current coordinating State/Organization be nominated for such task in accordance with the updated SNMC Terms of Reference.

2.2. Review of operational statistics of availability for AFISNET-supported links

2.2.1. Under this agenda item the meeting examined the statistics of availability of the links supported by AFISNET presented by the secretariat. When reviewing the performance of the AFTN circuits supported by the main AFI centers, the meeting noted important improvement around some main centers as Dakar and Niamey while others as Brazzaville are experiencing a low availability rate, less than the recommended target value of 97%.

2.2.2 It was also noted and concluded that the availability of new flight plan format, the requirements of RVSM space management, the automation of flight data processing (including flight plans) and the automation of AIS (including NOTAM messages), need to be enhanced and urged the States/Organizations to continue in their efforts to increase AFS AFTN performance in particular for those current failing to meet circuits performance.

3. Review of AFISNET earth stations performance

3.1 SNMC meeting agreed that many factors have to be taken into consideration for the assessment of Mean Time Between Failures (MTBF). It was also noted the lack of a common form with a consolidated list of components to be evaluated. The meeting discussed at length the parameters to be considered, and concluded that it was necessary to develop an assessment form to be circulated among member states and adopted. ASECNA and Ghana Civil Aviation Authority (GCAA) were tasked to provide SNMC members with a draft form.

4. Review/Updating of AFISNET nodes

4.1 The meeting discussed the updating of AFS nodes in terms of location, geographical coordinates, and frequency plan. It was stated that these data have been collected in the past and the meeting encouraged the stakeholders to update the data including those related to the new VSAT stations.

4.2 The meeting also agreed that all these data are available and could be sent quickly to the secretariat for compilation.

5. Implementation of Special AFI/RAN meeting (SP AFI RAN 2008) recommendations 6/19

5.1 The meeting examined the status of implementation of AFI/RAN Conclusion 6/19: Planning, implementation and operation of very small aperture terminal (VSAT) networks in the AFI Region that calls for regular meetings of all AFI network managers.

5.2 The meeting was provided with the ongoing information pertaining to the neighboring Networks that may be involved in such regular meetings (CAFSAT, NAFISAT, SADC/2…) called for by SP AFI RAN 08.

5.3 In particular, the meeting took into consideration the fact that the SAT/15 meeting (Lisbon, Portugal, 19-21 May 2010) has set up the CAFSAT Network Management Committee (CNMC) based on the SNMC model so that the similar management exercise of the two networks will be a step towards achieving the regular regional meetings called for by SP AFI RAN.

6. Ways of achieving fruitful participation at SNMC meetings.

6.1 It was agreed that in order to ensure good participation, consolidated Terms of Reference should be developed for the management of the meetings of each AFI local Sub-Network. The outcome of these meetings, which can be of common interest to all stakeholders, should serve as inputs for the regular AFI regional meetings.

7. The appropriate body for reporting results of Regional meetings.

Review of the report of the Joint Technical Evaluation Team

7.1 SNMC/18 examined the status of implementation of Conclusion 17/02 of SNMC/17: AFISNET Network Joint Technical Evaluation and Re-engineering that set up a Joint Technical Team for the Evaluation and the Re-engineering of AFISNET.

7.2 It was noted that the joint technical Team held its first coordinating meeting in Dakar from 13 to 14 April 2010. This meeting developed appropriate framework to conduct the evaluation of the system/strategy (Templates, Report frame, List of earth station components to be evaluated, etc.). The meeting approved the conclusions of the joint Technical meeting presented in Appendix C to its report.

Implementation of Special AFIRAN meeting recommendations 6/18 : AFISNET modernization and re-engineering

7.3 The meeting discussed the implementation of SP AFI/RAN Conclusion 6/18: AFISNET Technical Evaluation and re-engineering, that calls for AFISNET Evaluation and re-engineering through the actions undertaken on the subject since SNMC/17.7.1.4 The group noted that the joint technical evaluation and re-engineering exercise was successfully conducted from 01 to 30 June 2010, as stated in the relevant report presented in Appendix D to SNMC/ 18 reports.

7.5 The meeting examined the final Report of the Joint Technical Evaluation and re-engineering exercise. The main recommendations of the report stated that AFISNET challenges are mainly caused by:

- Failure of Automatic Messages Switch Systems;
- Failure or incompatibility between VCSS,;
- Lack of calibration of test equipments and;
- Lack of redundancy of modems.

The meeting agreed that SNMC members should remedy the above deficiencies

7.6 The secretariat informed the meeting that some SNMC neighboring centers, namely SAT states are modernizing their end users interface facilities and that exercise required regional coordination for end to end compatibility and interoperability. It was noted that for the current and forthcoming Messages or Voice Switching systems coordination should be undertaken to ensure their compatibility and interoperability. The meeting therefore raised the necessity to collect, compile and circulate the technical data to facilitate the interoperability of the systems.

7.7 The secretariat provided the meeting with the status of implementation of new messages switches in WACAF and its neighboring centers and informed the meeting that CNS/SG/3 made a draft conclusion asking APIRG/17 to create an AFI AMHS implementation Task Force (see WP/ 6). The meeting examined the status of implementation of the upgrade/replacement of AFTN messages Switches in SNMC centers and recognized that some progress is ongoing in the view of the implementation of AMHS as part of ATN.

7.8 Moreover, the meeting discussed the transition plan (from AFTN to AMHS) exercise and stated on the necessity to ensure AFS/AFTN continuity of service during this transition period.

7.9 The meeting examined the conclusion of SAT/15 meeting which deals with the issue of ATS-Voice numbering Plan in accordance with the ICAO Manual on ATS Ground-Ground Voice Switching and Signaling (Doc 9804, Chapter 2 Section 2.3). It was noted that some SAT States have been conducting trials on ATS-Voice switching which needs ATS-Voice numbering Plan.

7.10 It was recognized that the implementation of the Voice Switching in SNMC centers requires a close coordination between ANSPs.

7.11 The meeting supported the SAT/15 meeting conclusion that calls APIRG to create an AFI Working Group to conduct the technical study for the development of a global ATS voice numbering plan for AFI Region and harmonize its implementation frame.

7.12 The meeting agreed on the need to calibrate the AFISNET Test Equipments in order to ensure the reliability of the parameters measured during maintenance operations. The meeting also noted that in a RVSM managed space context there was need to comply with SMS requirements and the maintenance operations that meet required standards

7.13. However the investment for the realization of a Test Equipments Calibration Center is costly for individual ANSP in regard with the number of Test Equipments to be calibrated. The meeting decided that SNMC members' effort on cooperative arrangement are the best for a common regional calibration center for Test Equipments.

7.14 AFISNET Maintenance Personnel management was deeply discussed by the meeting. It was stated that all the SNMC Maintenance structures are facing lack of either adequate teams or suitable training courses for the maintenance Personnel.

7.15 It was also noted that real opportunities could be taken through partnership with satellite Providers and facilities Vendors for the provision of updated courses.

7.16 The meeting also recommended that the training mechanism be built in line with ICAO ATSEPs recommended programme followed by licensing of qualified Personnel.

7.1.17 The meeting discussed at length to find the best way to realize the re-engineering of the network based on the joint technical evaluation. It was agreed to update the mandate of the Joint Technical Team tasked to pursue the technical study for the re-engineering. The study should focus on AFISNET topology, components, base-band and satellite access, and bandwidth optimization.

7.1.18 Meanwhile, the meeting agreed that States/Organizations take the urgent appropriate actions to clear the pending current deficiencies before the end of year 2010.

8 AFISNET band width re-engineering;

8.1 The meeting recognized that the obsolete base-band components of AFISNET have been gradually replaced by other modems in the framework of coordinated arrangements between ASECNA, NAMA and Ghana. Thus, the major part of the spectrum allocated to the IBS system is currently unused, while States/Organizations continue to be charged for unused IBS bandwidth.

8.2 The meeting examined the status of implementation of Conclusion 17/10 of SNMC/17 calling for IBS band conversion and noted that it has not been implemented. The meeting agreed that each State/Organization should update the current status of usage of IBS frequencies for a technical/financial meeting with INTELSAT.

9. Review of CNS/SG/3 conclusions related to AFISNET

9.1 The meeting provided an opportunity to address the participants on the AFISNET related conclusions of the CNS/SG/3 meeting (Nairobi, Kenya, 26-30 April 2010). It was noted that the CNS/SG/3 meeting developed three draft conclusions dealing with the provision of Aeronautical Fixed Service (ATS/DS & AFTN) through AFISNET and one draft conclusion related to AFISNET Evaluation and re-engineering as follows:

- Conclusion 03/2 for AFTN links
- Conclusion 03/7& 03/9 for ATS/DS links
- Conclusion 03/11 for AFISNET Network evaluation and re-engineering

9.2 For the improvement of Aeronautical Mobile Service (AMS) in the AFI Region the meeting noted that CNS/SG/3 developed the following two draft conclusions that address VHF coverage in airspace of SNMC member States/Organizations and encourage AFI States to cooperate with IATA during the AMS (VHF/HF) Coverage surveys:

- Conclusion 03/14 calling for the completion and the improvement of VHF coverage; ASECNA and NAMA are concerned.

- Conclusion 03/15 urging AFI States to cooperate with IATA during the AMS (VHF/HF) coverage surveys; the forthcoming survey is planned from 7 to 25 June 2010.

9.3 The meeting noted that these CNS/SG/3 meeting conclusions are to be taken into account by SNMC members in order to clear the current deficiencies.

10. AFISNET integration with other AFI regional networks (CAFSAT, NAFISAT, SADC/2)

10.1 The meeting analyzed the status of interconnection between AFISNET and its neighboring Networks (CAFSAT, NAFISAT, and SADC/2) and noted that the interconnection was completed as planned. AFISNET is now linked to CAFSAT, NAFISAT and SADC/2 through a balanced interconnection procedure.

10.2 However, in order to clear some remaining unimplemented circuits the interconnection of AFISNET (Brazzaville & Bangui) with stations located in DRC (Kinshasa & G'badolite) should be undertaken.

11. Required Communication Performance for AFISNET

11.1 The meeting was introduced with the concept of Required Communication Performance (RCP) to support Aeronautical Mobile Service provision through satellite based remote VHF stations.

11.2 The meeting took note of this information and concluded that this concept is a helpful tool for the provision of AMS in the framework of RVSM and SMS requirements.

12. Updating SNMC Form of Agreement.

12.1 The meeting discussed a draft Form of Agreement and Terms of Reference for AFISNET presented in Appendix F to SNMC/18 report and decided that this proposal should be circulated for input before its final approval by the end of December 2010.

13. Any other business: Technical Audit of AFISNET

13.1.1 The meeting was informed by ASECNA that the Agency plans to conduct an external technical audit of AFISNET nodes located in its centers. The meeting applauded this exercise and noted that in order to reach successful results such audit should be global and should involve the whole AFISNET nodes.

13.1.2 ASECNA was invited to circulate the draft Terms of Reference of the audit for inputs and compilation by the secretariat.

14. SNMC Next Meeting

14.1 Since its inception, SNMC meetings are hosted by States/Organizations successively with no formal schedule. In view of the expected future Terms of Reference the meeting tasked the secretariat to develop a draft schedule of future meetings over the next 5 years. This template is presented in Appendix G to the report.

14.2 The meeting welcomed the offer of Ghana to host the next SNMC/19 meeting. ICAO will coordinate with Ghana on the precise venue and dates, and SNMC members notified in due course.

15. Action by APIRG

15.1 The meeting is invited to:

a) Note the information contained in this paper;

b) Note the work carried out by SNMC member States as a key sub-regional mechanism between AFI ANSPs in AFS and AMS provision;

c) Encourage States and Organizations concerned to implement SNMC/18 conclusion and SNMC outstanding conclusions in particular to complete the AFISNET joint technical evaluation and re-engineering exercise as recommended by conclusion 6/18 of AFI/RAN meeting;

d) Approve the SNMC/18 conclusions pertaining to actions to be taken in a regional level (ATS-Voice numbering plan, implementation of AMHS…);

e) Provide the SNMC members States with any appropriate guidance and support for the implementation of ICAO provisions.

APPENDIX A

LIST OF CONCLUSIONS AND DECISIONS OF THE SNMC/18 MEETING

Agenda Item 1: Follow up of SNMC/17 Conclusions

Conclusion 18/01: Implementation of SNMC/17 outstanding conclusions

That:

SNMC member States/Organizations are urged to implement SNMC/17 outstanding conclusions presented in Appendix B and pertaining to corrective actions to be undertaken in order to:

a) Restore and stabilize AFISNET reliability and availability as required;
b) Improve maintenance coordination and monitoring procedures.

Conclusion 18/02: Maintenance Personnel exchange and Training

That:

SNMC States/Organizations reinforce maintenance personnel exchange and training including language proficiency and develop a maintenance personnel training programme based on the common facilities by the end of December 2010 and ICAO coordinates the finalization of this programme.

Conclusion 18/03: Follow up on the status of implementation of SNMC conclusions

That:

1. SNMC member States forward, quarterly, to the current coordinating State/Organization the status of implementation of SNMC meeting conclusions for compilation and reporting to all stakeholders; and
2. ICAO continues to support States/organizations bilateral arrangements for their implementation.

Agenda Item 2: Review of operational statistics of availability for AFISNET-supported links

Conclusion 18/04: Improvement of Operational availability of AFISNET

That:

SNMC member States/organizations endeavor to clear out all the pending identified AFS deficiencies by the end of year 2010.

Agenda Item 3: Review of AFISNET earth stations performance

Conclusion 18/05: AFISNET earth station Performance Data Collection Form

That:

ASECNA and Ghana CAA develop and submit an Earth Stations Performance Data Collection Form (PDCF) to facilitate collection of stations availability data, taking into consideration the most sensitive components of the network.

Agenda Item 4: Review/Updating of AFISNET nodes

Conclusion 18/06: Updating AFISNET nodes

That:

States/Organizations update their nodes list with their coordinates, the frequency plan and report to ICAO not later than 15 July 2010 and for ICAO to circulate a consolidated file to the stakeholders.

Agenda Item 5: **Implementation of Special AFIRAN meeting recommendations 6/18 and 6/19**

Conclusion 18/07: Implementation of Conclusion 6/19 of SP AFI RAN

That:

a) SNMC members States/Organization participate in the AFI VSAT managers meeting called for by Conclusion 6/19 of the SP AFI RAN meeting on the basis of representative (s) from each SNMC members Sate/Organization (ie: NAMA, GCAA, Roberts FIR, ASECNA);
b) ICAO regional Offices (WACAF and ESAF) initiate suitable arrangements for the venue of the first meeting during which the Terms of Reference and frequency of meetings will be defined;
c) APIRG indicates the body to which reports of these global meetings will be addressed.

Agenda Item 6: Review of the report of the Joint Technical Team

Decision 18/01: Adoption of the Report of the first meeting of the Joint Technical Evaluation and Re-engineering Team

That;

The Conclusions of the first meeting of the Joint Technical Evaluation and Re-engineering Team be adopted as presented in Appendix C.

Agenda Item 7: AFISNET Modernization and Re-engineering

Conclusion 18/08: Implementation of the recommendations of the Joint Technical Team for AFISNET Evaluation and Re-engineering

That:

States/Organizations have urged to implement the recommendations of the report of the AFISNET Joint Technical Evaluation and Re-engineering Team as presented in Appendix D by focusing their efforts on the following items:

a) Clearing current malfunctions;
b) Upgrade of Multiplexers;
c) Upgrade of Automatic Messages Switching Systems
d) Upgrade of VCSS
e) Redundancy of modems and multiplexers
f) Calibration of test equipments

Conclusion 18/09: Sharing of technical data

That:

All Administrations/Organizations send relevant technical data on current and intended Automatic Messages Switching and Voice Communication Switching Systems upgrades to ICAO WACAF Office for tabulation and further remittance to administration for their study.

Conclusion 18/10: Continuity of AFTN Service

That:

When upgrading/replacing Automatic Messages Switching Systems, Administrations/Organizations should consider backward integration with existing messages switches with the emerging technology (AMHS) in order to ensure the continuity of AFTN service within the transition (AFTN/AMHS) time.

Conclusion 18/11: ATS-Voice Numbering Plan

That:

When upgrading/replacing Voice Communication Switching Systems Administrations/Organizations should take into consideration the need of an ATS-Voice numbering plan for AFI.

Decision 18/02: Need of a calibration center for AFISNET Test Equipments

That:

A common calibration center for test equipments be established in the WACAF region for the benefit of members States/Organizations as well as external client.

Conclusion 18/12: AFISNET Maintenance Human Factors

That:

AFISNET Administrations /Organizations provide AFISNET maintenance structures with adequate personnel with appropriate training:

a) Training workshops should be performed in partnership with industry (Satellite Service Providers, facilities vendors….) in order to take benefit from their expertise in the current and emerging technologies;
b) Training should be in line with ICAO ATSEPS recommended programme followed by licensing of qualified personnel.

Decision 18/03: Updating the mandate of the Joint Technical Evaluation and Re-engineering Team

That:

The Joint Technical Evaluation and Re-engineering Team pursues the task assigned to it by SNMC/17 and completes the study for AFISNET re-engineering by the end of October 2010.

This study will focus on the following items taking into consideration advantages/disadvantages, cost-effectiveness, reliability and safety risks aspects:

a) AFISNET topology;
b) AFISNET components;
c) AFISNET base band and satellite access; and
d) AFISNET bandwidth optimization.

Meanwhile, States/organizations take the urgent appropriate actions to clear out the pending current deficiencies before the end of year 2010.

Agenda Item 8: AFISNET band width re-engineering;

Conclusion 18/13: Conversion of IBS Band to leased band

That:

States/organizations pursue and complete the implementation of conclusion of SNMC17/10 by adopting the following process:

a) IBS carrier status of stations be forwarded to ASECNA for compilation and transmission to INTELSAT; and
b) A Technical/financial meeting be held by SNMC members with INTELSAT to ensure the conversion of IBS band to a leased band.

Agenda Item 9: Review of the CNS/SG/3 conclusions related to AFISNET

Conclusion 18/14: Implementation of CNS/SG/3 draft conclusions related to AFISNET

That:

SNMC members States/Organizations are urged to implement the draft conclusions of CNS/SG/3 related to AFISNET as presented in Appendix E;

When updating the current deficiencies status for submission to APIRG/17, ICAO deletes the operating Accra/ Luanda link from the list of AFS deficiencies.

Agenda Item 10: AFISNET integration with other AFI regional networks (CAFSAT, NAFISAT, SADC/2)

Conclusion18/15: Interconnection between AFISNET with neighboring Networks

That:

The concerned States/Organizations are urged to complete the interconnection exercise of AFISNET with neighboring networks, in particular ASECNA, to take the appropriate actions in coordination with RVA (DRC) in order to realize the interconnection between the following nodes by the end of year 2010:

a) Brazzaville/Kinshasa
b) Bangui/G'Badolite

ICAO WACAF supports the bilateral arrangements between ASECNA and RVA.

Agenda Item 11: Required Communication Performance for AFISNET

Conclusion18/16: RCP for AFISNET

That:

SNMC members take the advantage of RCP requirements stated in ICAO Doc 9869 to improve the provision of VSAT based Aeronautical Mobile Services and ensure the availability of AFISNET hubs and remote VHF stations accordingly.

Agenda Item 12: Updating SNMC Form of Agreement.

Conclusion18/17: Form of agreement and Terms of Reference of AFISNET

That:

The Form of Agreement and the Terms of Reference of AFISNET be circulated by SNMC secretariat as soon as possible;

States/Organizations forward their comments and remarks not later than 3 September 2010;

ICAO compiles and forwards the amended Form of Agreement and Terms of Reference of the SNMC to be signed by the end of December 2010.

Agenda Item 13: Any other business

Conclusion18/18: Audit of AFISNET.

That:

In the framework of the implementation of SP AFI RAN conclusion 6/18 and to consolidate the recommendations within the report of the Joint Technical Evaluation and Re-engineering Team, an AFISNET global audit be conducted in this regards.

a) ASECNA is to circulate a draft Terms of Reference for the Audit not later than end of September 2010;
b) SNMC members are to update the draft report and forward to ICAO; and
c) ICAO is to compile and finalize the Terms of Reference for a call for Tenders.

APPENDIX B : REPORT OF THE JOINT TECHNICAL EVALUATION AND RE-ENGINEERING

ASECNA/GCAA /NAMA/ROBERTS FIR

JOINT TECHNICAL EVALUATION OF AFISNET

DRAFT REPORT

May 2010

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GLOSSARY

8-PSK	8- Phase Shift Keying
	A
AAC	Aeronautical Administrative Communications
AFISNET	Africa Indian Sub NETwork ocean area
AFTN	Aeronautical Fixed Telecommunication Network
AMSS	Aeronautical Message Switching System
ANSP	AeroNautical Service Provider
ASR	Air Safety Report
ASECNA	Agency for the Safety of Air Navigation in Africa and Madagascar
ATN	Aeronautical Telecommunications Network
ATS	Air Traffic Services
	B
BW	Bandwidth
BER	Bit Error Rate
	F
FDMA	Frequency Division Multiple Access
FTDMA	Frequency Time Division Multiple Access
FEC	Forward Error Coding
	G
GCAA	Ghana Civil Aviation Authority
GNSS	Global Navigation Satellite System
	I
ICAO	International Civil Aviation Organization
INTELSAT	INTernational TELecommunication SATellite
	M

MF-TDMA Maintained Frequency – Time Division Multiple Access

MCPC Multiple Channel Per Carrier

MOL2P Multiplexeur Optimisant la Liaison avec Priorité à la Parole

N

NAFISAT North Eastern AFI VSAT network

NAMA Nigeria Airspace Management Agency

NMS Network Management System

O

OPMET **Operational Meteorological data exchanges**

P

PEP Performance Enhancing Proxies

Q

QoS Quality of Service

QPSK Quadrature Phase Shift Keying

R

RS Reed Solomon Error Correction Code

S

SADC Southern African Development Community

SCPC Single Channel Per Carrier

T

TCP Transmission Control Protocol

TDMA Time Division Multiple Access

V

VCSS Voice Communication Switching System

VSAT Very Small Aperture Terminal

Preamble

Background

In order to improve Air Navigation Safety in the Western and central Africa region, the satellite based Telecommunications network called AEROSATEL(renamed AFISNET) was conceived between 1986 and 1987 by ICAO and funded by European Union in 1992 . At the beginning eight stations for Nigeria, one for Ghana and six for ASECNA countries (Cameroon, Central Africa, Congo, Gabon, Niger and Chad) were implemented by ALCATEL.

Afterwards, the network was widened with the implementation of new stations in Dakar, Abidjan, Roberts FIR, Antananarivo and in other countries in western, Central, southern and northern Africa , Indian ocean (Maurice Island, Ile de la Reunion) and in Europe (Las Palmas, Toulouse).

As of today AFISNET comprises more than seventy (70) earth stations of B standard (11m), F2 (7.30m), F1 (3.7-4.5m) operating mainly in FDMA / SCPC mode in mesh/star topology.

AFISNET migrated successfully from satellite IS-903@325.5°East to satellite IS-10-02@359° East and is currently operating on transponders 20 EH/ 20 EH and 23 EH/ 23 EH and is fully interconnected to NAFISAT and SADC-2.

In the meantime, some domestic networks are using different protocols, satellite access as appeared in Ghana (FTDMA), Nigeria (TDMA), ASECNA (TDMA) and Roberts FDMA.

Purpose of the evaluation

- Evaluate the physical and operational performances of AFISNET
- Take corrective action in addressing malfunctioning of AFISNET nodes
- Preparation of the AFISNET audit

Assigned objectives

In accordance with the term of reference, the main objectives of the network evaluation are to:

- Identify its deficiencies and non-ICAO, WMO and ITU compliant elements/features;
- make the appropriate recommendations and proposals regarding the short-term, mid-term and long-term solutions and strategies to be implemented using appropriate modern technologies for achieving an enhanced, efficient, high performance, secure, CNS/ATM capable and cost-effective network, meeting interoperability and seamlessness requirements ; and
- evaluate the anticipated costs in view of a comprehensive project document to support a collective financing mechanism

Methodology

In accordance with the conclusions 16/07 and 17/02 and the SP RAN AFI/8 the SNMC established a joint technical team in order to conduct a comprehensive assessment of the network potential for current and future requirements and applications.

The first meeting of the joint technical Evaluation and Re-engineering team leaders was held in WACAF (Dakar 13-14 April 2010) and adopted the evaluation framework including the charts, the planning and the technical subgroups.

The joint technical team comprising representatives from ASECNA (Agency for the Safety of Air Navigation in Africa and Madagascar), NAMA (Nigeria Airspace Management Authority), GCAA (Ghana Civil Aviation Authority), Roberts FIR carried out the evaluation of AFISNET.

Samples of eleven (11) earth stations were identified for the evaluation process.

Presentation of AFISNET (Services, Applications, Topology)

The network was originally designed to support the following communication services in accordance with the Air navigation plan for the Africa-Indian Ocean (AFI) Region:

- ATS Direct Speech between adjacent FIRs;
- Aeronautical Fixed Telecommunications Network (AFTN);
- Operational meteorological data exchanges (OPMET);
- Operational Aeronautical Information Services exchanges.
- Support for remote VHF voice;
- Aeronautical Administrative support (AAC);

In addition to these services, the following communications could also be progressively supported by the network:

- Aeronautical Telecommunications Network (ATN)
- GNSS augmentation data transmission.
- Computer-to-computer data exchanges (ICC) between ATS Flight Data Processing Systems (FDPS); and
- Air/ground data link applications (ADS/CPDLC, ADS-B, DFIS, VDL…)

Description and evaluation of services and applications

Description and Evaluation of the AFTN

Operational Aspect

The Joint Technical Evaluation Team noted that most of the required AFTN circuits are implemented through direct satellite links with a minimum speed rate of 2400 bps, through X25 and/or V24 protocols and alphabet ITA2 or IA5. Bilateral circuits are also implemented and are taken into account in the AFTN routing table in order to improve the availability of AFTN service.

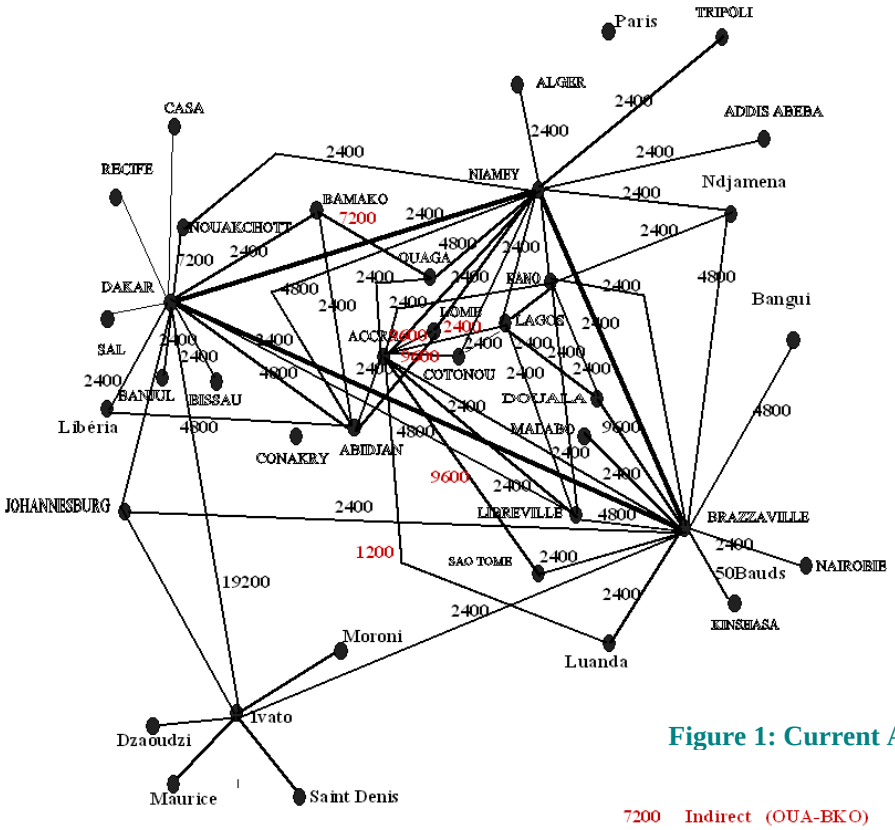

Figure 1: Current AFTN COM

Nevertheless the operational status recorded during the evaluation and the statistics provided by the visited sites indicated:

- A relative important number of AFTN circuits are performing below the required minimum of 97% and others are fluctuating between 80 and 97%.
- Instabilities on some links (Accra- Ouagadougou, Accra- Brazzaville, Kano-Brazzaville, etc);
- Several AFTN circuits have been out of service for a long time (Kano-Accra, Ndjamena-Maiduguri, Brazzaville-Luanda
- The lack of appropriate synchronization tool for Aeronautical Messages Switching Systems has resulted in difficulties to get accurate transit time statistics; however the transit times from the European CFMU are under five minutes.
- None concordance in transmit and receive messages statistics for the same circuit with difficulties to analyse the loss of messages ;
- Some AMSS statistics are not always accurate;
- Human errors are impacting on the accuracy of statistics.
- X25 AFTN circuits are being migrated to V24.

Technical aspects

The evaluation of the aeronautical message service (AFTN link availability, AFTN message availability, OPMET availability) shown that:

- Most of the AMSS were not synchronized to the general hour's system of the ANSP Technical Block. (transmit time was not possible to be assessed).
- The AMSS of some sites are outdated.

- Even the basic functionalities are not provided by the Aeronautical Messages Switching Systems, they must be upgraded on several sites where they have been in operation for more than ten years and cannot support some essential functionality (operational statistics based on the message type for example, management of messages tolerance as recommended by ICAO Annex 10 Volume 2, etc).

However, the mission was informed of the project relating to the implementation of a GPS clock on systems and operational services by some ANSP at ASECNA and NAMA.

Description and Evaluation of ATS/DS

Operational aspect

The Joint Technical Evaluation Team evaluated the ATS/DS in terms of implementation and performances and found out that:

- Most of the ATS/DS links are implemented through direct satellite links, however some links are still implemented by routing with double or triple hops (Ouagadougou/Abidjan, Bamako/Abidjan, Roberts/Bamako, Ouagadougou /Bamako) and are not reliable;
- Even though the performances are generally good, several links are not working properly and recorded long connection time. Time to establish communication, notably (Kano/Accra, Abidjan/Ouagadougou, Lagos/Libreville);

- ATS/DS links used direct or indirect connection with numbering through the VCS or PABX systems; if possible they should be implemented directly.
- Basically, most of the centers use Voice Communications Switching System, nevertheless some are out of date and don't work properly and faced spare parts problems;
- Several links are connected out of the VCCS due to incompatibility (FXS/FXO, E&M) or lack of capacity;

- The PoBox supplied at the beginning of the network is no longer used and the ANSP are implementing new VCSS;

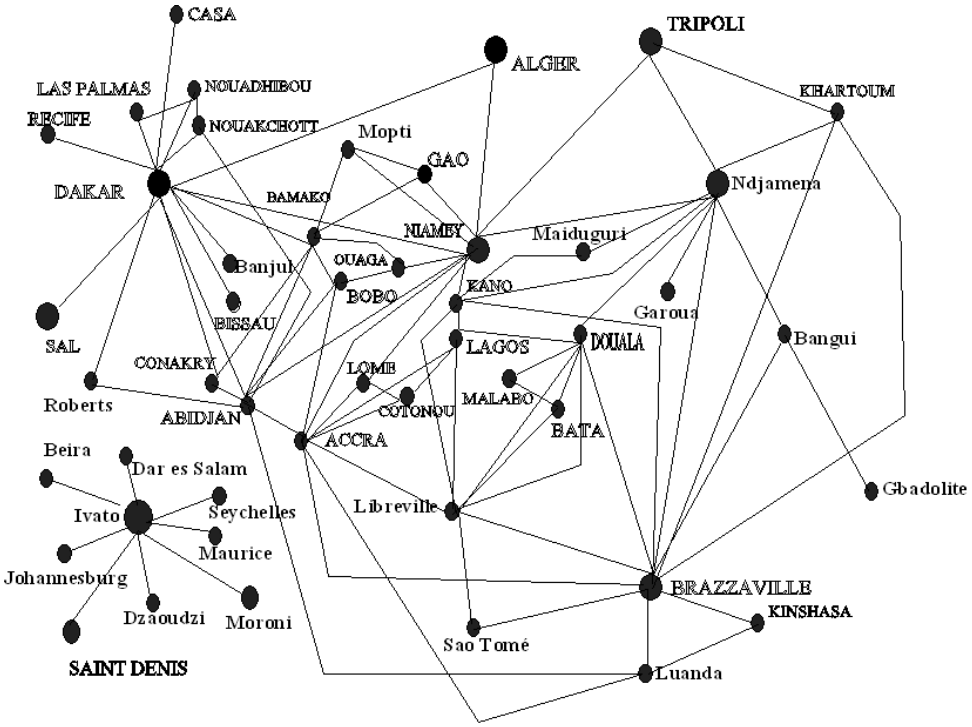

Figure 2: Current ATS/DS Links Chart

Technical aspect

The mission noted that:

- Some centers, are not yet equipped with VCSS and use many telephone sets installed generally in isolated ways in the controller's working Table, providing a difficult working environment for the controller.
- The installation project of VCSS in ongoing in Douala and Libreville
- Some of the centers are VCSS equipped with limited capacities making it impossible to integrate supplementary ATS/DS links.
- Most of the VCSS were not synchronized to GPS Clock Switch.
- The difficulties to implement some ATS/DS links are due to the interoperability issues between some ANSP VCSS.

The Joint technical Team noted ongoing VCSS projects in Kano, Douala, and Libreville.

Recommendations

Administrations/Organization:

- Should synchronize their VCSS to GPS clocks.
- Should accelerate the projects of implementing new VCSS.
- Should upgrade their VCSS in order to allow the integration of new ATS/DS links.
- Should solve the interoperability/interfacing aspects between ANSP VCSS by making their VCSS fully compliant with the "recommended switching and signalling system" as specified in ICAO Doc 9804 AN/762.

Description and Evaluation of remote VHF

ASECNA, GCAA, NAMA and Roberts FIR took advantage of AFISNET to extend their VHF coverage by deploying remote VHF via VSAT. As of today, more than fifty remote VHF stations have been implemented and are working normally under various conditions. These networks are built on star topology; around the hub stations with redundancy architecture guaranteeing an utmost availability of the service.

Based on the survey carried out by the controllers during the Joint Technical Evaluation, we came to the conclusion that the remote VHF providing air/ground communications are in good conditions. The quality (strength and clarity) of voice were evaluated and are between 3 and 5 when the remote stations are in operational mode.

However some deficiencies were recorded in the operation of remote VHF. The ASR (Air Safety Report) and the results of the last IATA/ANSP VHF/HF availability survey indicated sometimes lack of VHF or insufficient VHF coverage, low quality of the VHF. Some stations stay out of service for a long time. Most of the deficiencies regarding extended VHF coverage are in majority related to maintenance problems.

Extended VHF coverage projects are ongoing in Roberts FIR and in ASECNA areas to improve the VHF availability (densification).

- Power Supply problems;
- Delays in repairing stations failures ;
- Hostile environment (isolated sites)

Description and evaluation of the architecture and hardware

AFISNET operates on the satellite IS-10-02@359°E on transponders 20EH /20EH and 23EH /23EH and is built as a mesh /star network topologies operating on SCPC/ FDMA access. Based on the services requirement, AFISNET operate on 19.2 Kb/s, 32 Kb/s and 64 Kb/s carriers.

The following diagram provides the current architecture derived from the existing equipment and services.

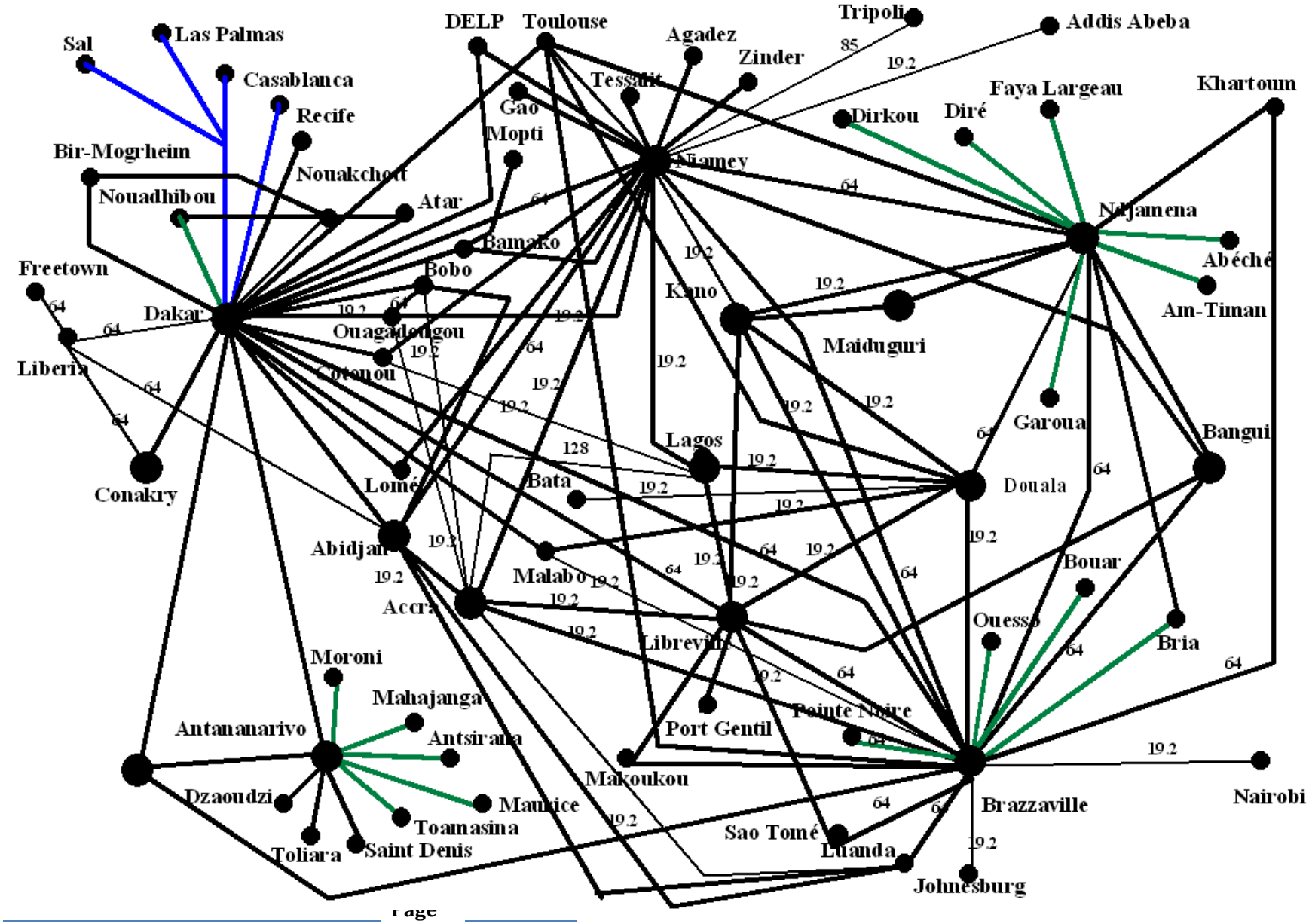

Figure 3: Current Composite Satellite Links Chart

Hardware

Multiplexers

The mission noted that most of the multiplexers in used were put into service more than ten (10) years ago. Some of these multiplexers (MICOM for example) are no longer manufactured consequently; their spare parts are no longer available.

The job cards of each equipment, after the installation were not available, that is why the MTTR and MTBF were not available in order to establish the availability ratios of the multiplexers.

The mission is also aware about the migration project of MICOM multiplexers in ASECNA, by the new generation of multiplexers available on the market.

In most of the sites multiplexers are not redundant in order to ensure the reliability of the links.

Satellite Modems

Currently different modems are deployed in many AFISNET nodes. Notably: FASTCOM, DATUM, COMTECH, COMSTREAM and PARADISE. Some of these modems operate in L band and C band (70 and 140 MHz).

Up/Down Converter

The mission has inventoried the following types of UP/DOWN Converters: ADVANTECH, MITEQ, and ALCATEL. The mission noted the usage of many additional amplifiers and splitters in cascaded connections.

Solid State Power Amplifier (SSPA)

The recorded SSPAs have been in service for ten (10) and are presently experiencing signs of aging deficiencies and they have to be progressively replaced.

Antenna Control Unit ACU/Motorization Unit (MU)

Those units have been put in service since the installation of the earth stations and deserve to be modernized.

Test Equipments

The joint technical evaluation has noted that almost all the test equipment used for maintenance purposes weren’t calibrated since their acquisition.

Spare Parts

The JTE noted the unavailability of spare parts for all types of equipment in operation and backup equipments in some centers.

Environment

The visited earth stations are working in relatively, good conditions with ambient temperature and an uninterrupted supply of clean energy. However most of them don't have hygrometer and thermometer sensors.

Human factors

The earth stations should compose of staff in quantity and quality to be able to face adequately the different technical challenges. But most of the time, the Technical and operational staff did not benefit from adequate training in satellite techniques, unless occasional site and factory trainings often quick and not in depth.

Summary Conclusions and Proposals

Compare to the initial architecture and topology, AFISNET has experienced a significant and deep evolution at the base band level, the large band and the RF equipment. The analogical ALCATEL multiplexer have been entirely replaced by digital MICOM/ MOL2P multiplexers since 2000 and the migration is still ongoing with the introduction of MEMOTEC type multiplexer.

To harmonize the networks, AFISNET States/Organizations should agree on the choice of a new generation multiplexer as the MICOM/ MOL2P are not currently manufactured and the spare parts are limited.

In all the sites the IBS modems and transpositions equipments have been decommissioned and replaced by modern satellite modems and transposition equipments, with modern protocols and efficient modulation (QPSK, 8-QPSK…). DATUM modems are currently the most used in majority of the sites visited whereas COMTECH EF DATA is used in Roberts FIR and PARADISE in NAMA domestic stations. These equipments are performing very well and are recording good reliability.

All the RF subsystems have been upgraded with SSPA which are performing quite well. States/Organizations should have a progressive upgrading plan of these equipments before they reach the end of their span.

Terminal equipments (AMSS, VCSS…) and human factors contributed greatly to the level of performance of the networks. AFISNET States/Organizations must address this issue and provide the necessary training required to operate modern equipment.

During the evaluation, some deficiencies were identified and addressed; others require more time or a deeper investigation. However these deficiencies are often due to lack of coordination or language barrier.

Even with these deficiencies, services are provided with relative satisfactory; all of the above concerns need to be adequately addressed for a smooth transition of the network into the new satellite communications technology to optimize the network in terms of efficiency and

bandwidth. The evolution should take into account the existing status of the network including the improvement done by each States/Organization in diversified circumstances.

- First solution : Using the current satellite access FDMA, migrate the users access (SCPC) to MCPC
- Second solution : changing the satellite access type from FDMA to TDMA

The two solutions have to be evaluated in term of cost and operational impact.

RECOMMENDATIONS OF THE JOINT TECHNICAL EVALUATION TEAM

The joint technical evaluation exercise was conducted on the framework of the agreed templates adopted by all members present in the Dakar meeting.

The teams are pleased to bring to ICAO notice that, we were well received in all the stations visited; technical staffs were extremely willing to readily make available required information/data. Overall, all the stations visited are robust and are working normally. However, since aeronautical services require the utmost from each telecommunication node, the team is recommending the following:

Upgrade of the Automatic Messages Switching Systems

The States/Organizations should upgrade and synchronize their Automatic Messages Switching Systems in order to be fully compliant with ICAO standard as they are almost reaching the end of their lifespan in order to provide reliable statistics tools to assess rightly the performances of the network.

Eliminating of the AFTN and ATS/DS Circuits deficiencies

As a matter of emergency, the States/Organizations should improve the availability of AFTN circuits performing less than 97% and restore the faulty circuits identified during the evaluation process particularly: Kano/Accra, Brazzaville/Kinshasa, Brazzaville Luanda, Brazzaville/Accra, Accra/Ouagadougou, Accra/Libreville, Libreville/Kano, etc.

Upgrade of the VCSS

As soon as possible the States/Organizations unless it has been done, should upgrade their VCSS in order to improve the availability of the ATS/DS links.

They should coordinated and take into account interface issues when implementing new systems in order to eliminate the problem of compatibility and interoperability

Maintenance of remote VHF stations

The States/Organization should improve the maintenance procedure of remote VHF to reduce the unavailability of remote VHF stations and should expedite the implementation of new remote VHF stations to provide a good coverage of the airspace

Maintenance and Operational procedures between adjacent centers

Standard Operational and maintenance Procedures should be established and applied between adjacent centers in order to minimize the impact of coordination on the performances of the network; the procedure manuals should be made readily available between the adjacent centers.

Redundancy and migration of the multiplexers

In order to improve the reliability of all the satellite links, the States/Organizations should plan the migration of current multiplexers as they are reaching the end of their lifespan and some manufacturers have ran out of business; so they should agree to choose robust multiplexers which allow dynamic routing for the management of the service channels and adopt multiplexers redundancy in their project

Redundancy of the modems

In order to enhance the reliability of the links, States/Organizations should ensure the redundancy N+1 of satellite modems, and should coordinate for the technology choices in order to avoid incompatibility/interoperability problem before implementing new satellite links; Administrations/Organization should promote the usage of satellite modems in L band (wide spectrum) during the implementation of new satellite links.

Spare parts availability

Spare parts should be made readily available at all stations and the means used to transport spares from one node to the other should be greatly improved in order to shorten down time of aeronautical services.

Test Equipments

Administrations/Organization should make the necessary arrangements in order to calibrate all the test equipments.

Planning of the SSPA /ACU/MU replacement

Administrations/Organization should plan the progressive replacement of SSPA, ACU and MU as they are reaching the end of their lifespan.

Up/Down Converter

Administrations/Organization should provide their earth stations with the active combiner/ amplifiers and splitters equipped with many inputs (12 or 24 inputs) in order to optimize the satellite modems operation.

Supervision

Administrations/Organization should equip their earth stations with global supervision system of each functional component of the earth station for the purpose of remote control maintenance operations.

Human factors

States/Organizations should endeavour to provide adequate training for all technical and operational staff in satellite communications including AFTN, ATS/DS and remote VHF.

Moreover, states/organizations should harmonize training programs for all technical and operational staff.

Application of safety case in the implementation of new ATM changes

With new ATM changes (installation of new equipments) states/organizations should ensure the maintenance of the air traffic services provision and to demonstrate through a safety assessment, that the safety of any significant change to the ATM systems will meet acceptable levels as required in ICAO Annex 11 in order to guarantee at least the same level of service before ATM changes.

Implementation of the future AFISNET Central Flow Management Unit (CFMU)

By taking into account:

- the current communications services in accordance with air navigation plan for the AFI region (AFTN, OPMET, AAC) supported by the AFISNET;

- the future services which will be progressively supported by the current network (AFISNET) (AMHS, GNSS and augmentation data transmission, Computer-to-computer data exchanges (ICC) between ATS Flight Data Processing Systems (FDPS), Air/ground data link applications (ADS/CPDLC, ADS-B, DFIS, VDL…);
- loss of operational messages between AMSS of adjacent operational centres;
- the erroneous operational statistics provided by the AMSS of the operational centres due to software conception default which do not respect ICAO practices and standard;
- great delays of putting back in service the AFTN links due to technical aspects of coordination between ANSP;

States/Organizations should envisage and anticipate the implementation of future AFISNET Central Flow Management Unit by step, with many levels in order to handle all the operational aeronautical data which will contribute to the safety of air navigation.

- Level 1: integrated system should be able to process flight plans, OPMET, environment data, airways and aerodrome cartography, SID procedures, STAR procedures coming from all the ANSP AMSS, in order to solve all the problems listed above before forwarding these data to the corresponding ANSP AMSS.
- Level 2: integrated system should be able to process future ATM services (AMHS, GNSS and augmentation data, ICC between ATS FDPS, ADS-B data sharing, DFIS, VDL...)
- Etc.