ATN/TF/1 – REPORT

INTERNATIONAL CIVIL AVIATION ORGANIZATION

FIRST MEETING OF THE
AERONAUTICAL TELECOMMUNICATION PLANNING TASK FORCE
(ATN/TF/1)

(Dakar, 29 - 31 May 2002)

REPORT

Prepared by the ICAO Western and Central African Office

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Glossary of Terms

ACC	Area Control Centre
ADS	Automatic Dependent Surveillance
AFS	Aeronautical Fixed Service
AFTN	Aeronautical Fixed Telecommunication Network
AIC	Aeronautical Information Circular
AIDC	ATS interfacility data communications
AIRAC	Aeronautical information regulation and control
AIS	Aeronautical Information Service
AMCP	Aeronautical Mobile Communications Panel
AMHS	ATS message handling system
AMS(R)S	Aeronautical Mobile-Satellite (R) Service
AMSS	Aeronautical Mobile-Satellite Service
APANPIRG	ASIA/PAC Air Navigation Planning and Implementation Regional Group
AR	Area of Routing
ASECNA	Agency for the Safety of Aerial Navigation in Africa and Madagascar
ATC	Air Traffic Control
ATM	Air Traffic Management
ATN	Aeronautical Telecommunication Network
ATNP	Aeronautical Telecommunication Network Panel
ATS	Air Traffic Services
BIS	Boundary Intermediate System
BBIS	Backbone Boundary Intermediate System
CIDIN	Common ICAO Data Interchange Network
CNS	Communications, Navigation, and Surveillance
COM/MET/OPS	Communications/Meteorology/Operations
CPDLC	Controller pilot data link communications
CSP	Communication Service Provider
DGNSS	Differential Global Navigation Satellite System
DME	Distance Measuring Equipment
EGNOS	European Geostationary Navigation Overlay System
ES	End System
EUROCONTROL	European Organization for the Safety of Air Navigation
FAA	Federal Aviation Administration
FIR	Flight Information Region
FM	Frequency Modulation
FMC	Flight Management Computer
FMS	Flight Management System
GES	Ground Earth Station
GIC	GNSS Integrity Channel
GLONASS	Global Orbiting Navigation Satellite System (Russian Federation)
GNSS	Global Navigation Satellite System
GPS	Global Positioning System (United States)
HF	High Frequency
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ICG	Implementation Coordination Group
IFR	Instrument Flight Rules
ILS	Instrument Landing System
INS	Inertial Navigation System

IRS	Inertial Reference System
INMARSAT	International Mobile Satellite Organization
INS	Inertial Navigation System
IS	Intermediate System
ISO	International Organization for Standardization
ITU	International Telecommunication Union
JAA	Joint Aviation Authorities
LAAS	Local Area Augmentation system
LEO	Low Earth Orbit
MLS	Microwave Landing System
MODE S	Mode S - SSR Data Link
MSAW	Minimum safe altitude warning system
MTSAT	Multi-Functional Transport Satellite (Japan)
OSI	Open Systems Interconnection
RAIM	Receiver Autonomous Integrity Monitoring
RD	Routing Domain
RNAV	Area Navigation
RNP	Required Navigation Performance
SARPs	Standards and Recommended Practices
SATCOM	Satellite Communication
SITA	Société Internationale de Télécommunications Aéronautiques
SSR	Secondary Surveillance Radar
TCP/IP	Transport Control Procol/Internet Protocol
TMA	Terminal Control Area
VDR	VHF Data Radio
VHF	Very High Frequency
VOR	VHF Omnidirectional Radio Range
WAAS	Wide Area Augmentation System
WGS-84	World Geodetic Reference System - 1984
WRC	World Radiocommunication Conference

History of the meeting

1. Duration and Venue of the Meeting

1.1 The first meeting of the Aeronautical Telecommunication Network Planning Task Force (ATN/TF/1) was held in Dakar, Senegal from 29 to 31 May 2002. It was convened pursuant to Decision 5/9 of the APIRG Communications Sub-group which was endorsed by APIRG/13.

2. Officers and Secretariat

2.1 Mr. Prosper Zo'o – Minto'o, Regional Technical Officer Communications, Navigation and Surveillance (RO/CNS) of ICAO Western and Central Office, Dakar was the Secretary of the Task Force. He was assisted by :

- Mr. Amadou Sene, RO/CNS, ICAO Eastern and Southern, Nairobi ; and
- Mrs. Mary A. Obeng, RO/CNS, ICAO Western and Central Office, Dakar.

He also acted the moderator of the meeting.

2.3 Mr. Amadou Cheiffou, ICAO Regional Director for Western and Central Africa, opened the meeting. In his address he emphasized the expectations of APIRG Communications Sub-group from the work of the Aeronautical Telecommunication Planning Task Force, the need to find solutions to the deficiencies in the field of communications and the forward planning for the implementation of the ATN elements as part of the AFI CNS/ATM Plan. He particularly recommended the Task Force to adopt a step-by-step approach due to the large scope of issues to be addressed, and to give priority to ways and means of improving the implementation and operation of the current AFTN.

2.4 Mr. Andrew K. Mensah, ICAO Deputy Regional Director also attended the meeting.

3. Attendance

3.1 The meeting was attended by 21 delegates from 7 States and 2 International Organizations.

3.2 The list of participants is at **Appendix A** to this part of the Report (page ii-1).

4. Working Language

4.1 English was used as the working language and documentation was issued in this language.

5. **Agenda**

5.1 The Meeting adopted the following Agenda:

Agenda Item 1 :	Review of the ATN Planning Task Force terms of reference and work programme
Agenda Item 2 :	Critical analysis of the AFI current AFTN
Agenda Item 3 :	Description of the AFI ATN topology
Agenda Item 4 :	Future work programme and composition of the ATN Planning Task Force
Agenda Item 5:	Any other business

6. **Conclusions and Decisions**

6.1 The Meeting records its action in the form of draft Conclusions and draft Decisions with the following significance:

6.2 **Draft Conclusions**

6.2.1 Draft Conclusions deal with matters which directly merit the attention of States, or on which further action will be initiated by ICAO in accordance with established procedures.

6.3 **Draft Decisions**

6.3.1 Draft Decisions deal with matters of concern to the Communications Sub-group and the ATN Planning Task Force.

6.4 **List of Draft Conclusions**

6.5 **List of draft Decisions**

FIRST MEETING OF THE AERONAUTICAL TELECOMMUNICATION NETWORK PLANNING TASK FORCE (ATN/TF/1)

(Dakar, 29-31 May 2002)

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Agenda Item 1 : Election of the Chairperson and the Vice-Chairperson of the ATN Planning Task Force

The meeting opted not to elect a chairperson and a vice-chairperson for the ATN Planning Task Force. The Secretary of the Task Force acted as the moderator of the meeting.

Agenda Item 2 : Review of the terms of reference , work programme and composition

2.1 Under this Agenda Item, the meeting recalled Decision 9/33 of the AFI Planning and Implementation Regional Group (APIRG) relating to the planning for the introduction of the Aeronautical Telecommunication Network (ATN), and requesting the Communications, Navigation, Surveillance/Air Traffic Management Implementation Coordination Sub-group (CNS/ATM/IC/SG) and the Communications Sub-group (COM/SG) *to undertake the necessary studies related to the technical, administrative, operational and institutional aspects to ensure the timely cost-effective introduction of ATN in the AFI Region.*

2.2 APIRG then reviewed its Decision 9/33 and decided that the COM/SG would continue with the follow-up of the transition from AFTN to ATN. Consequently:

- at its fourth meeting (Nairobi, November 1998), the COM/SG accordingly set up an Aeronautical Fixed Service Task Force (AFS/TF), which was tasked – among other issues – to formulate proposals for the migration of the AFI AFTN to the ground-ground element of the ATN; and

- at its fifth meeting (Dakar, 3-6 October 2000), when reviewing the report of the AFS Task Force meeting (Nairobi, 2000), the COM/SG identified sub-tasks to be achieved in the planning for the ground portion of the ATN, and accordingly adopted its Decision 5/9 on the creation of an AFI *Aeronautical Telecommunication Network Planning Task Force* (COM/SG/ATN/TF), the members of which being those of the previous AFS Task Force.

2.3 The meeting then reviewed the terms of reference and work programme of the ATN Planning Task Force as assigned to it by the COM/SG. The meeting also noted comments thereon from APIRG/13 (Sal, Cape Verde, 25-29 June 2001) when reviewing the COM/SG/5 Report. The initial terms of reference, work programme and composition of the ATN Planning Task Force are given at **Appendix 2A** to this part of the Report.

(INITIAL) TERMS OF REFERENCE
OF THE ATN PLANNING TASK FORCE

To plan for the implementation of the aeronautical telecommunication network (ATN) in the AFI Region in order to meet CNS/ATM system performance requirements and capacity.

WORK PROGRAMME

TASK No.	SUBJECT	TARGET DATE
1	Critical analysis of the current AFTN in the AFI Region	APIRG/14
2	Description of the ATN inter-network topology, including identification of the administrative domains, their routing domains to include routers (intermediate systems and end systems), location and type of intermediate systems to interconnect the sub-networks, and definition of the interconnections.	APIRG/14
3	Description of the ATN ground-ground applications (AMHS, AIDC)	APIRG/14
TASK No.	**SUBJECT**	**TARGET DATE**
4	Preparation of an ATN addressing plan	APIRG/15
5	Preparation of an AMHS naming and addressing plan	APIRG/15
6	Preparation of guidance material to assist States, as necessary	APIRG/15
7	Update of the guidelines on ATN in the CNS/ATM Implementation Plan (Doc 003)	APIRG/15
8	Formulation of proposals to achieve the interoperability of existing VSAT networks	APIRG/15

COMPOSITION

Algeria, Angola, Burundi, Egypt, Ethiopia, Guinea, Kenya, Malawi,
Niger, Nigeria, Senegal, South Africa, Tunisia, ASECNA and IATA.

Agenda Item 3 : Critical analysis of the current AFTN

3.1 Under this Agenda Item, the Task Force undertook a critical analysis of the current AFI aeronautical fixed telecommunication network (AFTN) :

a) in order to assess the extent to which requirements contained in ICAO Standards and Recommended Practices (SARPs) on *Aeronautical Telecommunication (Annex 10)* and Africa-Indian Ocean Air Navigation Plan (AFI ANP) are met; and

b) from the perspective of the migration to the aeronautical telecommunication network (ATN) ground-ground applications (air traffic services (ATS) message handling services (ATSMHS), inter-centre communications (ICC)).

3.2 Before proceeding with actual analysis of the current AFTN, the meeting was first reminded the role of the AFTN as a common user network designed primarily for the safety of air navigation and additionally for the regular, efficient and economical operation of air services, and which handles various categories of messages, of which *distress, urgency, flight safety, meteorological, flight regularity, aeronautical information service (AIS), aeronautical administrative and service messages.*

3.3 The meeting was also reminded ICAO policy for the planning and implementation of AFTN as contained in ICAO Doc 8259. The policy on AFTN planning is to configure and maintain the AFTN as a meshed network of main trunk circuits interconnecting a limited number of main AFTN communication centres with which tributary AFTN communication centres and AFTN stations are associated; and the policy on AFTN implementation is to effect the fully co-ordinated and timely implementation of main AFTN communication centres and main trunk circuits and tributary AFTN communication centres, AFTN stations and related circuits of the AFTN.

Implementation and operational status of the AFI AFTN

3.4 The meeting was presented with the list of reported AFTN deficiencies as updated by the Secretariat. The main deficiencies in this field are summarized as follows:

- partial implementation of the aeronautical fixed telecommunication network (AFTN)
- low availability of existing circuits
- low-speed circuits
- very long transit times
- incompatible sub-regional satellite telecommunication networks
- large use of analogue technology
- human factors, including inadequate staffing and lack of or insufficient training on aeronautical equipment and associated technologies

Appendix 3A to this part of the Report contains deficiencies affecting AFTN in the AFI Region.

3.5 The meeting also noted with appreciation that RTT circuits were no longer in use in the AFI Region for AFTN purpose.

3.6 The meeting then proceeded with the in-depth analysis of the AFI AFTN. The following was noted:

Implementation status of main circuits

3.7 Concerning AFTN main circuits, it was noted that Algiers/Niamey, Brazzaville/Johannesburg and Brazzaville/Nairobi circuits have not been implemented. Consequently, north/south traffic has to be diverted through Dakar/Johannesburg and Johannesburg/Nairobi, thus increasing transit times and risk of congestion and/or message loss.

3.8 In addition, the meeting also noted that the AFI/SAM entry/exit circuit through Johannesburg is not yet implemented and that, for the moment, traffic is rerouted via Dakar/Johannesburg.

Implementation status of tributary circuits

3.9 Concerning AFTN tributary circuits, it was noted that some tributary circuits are yet to be implemented such as Bissau/Dakar, Sao Tome/Brazzaville, etc. As a result, corresponding States/Centres are completely cut off, this having adverse effect on ATS coordination and flight safety.

Circuit availability

3.10 The meeting noted that though significant improvements have been achieved in the Region, many AFTN circuits still suffer from low availability rates, even far below the specified minimum of 97% *(AFI/7 Recommendation 9/3 refers)*, resulting in the lack of coordination between ATS units and missing ATS, AIS, MET and SAR messages.

3.11 The meeting agreed that non-availability of AFTN circuits is one of most concern. In fact, due to the star-shaped configuration of the network, communications to or from AFTN tributary centres or stations cannot be routed through alternative circuits, with some exceptions where VSAT networks and/or the AFTN topology in some areas contribute to increasing flexibility.

Transit-time

3.13 The meeting considered the performance of the AFTN as referring to the volume of traffic which the network can handle, the cost of its operation in relation to the traffic volume, or the speed with which it can transfer its messages from originator to addressee. Noting that these three factors are largely interdependent, attention was directed to AFTN performance in respect of message transit-times, which is the factor of most concern to the users of the network.

3.14 The meeting was reminded that AFTN users establish their requirement for transit-time performance as a criterion to be achieved between two AFTN stations in the average peak hour in the peak season for at least 95% of messages of higher priority classifications (SS, DD and FF priority indicators).

3.15 The meeting was then presented with transit-time data provided by some AFTN centres in the Region, showing that the agreed requirements of five (5) minutes and ten (10) minutes depending upon message priority are not met most of the time. Given the importance of transit-time parameter in assessing AFTN operational performance, the meeting called for establishment of quarterly statistics thereon.

Transmission speed

3.16 The meeting recalled APIRG Conclusion 12/13 on the minimum modulation rate of 1200 baud for AFTN main circuits in order for the AFI AFTN to meet transit-time requirements, and noted that many AFTN main circuits do not meet the requirement. The meeting noted that action by concerned States on Conclusion 12/13 was rendered more urgent since tributary circuits connected to the main centres of Brazzaville, Dakar, Johannesburg and Niamey had been upgraded to higher transmission speeds, while the outgoing main circuits operated still at 50 baud.

3.17 The meeting also noted that the need for a minimum requirement in respect of the transmission speed of AFTN tributary circuits, and agreed that the minimum of 1200 baud modulation rate should be considered for both main and tributary AFTN circuits.

VSAT networks

3.18 The meeting recalled that four (4) aeronautical satellite telecommunication networks are being/are planned to be operated in the AFI Region:

- the western and central African satellite network: AFISNET
- the southern African network: SADC
- the central Atlantic FIRs satellite network: CAFSAT; and
- the northern-eastern AFI satellite network: NAFISAT.

3.19 These networks which have been devised independently are using different space segments; hence the need for them to be interconnected in order to improve the AFTN performance and also to facilitate its readiness for the gradual migration to the future ATN ground element.

Corrective measures

3.20 In view of the above, the meeting discussed at length solutions to improve AFTN in the AFI Region, and agreed that improvements could be brought by using/resorting to the following (when and where applicable) subject to further investigations:

- integrated service digital network (ISDN);
- public data network (PDN) and X.25;
- expansion of existing VSAT networks, notably expansion of CAFSAT network to Abidjan, Accra, Brazzaville and Luanda as proposed by IATA (mainly to cater for ATS/DS requirements);
- interconnection of these VSAT networks as called for by APIRG to cater for identified requirements, including those involving Abidjan, Accra, Brazzaville and Luanda;
- existing well performing bilateral circuit, to include in the AFTN configuration (applicable to Cairo/Tripoli);
- use of SADIS as a supplementary means; or
- use of commercial Internet for non time-critical applications.

3.21 Regarding integrated service digital networks (ISDNs) and public data networks (PDNs), the meeting tasked the Secretariat to conduct a survey on the availability and usage costs of such services in the Region so as to ascertain the appropriateness and cost-effectiveness of these solutions proposed to improve Addis Ababa/Nairobi, Algiers/Niamey, Bombay/Nairobi, Brazzaville/Nairobi, Cairo/Nairobi and Johannesburg/Nairobi.

3.22 The meeting was apprised of a proposal for a by-pass circuit Algiers/Johannesburg. It was recalled that this issue was considered by COM/SG/5, which had recommended that the two States, if they so wish, establish the circuit on a bilateral basis. The Task Force, after discussion proposed that the matter be reviewed by COM/SG/6.

Implementation requirements

3.23 The meeting also agreed on requirements to be taken into account by States when implementing AFTN facilities. These implementation requirements are contained in **Appendix 3B** to this part of the Report.

Application of bit-oriented protocols

3.24 The meeting recalled AFI/7 Recommendation 9/6 – *Application of circuit control protocols between AFTN main centres* – calling for the definition of a uniform system of interface control. AFI/7 recommended that a regional Interface Control Document (ICD) be defined for the interface between centres employing X.25 protocols as has been done in other ICAO Regions. As a matter of fact, X.25 procedures are supposed to be more robust than the International Telegraph Alphabet No.2 (ITA-2) processor-to-processor protocol, which was recommended by LIM AFI (COM/MET/RAC), 1988 *(Recommendation 7/2 refers)*. ASECNA provided the meeting with useful information on its experience in implementing and operating

X.25 protocol within its area of responsibility. This information is contained in **Appendix 3D** to this part of the Report.

3.25 The meeting also recalled APIRG *Conclusion 13/10* requesting all AFI AFTN main centres to gradually introduce bit-oriented protocols based on provisions contained in ICAO *Annex 10, Volume III* with a view to upgrading the integrity of data transmission and paving the way to the migration to the ATN.

3.26 The following draft Conclusions and Decisions were formulated accordingly:

Draft Conclusion 1/1: Upgrading of AFTN main circuits and entry/exit circuits

That, in view of the availability of improved tributary circuits, States concerned expedite the upgrading of AFTN main circuits and entry/exit circuits to a minimum modulation rate of 1200 bits/s and to bit-oriented circuit control protocols for data integrity.

Draft Conclusion 1/2: Implementation of AFTN main circuits

That States concerned implement/upgrade the following AFTN main circuits by using to the extent possible PDN, ISDN in the absence of dedicated circuits, and X25/1200 bps:

-	**Addis Ababa/Niamey**	:	**X25**
-	**Addis Ababa/Nairobi**	:	**PDN**
-	**Algiers/Niamey**	:	**PDN or dedicated X25**
-	**Bombay/Nairobi**	:	**PDN**
-	**Brazzaville/Nairobi Niamey**	:	**PDN, via Dakar or**
-	**Brazzaville/Johannesburg**	:	**PVC/X25** ***(via Dakar, temporarily)***
-	**Cairo/Nairobi**	:	**PDN**
-	**Casablanca/Dakar**	:	**CAFSAT**
-	**Johannesburg/Nairobi**	:	**PDN or ISDN**

Draft Decision 1/3: Survey of availability and usage cost of public data networks (PDNs) and integrated service digital networks (ISDNs)

That the Secretariat conduct a survey on the availability and usage costs of public data networks and integrated service digital networks in the Region.

Draft Conclusion 1/4: Addition of Cairo/Tripoli circuit to AFI AFTN Plan

That the AFI AFTN Plan be amended to include the existing circuit between Cairo and Tripoli.

Draft Conclusion 1/5: Implementation of AFTN requirements

That, in implementing their AFTN circuits in accordance with the AFI rationalized AFTN Plan, States take due account of requirements contained in Appendix 3B to this part of the Report.

Draft Conclusion 1/6: AFTN transit time statistics

That in order to permit the assessment of AFTN performance on a regular basis, States establish quarterly transit time statistics for their AFTN centres, using the reporting format as per Appendix 3C to this part of the Report.

Draft Conclusion 1/7: Extension of CAFSAT network to Abidjan, Accra, Brazzaville and Luanda

That the proposed extension of CAFSAT network to Abidjan, Accra, Brazzaville and Luanda be reviewed by the forthcoming coordination meeting (September 2002), along with other options reviewed by ATN/TF/1 (such as interconnection of ASECNA/SADC VSAT networks, or implementation of Brazzaville/Luanda link).

AFTN/SADIS

3.27 The meeting acknowledged that, though the implementation of VSAT networks has proven an effective means of implementing AFTN requirements, there are some requirements for which this solution will not work when transit time is a critical constraint, due to a double or triple hop required to establish a connection. It was proposed that, to respond to these requirements, maximum use be made of ground-based infrastructure to route the signal after the first hop, in order to increase reliability, improve transit times, reduce load on intermediate circuits and switching centres and reduce costs to ATS providers.

3.28 In this respect, the meeting felt that this objective is partially to be met with the implementation of two-way SADIS stations in Cairo, Dakar, Johannesburg and Nairobi, allowing for the forwarding of OPMET data directly to WAFC London, and eventually AIS data to European data banks. The meeting therefore recommended close co-ordination between COM, ATS, AIS and MET experts in order to finalize the definition of the types of data to be exchanged through SADIS, and refine its configuration with a view to better meeting the defined requirements. The following draft Conclusion was formulated:

Draft Conclusion 1/8: AFTN/SADIS

That:

- **APIRG ATS/AIS/SAR and MET Sub-groups finalize feasibility studies on the use of SADIS for the distribution of information relating to air navigation, including operating procedures and interface issues (modalities of operation, message format, conversion procedures, etc.); and**

- **ATS, AIS and MET experts be invited to participate in the next ATN/TF meeting.**

Human factors

3.29 The meeting acknowledged that many deficiencies affecting aeronautical communications in the Region are more or less are due to human factors in terms of lack of adequate human resources and training. Thus the need for human resource and training programmes region-wide for communication personnel to remain proficient in the skills necessary to operate and maintain facilities.

3.30 Moreover, the meeting noted that some States had set up co-operation arrangements in order to optimise the expertise available for operations, maintenance, exchange of personnel, etc., and encouraged other States to consider such agreements.

3.31 The following draft Conclusion was formulated:

Draft Conclusion 1/9: Communications human resources and training – related issues

> **That human resources and training issues relating to the Communications field be taken into account by an APIRG appropriate body, in order to ensure that a sufficient number of personnel is available and remain proficient in the skills necessary to operate and maintain facilities.**

Use of the Internet

3.32 The meeting noted that difficulties are being encountered by some States in implementing or maintaining AFTN facilities whilst these States have commercial Internet facilities. Notwithstanding the final decision that would be made at a further stage taking into consideration experience gained, available technology and cost-benefit aspects on the use of the Internet for aeronautical applications, the meeting was of the view that those States experiencing difficulties to implement and maintain their communication facilities should use the Internet (when available) for the exchange of non time-critical applications. It was also proposed by one participant that the use of TCP/IP be considered on a trial basis between air navigation services providers as an overlay to AFTN. However, the meeting did not adopt this proposal. The following draft Conclusion was formulated:

Draft Conclusion 1/10: Use of the Internet

> **That States having difficulties to implement or maintain facilities required in the AFI AFTN Plan consider the use of the Internet when available, particularly for the exchange of non time-critical applications (e.g. flight regularity, administrative, etc.).**

Deficiencies in the AFTN field

Identification		**Deficiencies**			**Corrective action**			
Requirements	States/ facilities	Description	Date first reported	Remarks	Description	Executing body	Date of complete	Priority for action**
1	2	3	4	5	6	7	8	9

Notes:

Priority and classification

** "U" priority = **Urgent** requirements having a **direct** impact on **safety** and requiring i**mmediate** corrective actions.
Urgent requirement consisting of any physical, configuration, material, performance or procedures specification, the application of which is urgently required for air navigation safety

"A" priority = **Top priority** requirements **necessary** for air navigation **safety**.

Top priority requirement consisting of any physical, configuration, material, performance, personnel or procedures specification, the application of which is considered necessary for air navigation safety.

"B" priority = **Intermediate** requirements **necessary** for air navigation **regularity** and efficiency

Intermediate priority requirement consisting of any physical, configuration, material, performance, personnel or procedures specification, the application of which is considered necessary for air navigation, regularity and efficiency.

AFTN Deficiencies

Identification		Deficiencies			Corrective action			
Requirements	States/facilities	Description	Date first reported	Comments	Description	Executing body	Date of completion	Priority
1	2	3	4	5	6	7	8	9
Rationalized AFTN Plan AFI/7 Rec.9/7	Algeria Niger	Main circuit Alger/ Niamey	10/2/98	Unreliable	VSAT being implemented	Algeria ASECNA	28/11/02	U
	Angola Congo	Circuit Brazzaville/Luanda	10/2/98		Implement the circuit	Angola ASECNA	28/11/02	A
	CONGO South Africa	Main circuit Brazzaville/ Johannesburg	10/2/98	All traffic to/from Southern Africa is hindered	The two States have agreed to interconnect the ASECNA and SADC VSAT networks	ASECNA South Africa	Temporarily implemented via Dakar/Johannesburg since July 1999	U
	Ethiopia Djibouti	Circuit Addis-Ababa/Djibouti	25/5/97	To be improved	To implement LTT circuit	Ethiopia Djibouti	Both States are discussing implementation of an LTT upgrade	A
	Ethiopia Eritrea	Circuit Addis-Ababa/Asmara	25/8/98	To be restored	The circuit has been discontinued	Eritrea Ethiopia		A
	Ethiopia Sudan	Circuit Addis-Ababa/Khartoum	7/6/96			Ethiopia Sudan		A
	Guinea Bissau Senegal	Circuit Dakar/ Bissau	10/2/98		To implement LTT circuit	ASECNA Guinea Bissau	28/11/02	A
	Madagascar South Africa	Circuit Antananarivo/ Johannesburg	7/6/96	-	VSAT being implemented	ASECNA South Africa	Planned in short term	A
	Madagascar Comoros	Circuit Antananarivo/ Dzaoudzi	7/6/96	-	To implement LTT circuit	ASECNA Comoros	Planned in mid term	A

Rationalized AFTN Plan AFI/7 Rec.9/7	Burundi Tanzania	Circuit Bujumbura/ Dar-es-salaam	7/6/96	VSAT being considered. VSAT OP in Tanzania	VSAT being implemented	Burundi Tanzania	28/11/02	U
	Rwanda Tanzania	Circuit Kigali/ Dar-es-salaam	7/6/96	VSAT being considered. VSAT OP in Tanzania	Implement VSAT at Kigali	Rwanda (Tanzania for coordination)	28/11/02	U
	Kenya Congo	Circuit Brazzaville/ Nairobi	25/11/98		To implement VSAT	ASECNA Kenya	28/11/02	
	Kenya Somalia	Circuit Nairobi/ Mogadishu	7/6/96	SITA OP between FICs		Kenya Somalia	28/11/02	A
	South Africa SAM (Argentina)	Circuit Johannesburg/ Buenos Aires	7/6/96			South Africa Argentina	28/11/02	A

AFI Rationalized AFTN – Implementation requirements/RSFTA rationalisé – Besoins de mise en oeuvre

Explanation of the table
Explication du tableau

Col. N°	Explanations
1	Terminal I and Terminal II. Each circuit appears once in the Table./*Terminal I et Terminal II. Chaque circuit n'apparaît qu'une fois dans le Tableau*
2	Category of circuit/*Catégorie de circuit*: M - main circuit/*circuit principal* T - tributary circuit/*circuit tributaire* S - AFTN station circuit/*circuit de station RSFTA*
3 and 8	Circuit type/*Type de circuit*: NIL - not implemented/*Non mis en oeuvre* LTT/A - landline teletypewriter, analogue (eg cable, microwave/*circuit télétype terrestre, analogue (i.e. câble, faisceau hertzien)* LTT/D - landline teletypewriter, digital (eg cable, microwave/*circuit télétype terrestre, numérique (i.e. câble, faisceau hertzien)* LDD/A - landline data circuit, analogue (eg cable, microwave/*circuit de données terrestre, analogue (i.e. câble, faisceau hertzien)* LDD/D- landline data circuit, digital (eg cable, microwave/*circuit de données terrestre, numérique (i.e. câble, faisceau hertzien)* RTT - radio teletype circuit (HF)/*circuit radiotélétype (HF)* SAT/A/D- satellite circuit /a digital or/d digital/*circuit par satellite /a analogue ou /d numérique*
4 and 9	Circuit signalling speed/ *Vitesse demodulation du circuit*
5 and 10	Circuit protocol / *Protocol de circuit* NONE: No protocol/*Aucun protocol* X.25: ITU X.25 protocol/*Protocol X.25 de l'UIT*
6 and 11	Data transfer code (syntax) ITA-2: International Telegragh Alphabet N°2/*Alphabet international N°2* IA-5: International Alphabet N°5/*Alphabet international N°5* CBI: Code and byte independent (ATN compliant) /*Indépendant des codes et multiplets (compatible ATN)*
7 and 12	Aeronautical network served (AFTN or ATN)/*Réseau aéronautique desservi (RSFTA ou ATN)*
13	Implementation target date/*Date cible pour la mise en oeuvre*
14	Remarks/*Observations*

AFI AFTN RATIONALIZED PLAN - IMPLEMENTATION REQUIREMENTS

Terminal I/ Terminal II	Circ. Cat./ Caté. de circ.	Current/Existant					Planned/Prévu					Target Implem. date / Date de mise en oeuvre	Remarks/ Observations
		Circuit type/ Type de circuit	Modulation rate/ Rapidité de modulation (bps)	Prot.	Code	Network/ Réseau	Circuit type/ Type de circuit	Minimum Modulation rate/ Rapidité de modulation bps	Prot.	Code	Network / Réseau		
1	2	3	4	5	6	7	8	9	10	11	12	13	14
ADDIS ABABA													Addis centre can accommodate X25
Asmara	T	NIL					SAT	1200	X25	ITA2	AFTN		NAFISAT
Djibouti	T	RTT	50	NONE	ITA-2	AFTN	SAT	1200	X25	ITA-2	AFTN		NAFISAT
Khartoum	T	NIL					SAT/D	1200	X25	ITA-2	AFTN		NAFISAT
Nairobi	M	SAT/A/	50	NONE	ITA-2	AFTN	SAT/D	1200	X25	IA-5	AFTN		ISDN to explore
Niamey	M	SAT/A	50	TTY	ITA-2	AFTN	SAT/D	1200	X25	IA-5	AFTN		
MID(Jeddah)	M	SAT/A	50	A	ITA-2	AFTN	SAT/A	1200	X.25	IA-5	AFTN		ISDN to explore

ALGER													
Casablanca	M	SAT/A	50	NONE	ITA-2	AFTN	LTT/A	1200	X.25	IA-5	AFTN		
Niamey	M	NIL				AFTN	LTT	1200	X.25	IA-5	AFTN		
Tunis	M	SAT/A	1200	A	ITA-2	AFTN	SAT/D	1200	X.25	IA-5	AFTN		
EUR (Bordeaux)	M	SAT/A	1200	A	ITA-2	AFTN	SAT/D	1200	X.25	IA-5	AFTN		

BRAZZAVILLE													
Bangui	T	SAT/D	1200	X.25	ITA-2	AFTN	SAT/D	1200	X25	ITA-2	AFTN		
Dakar	M	SAT/D	2400	X.25	IA-5	AFTN	SAT/D	2400	X-25	IA-5	AFTN		
Douala	T	SAT/D	1200	X.25	ITA-2	AFTN	SAT/D	1200	X.25	ITA-2	AFTN		
Kinshasa	T	MW/V	50	V.24	ITA-2	AFTN	LTT/D	50	TTY	ITA-2	AFTN		
Johannesburg	M	NIL					SAT/D	1200	X.25	IA-5	AFTN		
Libreville	T	SAT/D	2400	X25	IA-5	AFTN	SAT/D	2400	X.25	IA-5	AFTN		
Luanda	T	NIL					SAT/D	1200	X.25	ITA-2	AFTN		
Nairobi	M	NIL					SAT/D	1200	X.25	ITA-2	AFTN		Nairobi/Dakar/brazzaville
N'Djamena	T	SAT/D	2400	X25	IA-5	AFTN	SAT/D	2400	X.25	IA-5	AFTN		
Niamey	M	SAT/D	2400	X.25	IA-5	AFTN	SAT/D	2400	X.25	IA-5	AFTN		
Sao Tome	T	NIL				AFTN	SAT/D	1200	X.25	ITA-2	AFTN		

CAIRO													
Khartoum	T	SAT/A	50	TTY	ITA-2	AFTN	SAT/D	300	TTY	ITA-2	AFTN		To coordinate with Khartoum
Nairobi	M	SAT SAT/A	50	TTY	ITA-2	AFTN	SAT/D	1200	X.25	IA-5 IA-5	AFTN		9600 bps proposed by Egypt
Tunis	M	SAT/A	100	NONE	ITA-2	AFTN	SAT/D	1200	X.25	IA-5	AFTN		CIDIN
EUR(Athens)	M	SAT/D	9600	CIDIN	IA-5	AFTN	SAT/D	9600	CIDIN	IA-5	AFTN		
MID(Beirut)	M	SAT/D	9600	CIDIN	IA-5	AFTN	SAT/D	9600	CIDIN	IA-5	AFTN		
MID(Jeddah)	M	SAT/D	9600	CIDIN	IA-5	AFTN	SAT/D	9600	CIDIN	IA-5	AFTN		
CASABLANCA													
Dakar	M	LTT/A	2X75		ITA-2	AFTN	SAT/D	2400	V24/FR	IA-5	AFTN		
Las Palmas	T	LTT/A	50		ITA-2	AFTN	LTT/A	50	CIDIN	IA-5	AFTN		
EUR(Madrid)	M	SAT/A	50+1X200		IA-5	AFTN	SAT/A	9000	CIDN	IA-5	AFTN		
DAKAR													
Abidjan	T	SAT/D	2400	X-25	IA-5	AFTN	SAT/D	2400	X.25	IA-5	AFTN		
Bamako	T	SAT/D	2400	X-25	IA-5	AFTN	SAT/D	2400	X.25	IA-5	AFTN		
Banjul	T	LLT	75	TTY	ITA-2	AFTN	LTT/D	2400	X.25	ITA-2	AFTN		
Bissau	T	NIL					SAT/D	2400	X-25	ITA-2	AFTN		
Johannesburg	M	LTT	2400	V-24	IA-5	AFTN	SAT/D	2400	X.25	IA-5	AFTN		

Niamey	M	SAT/D	2400	X.25	IA-5	AFTN	SAT/D	2400	X.25	IA-5	AFTN		
Nouakchott	T	SAT/D	2400	X.25	IA-5	AFTN	SAT/D	2400	X.25	IA-5	AFTN		
Conakry (Robertsfiield)	T	SAT	2400	V-24	IA-5	AFTN	SAT/D	2400	V24	IA-5	AFTN		
Sal	T	SAT/D	2400	V.24	IA-5	AFTN	SAT/D	2400	X-25	IA-5	AFTN		
SAM(RIO)	M	SAT	2400	V24	IA-5	AFTN	SAT/D	2400	V.24	IA-5	AFTN		
JOHANNES-BURG													X25 planned/ IA-5 capable
Antananarivo	T	NIL				AFTN	SAT/D	1200	V.24	IA-5	AFTN		
Beira	T	SAT/D	1200	TTY	ITA-2	AFTN	SAT/D	1200	TTY	ITA-2	AFTN		
Bujumbura	T	NIL					SAT/D	1200	TTY	ITA-2	AFTN		VSAT planned
Gaborone	T	SAT/D	1200	TTY	ITA-2	AFTN	SAT/D	1200	TTY A	ITA-2	AFTN		
Harare	T	SAT/D	1200	TTY A	ITA-2	AFTN	SAT/D	1200	A	ITA-2	AFTN		
Kigali	T	NIL					SAT/D	1200	TTY	ITA-2	AFTN		
Lilongwe	T	SAT/D	1200	TTY A	ITA-2	AFTN	SAT/D	1200	TTY A	ITA-2	AFTN		
Lusaka	T	SAT/D	1200	TTY A	ITA-2	AFTN	SAT/D	1200	TTY A	ITA-2	AFTN		
Maputo	T	SAT/D	1200	TTY A	ITA-2	AFTN	SAT/D	1200	TTY A	ITA-2	AFTN		
Maseru	T	SAT/D	1200	TTY	ITA-2	AFTN	SAT/D	1200	TTY	ITA-2	AFTN		
Manzini	T	LTT/A	1200	TTY	ITA-2	AFTN	SAT/D	1200	TTY A	ITA-2	AFTN		

Nairobi	M	LTT/A	50	TTY A	ITA-2	AFTN	SAT/D	1200	X.25	ITA-2	AFTN		
Windhoek	T	SAT/D	1200	TTY	ITA-2	AFTN	SAT/D	1200	NONE	ITA-2	AFTN		
ASIA/PAC (Brisbane)	M	NIL					SAT/D	1200	X.25 A	IA-5	AFTN		
SAM (Buenos Aeres)	M	NIL					SAT/D	1200	X.25	IA-5	AFTN		
NAIROBI													
Dar es Salaam	T	LTT/A	50	NONE	ITA-2	AFTN	LTT/A	50	NONE	ITA-2	AFTN		
Entebbe	T	LTT/A	50	A	ITA-2	AFTN	LTT/A	50	A	ITA-2	AFTN		
Mauritius	T	SAT/A	50	A	ITA-2	AFTN	SAT/A	50	A	ITA-2	AFTN		
Mogadishu	T	NIL		A		AFTN	SAT/A	50	A	ITA-2	AFTN		SITA
Seychelles	T	SAT/A	50	A	ITA-2	AFTN	SAT/A	50	NONE	ITA-2	AFTN		
ASIA (Mumbai)	M	LTT/A	50	A	ITA-2	AFTN	LTT/A	1200	X.25	ITA-2	AFTN		
NIAMEY													
Accra	T	SAT/A	50	TTY	ITA-2	AFTN	SAT/D	2400	X.25	IA-5	AFTN		ACCRA X25 TBC
Kano	T	SAT/D	50	A	ITA-2	AFTN	SAT/D	2400	X25	IA-5	AFTN		
N'Djamena	T	SAT/D	2400	X.25	IA-5	AFTN	SAT/D	2400	X.25	IA-5	AFTN		
Ouagadougou	T	SAT/D	2400	X25	IA-5	AFTN	SAT/D	2400	X25	IA-5	AFTN		
TUNIS													
Tripoli	T	LTT/A	50	NONE	ITA-2	AFTN	LTT/A	50	NONE	ITA-2	AFTN		TBC with TUNIS

EUR(Rome)	M	SAT/A	1200	X-25		AFTN	SAT/A	1200	X.25	ITA-2	AFTN		
ACCRA													
Cotonou	S	LTT/A	50	NONE	ITA-2	AFTN	LTT/A	2400	X25	IA-5	AFTN		
Lome	S	LTT/A	50	A	ITA-2	AFTN	LTT/A	2400	X25	IA-5	AFTN		
ANTANA-NARIVO													
Dzaoudzi	S	SAT/D	2400	V24	IA-5	AFTN	SAT/D	2400	X.25	IA-5	AFTN		
Mauritius	T	SAT/D	2400	V24	IA-5	AFTN	SAT/D	2400	V24	IA-5	AFTN		
Moroni	S	SAT/D	2400	V.24	IA-5	AFTN	SAT/D	2400	V24	IA-5	AFTN		
DOUALA													
Malabo	S	SAT/D	1200	X25	IA-5	AFTN	SAT/D	1200	X.25	IA-5	AFTN		
KANO													
Lagos	S	SAT/A	50	NONE	ITA-2	AFTN	SAT/D	2400	X25	IA-5	AFTN		

LAGOS													
Cotonou	S	LTT/A	50	NONE	ITA-2	AFTN	SAT/D	2400	X.25	IA-5	AFTN		

MAURITIUS													
Saint Denis	S	SAT/D	2400	V24	IA-5	AFTN	SAT/A	2400	V24	IA-5	AFTN		
ASIA/PAC (Brisbane)	T	SAT/A	50	A	ITA-2	AFTN							To maintain until operation of J'Burg /ASIA/PAC
Johannesburg	T	SAT/D	1200	TTY	ITA-2	AFTN	SAT/D	1200	X.25	IA-5	AFTN		
Conakry													
Robertsfield	S	SAT/D	1200	X25	IA-5	AFTN	SAT/D	1200	X25	IA-5	AFTN		
Freetown	S	SAT/D	1200	X25	IA-5	AFTN	SAT/D	1200	X25	IA-5	AFTN		

---END---

AERONATICAL FIXED TELECOMMUNICATION NETWORK (AFTN) TRANSIT TIME STATISTICS

AFTN CENTRE:……………..………………………………………………DATE: d d / m m / y y y y

CENTRE OF ORIGIN	LAST RELAY CENTRE	PRIORITY INDICATOR	TOTAL NUMBER OF MESSAGES IN EACH PRIORITY GROUP	MEDIAN TRANSIT TIME	MEDIAN IN STATION TRANSIT TIME	REGIONAL TRANSIT TIME REQUIREMENT	HIGHEST TRANSIT TIME EXPERIENCED	REMARKS
1	2	3	4	***5***	6	***7***	***8***	9

APPLICATION OF BIT – ORIENTED PROTOCOLS IN THE AFI REGION
ASECNA X.25 EXPERIENCE

This paper provides information on ASECNA X.25 experience in its area of responsibility for AFTN, GTS and ATS/DS purposes, together with maintenance coordination and network monitoring.

INTRODUCTION

ASECNA operates an integrated voice/data network composed of owned stand-alone VSAT stations. The network supports provision of the following services:

- ATS/DS
- AFTN
- GTS
- Facilities monitoring
- Message handling system
- Internet access

The rationale for the integration of data communications and voice communications into a single network is :

- To benefit from possibilities associated with emerging technologies;
- To improve reliability of facilities and quality of service; and
- To find out solutions to some problems experienced by ATS units, such as:
    - Incompatibility between N5 protocol recommended for AFI ATS/DS network and the use of echo canceller devices;
    - Number of ATS/DS dedicated telephone handsets (each ATS/DS link having its handset); and
    - Bandwidth utilization non-optimized.

X.25 IN ASECNA AREA

ASECNA has been using the X.25 protocol in its area for AFTN purpose since 1992. It is expected that the X.25 network will expand so as to include all AFTN/GTS switching centers, and that the transmission speed will be upgraded up to 19200 bps. X.25, which is the ICAO bit-oriented protocol referred to in Annex 10, will enable ASECNA to improve the quality of services rendered, with high transmission circuit between nodes and flexibility in implementing new links by means of virtual circuits.

X.25 protocol processes the three (3) lower layers of the OSI (Open System Interconnection) model, which perform the following tasks :

Layer 3	• Packet type check • Sequence control • Window and Timer process • Acknowledgement process • Routing process
Layer 2	• Frame type check • Error recovery check • Sequence control • Window and Timer process • Acknowledgement process
Layer 1	• Bit and transparency processing

Processing those various tasks result in transmission of unacknowledged frames, and requires extra cycles and memory at the end - user level, as well as extra bandwidth.

Roberts FIR is the only AFTN center having implemented one X.25 circuit with ASECNA on Dakar/Conakry circuit. An X.25 circuit was also implemented for GTS purpose via Toulouse, France using TRANSPAC, the French X.25 public network operated by France Telecom Company. The rest of AFTN circuits involving non-ASECNA centers are using TTY or V24, thus limiting the transmission rate from/to these centers.

Consequently, message-switching centers are at risk of congestion/braking down, with increased transit time. So, to which extent improvements can be achieved in implementing and enhancing reliability of circuits linking ASECNA centers to non-ASECNA centers?

ASECNA X.25 network was built step by step. Difficulties encountered at each stage were solved thanks to in-house competences or co-operation with packet/message switches providers. These difficulties, which are software and hardware-related concern:

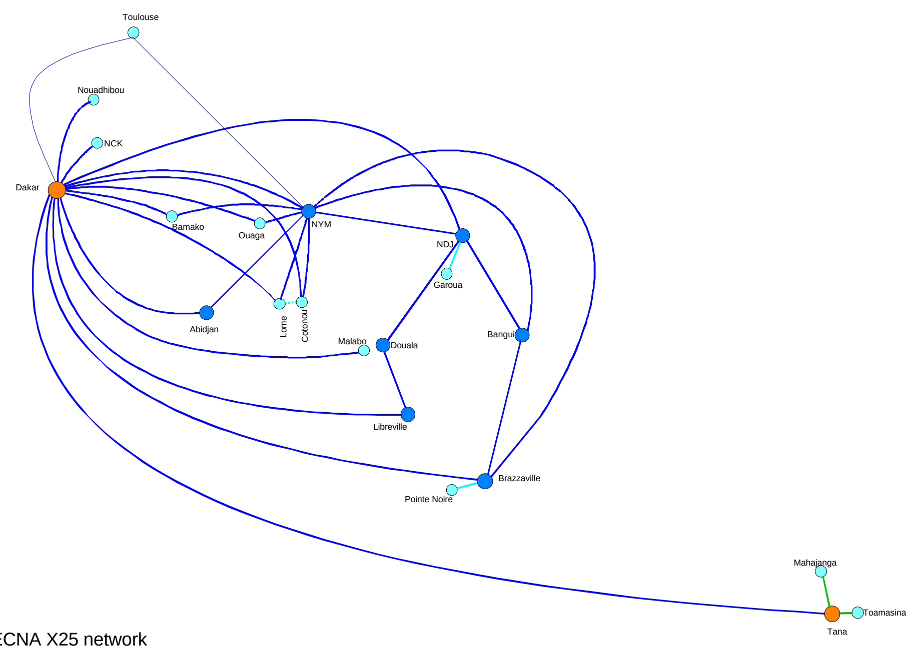
- The Interconnection of packet switching devices; and
- The interconnection of message switching devices via packet switching devices.

One would think that, though X.25 is a standardized protocol, providers may have their specificities to implement it, resulting in difficulties deriving from a heterogeneous technical environment. Therefore, close co-operation with providers’ staff members appears to be essential to minimize such difficulties.

The introduction of X.25 protocol and the notion of virtual circuit changed drastically operators’ habits. For instance, technical staff manages X.25 routing, which is completely transparent to operators thus placed in a position such that they cannot know at any time the actual circuit followed by messages. Indeed, though the service is delivered, availability of direct circuits could be hidden. Flexibility offered by X.25 virtual circuits enables data exchange between centers whose direct circuit is not available: circuit availability and service availability are no longer linked necessarily. For the moment, unavailability of X.25 access at a given node induces unavailability of all links (virtual circuits) with other nodes without any possibility to revert to manual procedures. Studies are being undertaken by ASECNA to fix the problem. In this respect, some asynchronous links operating at 9600 bps have been implemented between ASECNA centers and will be assessed in the short term. The following links are concerned:

- Dakar-Conakry
- Dakar-Recife
- Dakar-Las Palmas
- Antananarivo-Moroni
- Antananarivo-Plaisance
- Antananarivo-Saint Dénis

The network requires enhanced monitoring. A central monitoring unit was developed by ASECNA in this regard, with virtual accesses and circuits. The following diagram represents ASECNA X.25 network. Integration of voice and data will necessitate the implementation of voice-data multiplexers in ASECNA centers.



ASECNA X25 network

X.25 OVER FRAME RELAY

The use of voice-data multiplexers enabled ASECNA X.25 network to migrate to a Frame Relay (FR) VSAT network supporting AFTN, GTS and ATS/DS. Priority is given to ATS/DS communications. Given incompatibility between N5 protocol and VSATs echo canceller devices, and environmental problems mentioned in the introduction, ASECNA has implemented ATS/DS communications using classic digital PABXs. One would appreciate such a technical optional based on published service availability rates. AFTN and GTS data are sent using X.25 protocol over Frame Relay. Encapsulation also concerns asynchronous links listed in the previous paragraph.

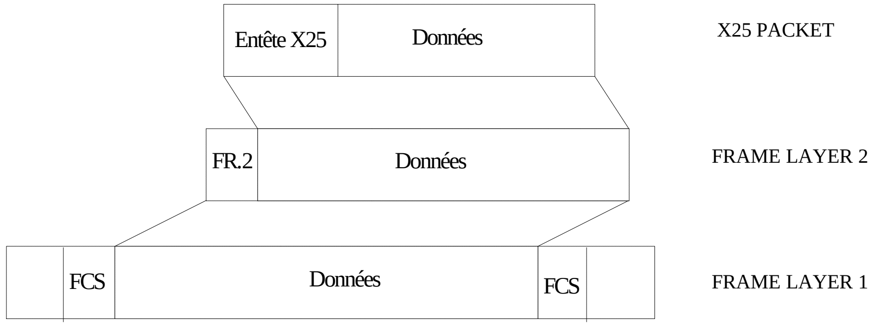
The rationale for Frame relay is related to its inherent performance, VSATs performance and the need to optimize the bandwidth available. Frame Relay uses the two (2) lower layers of the OSI model and performs the following tasks:

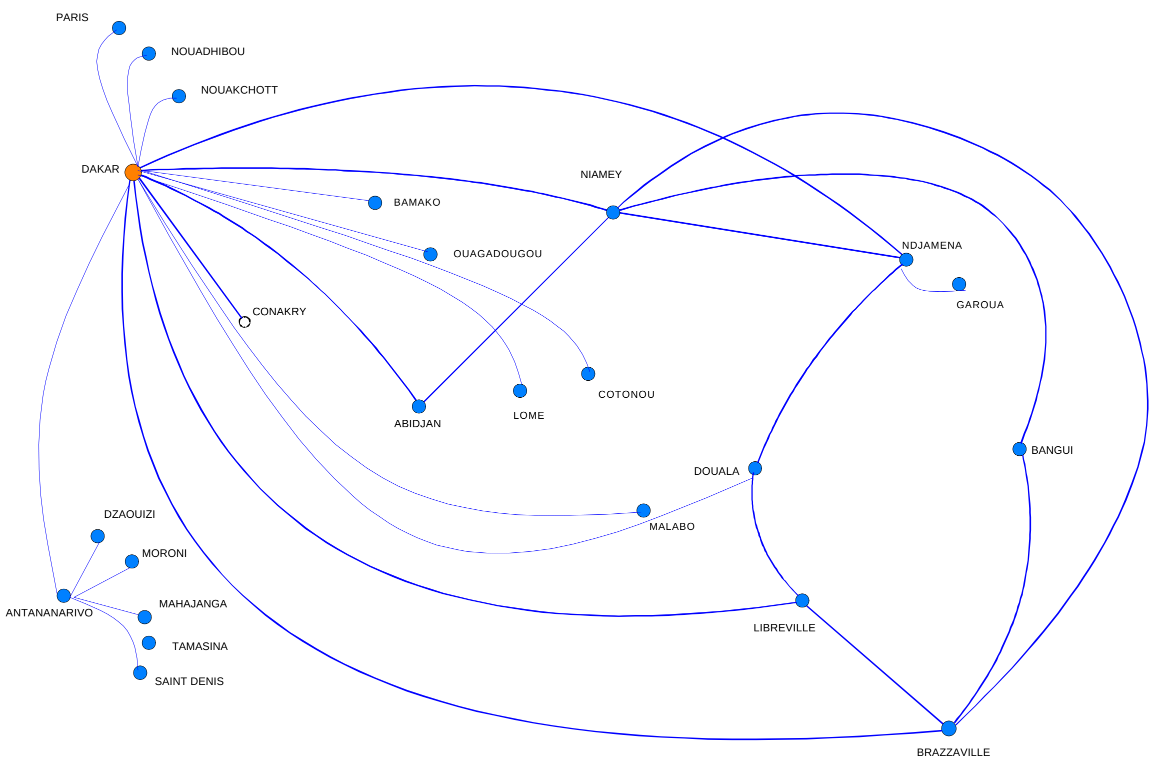
Layer 2	Error recovery processing DLCI validity check Frame delivery Congestion check
Layer 1	Bit processing

Thus, while managing layers 1 and 2 with Frame Relay, packet switches can be relieved and extra bandwidth is not required for X.25. Data and voice will be multiplexed on composite trunks. Operation of X.25 only at layer 3 prevents from loss of data. In fact, in case of error detection at layer 1 or layer 2 or congestion, Frame Relay protocol rejects the concerned frame without notice and handovers its processing to X.25, the higher layer protocol.

Mindful of adverse effects of congestion on data exchange over Frame Relay, ASECNA has implemented a centralized bandwidth occupation-monitoring unit equipped with specific tools for analyses and assistance to decision-making. The entire network is managed from the central unit, whilst the network nodes perform routing functions.

Encapsulation of X.25 data over Frame Relay could be illustrated as follows:





ASECNA FRAME RELAY NETWORK
AFS

Agenda Item 4 : Description of the AFI ATN topology

4.1 Under this Agenda Item, the meeting was first presented with an overview of the Aeronautical Telecommunication Network (ATN) adopted some ten years ago by international civil aviation community within the framework of communications, navigation, surveillance and air traffic management (CNS/ATM) systems. Participants were also provided useful information on the ATN concept.

Concerns on ATN implementation

4.2 Before dealing with the description of the AFI ATN topology, the meeting expressed some concerns related to the implementation of a functional global aeronautical telecommunication network. Particularly, the meeting pointed out that, whilst there is an increasing intention to move to ATN, there is also an increasing concern whether the objectives will ever be met and at which costs.

4.3 It was noted that the ATN concept as embodied in the ATN Manual, was conceived in an era when reliable data communication services were not available in many parts of the world and if they were available, it was often at a prohibitive cost. Since then, the state of the art in data communications has advanced dramatically, with many Communications Service Providers (CSPs) or consortiums of CSPs, able to provide highly reliable services, globally. Among the portfolios of these CSPs are managed services, which can be customized to meet the operational needs of the customer. The fact is that, although the aviation industry pioneered data communications, it has been surpassed by many other industries (such as banking, news services, etc), this having the fortunate consequence that the cost of the networks provided by the commercial CSPs can be defrayed across many users.

4.4 In these circumstances, desirability of commercial provision of managed network services becomes increasingly apparent given unsustainability of ad hoc development by States, which includes concerns relating to interoperability of separate network segments, backwards compatibility, accommodation of differences, communications efficiency and flexibility and cost-benefit. Thus the very real need to define required network performance and quality of service (QoS) in a simple, realistic and achievable set of performance based specifications to be used by ATS providers and aircraft operators when leasing ATN services from CSPs. The meeting accordingly formulated the following draft Conclusion:

Draft Conclusion 1/11: Performance criteria for use by ATS providers and aircraft operators when leasing ATN services from communication service providers

That ICAO develop performance criteria to be taken into consideration by air traffic services and aircraft operators when leasing ATN services (at subnetwork or end-to-end levels) from communication service providers.

Draft of ATN routing architecture

4.5 The meeting reviewed a draft of an initial Plan for the routing ATN routing architecture within the AFI Region, based on a comprehensive paper prepared by the Secretariat (See **Appendix 4A** to this part of the Report).

4.6 The meeting then focussed on a proposed representation scheme for the ATN Ground Portion Plan, noting that such a plan is described in terms of formatted tables in the other Regions (e.g. ASIA/PAC and CAR/SAM). Attention was directed to the following basic rules:

Requirements for Plan description

4.7 It is necessary to identify the purpose of the Plan document:

- to provide an appropriate and accurate description of planned facilities.
- to provide an appropriate and accurate description of implemented facilities.
- to provide a comprehensive view for management of the plan.

4.8 It is also necessary to identify the entities to be described.

- To describe the ATN networking topology
  - ◻ Domain to include routers (IS, Intermediate System) and End Systems
  - ◻ Router to interconnect networks
  - ◻ Interconnections

- To describe the ATN ground applications
  - ◻ AMHS
  - ◻ AIDC

4.9 The reason to identify five types of entities is that each entity has different property; namely:

- Interconnection has one location/station to one location/station relationship;
- Router has possibly one router to many routers;
- AMHS has one AMHS to many AMHS(servers or stations; UA) relationship;

  Note: Any AMHS Server is capable to send messages to any AMHS Server. If this is the common knowledge, then there is no need to specify AMHS locations to communicate with.

  It is also noted that, if UA is described as in CAR/SAM regional document, there should be the description of Server/Station relationship.

- AIDC has one AIDC application to one AIDC application relationship.

4.10 Another aspect of the plan is that there is a need to describe the acceptable entities and time order of implementation plan, for instance:

- at the time any interconnection is installed, at both sides of interconnection, there has to be installed at least one router of compatible type.
- Prior to any ground application installation, there should be one router installed to route their message to other end systems.

Note: The ATN Ground application locations may differ from the locations of routers. There might be a need to show the location names for each Ground Application.

4.11 Although it is hard to capture all rules shown above, it is essential to provide ATN Implementation Plan as an effective management tool to make the Plan well managed.

Detailed analysis of each entity

Domain

4.12 The domain contains Routers (ISs; Intermediate Systems) and ESs (End Systems). The domain is the first primary key of the ATN plan. If each State has its own one or more than one domain, then such domain(s) are managed by the State. Even if multiple States form one domain, where such a domain is possibly managed jointly among the concerned States, the interconnection between such States will be provided through routers.

Router

4.13 The router within a domain shall be the second primary key of ATN plan, since the mere configuration of interconnected communication lines without routers shall not be qualified as the ATN. The router rather than the interconnection is the focal point in the ATN.

a) There might be more than one router within one domain. Each relevant router in the ATN domain of AFI region has to be identified by location. Any irrelevant routers in AFI region are the ones of internal use of States/Organizations in the region.

b) The type of any routers identified in AFI region is to be given for the consistency of interconnection between routers.

4.14 In AFI Region, three types of router are identified:

- Backbone Boundary Intermediate System (BBIS);
- Boundary Intermediate System (BIS); and
- Intermediate System (IS).

Note: In the draft ATN Architecture, reference is made to Inter-regional Backbone BBISs. These are BBISs which link the AFI ATN to other ICAO Regions.

Routing architecture

4.15 The proposed routing architecture is composed of:

a) A backbone network to concentrate ATN traffic at designated locations, and possibly support air-ground applications operating over the ATN;
b) ATN routing sub-regions around each backbone BIS connecting the routing domains to the backbone.

4.16 The description of the ground-ground ATN architecture will comprise then two tables:

a) A table for the Backbone BIS interconnections; and
b) A table describing the routing domain BIS connections to the backbone in the AFI Region

Description of the ATN ground-ground network

4.17 The proposed ATN Backbone BIS and Circuits Implementation Table and the ATN BIS and Connections Implementation Table are shown at **Appendices 4B and 4C** to this part of the Report, based upon the initial ATN architecture described in **Appendix 4A** to this part of the Report. **Appendix 4D** shows a Chart of the complete ground-ground ATN network for the AFI region. These tables and plans are subject to further refinements.

Transition Issues

4.18 The implementation of the ATN within the AFI Region may require considerable planning for the transition of the AFTN.

4.19 The meeting agreed that this area needs further work. Information about plans of the States for ATN ground-ground applications (ATS Inter-facility Data Communications and ATS Messages Handling System) is required.

4.20 The following draft Conclusions and Decision were formulated:

Draft Conclusion 1/12: Timescale for the implementation of AIDC

That the APIRG ATS/AIS/SAR Sub-group be requested to provide necessary information on the timescale of implementation of ATS Inter-facility Data Communications (AIDC).

Draft Conclusion 1/13: Information on States' plans for the implementation of AMHS

That the Secretariat conduct a survey on States plans for the implementation of the AMHS application to be supported by the ATN.

Draft Decision 1/14: Draft AFI ATN routing architecture

That the draft AFI ATN routing architecture as described at Appendices 4B, 4C and 4D be refined by the ATN Planning Task Force.

DRAFT OF AFI ATN
ROUTING ARCHITECTURE PLAN

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 paper 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 systems (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.

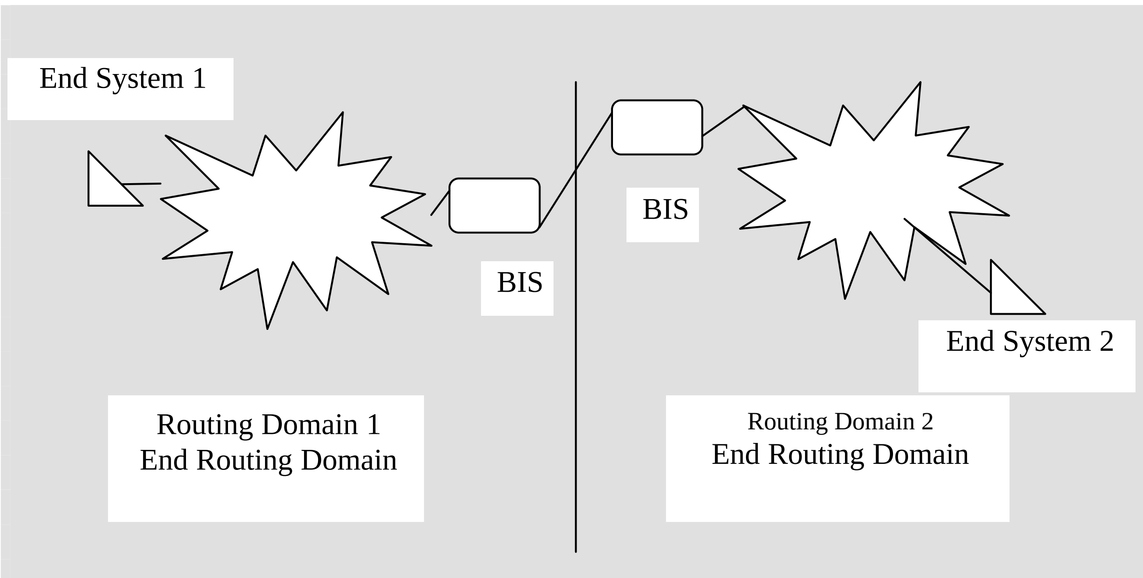


Figure 1 – End Routing Domains

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.

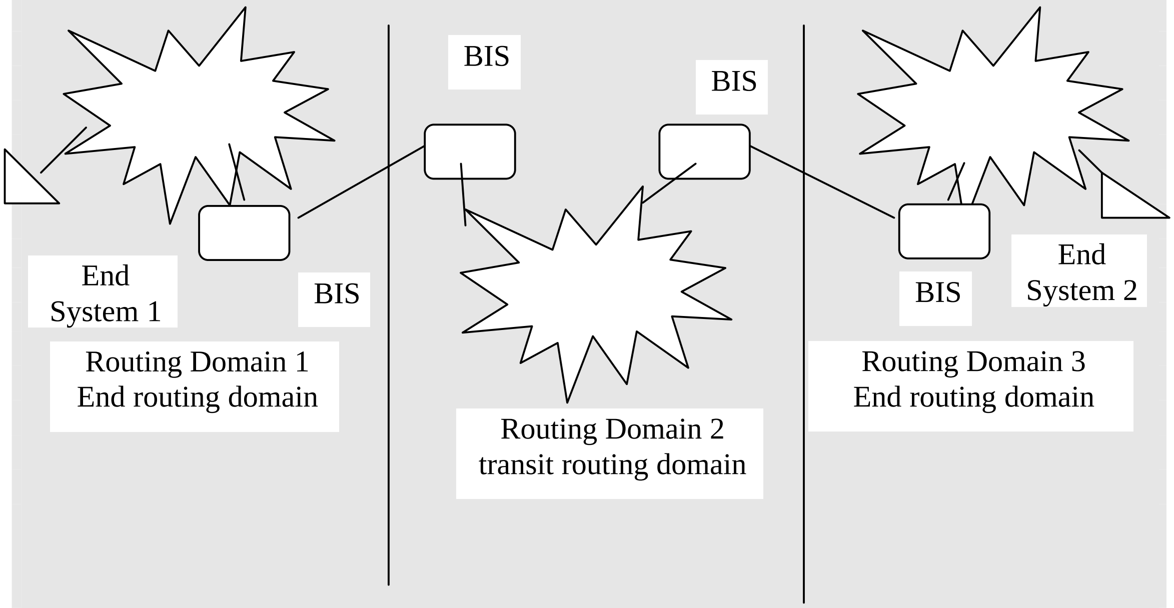


Figure 2 – Transit Routing Domains

Note: A transit routing domain may or may not be part of the backbone. That is, a routing domain may consist of BISs none of which are backbone routers.

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. 9705 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. 9705 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.

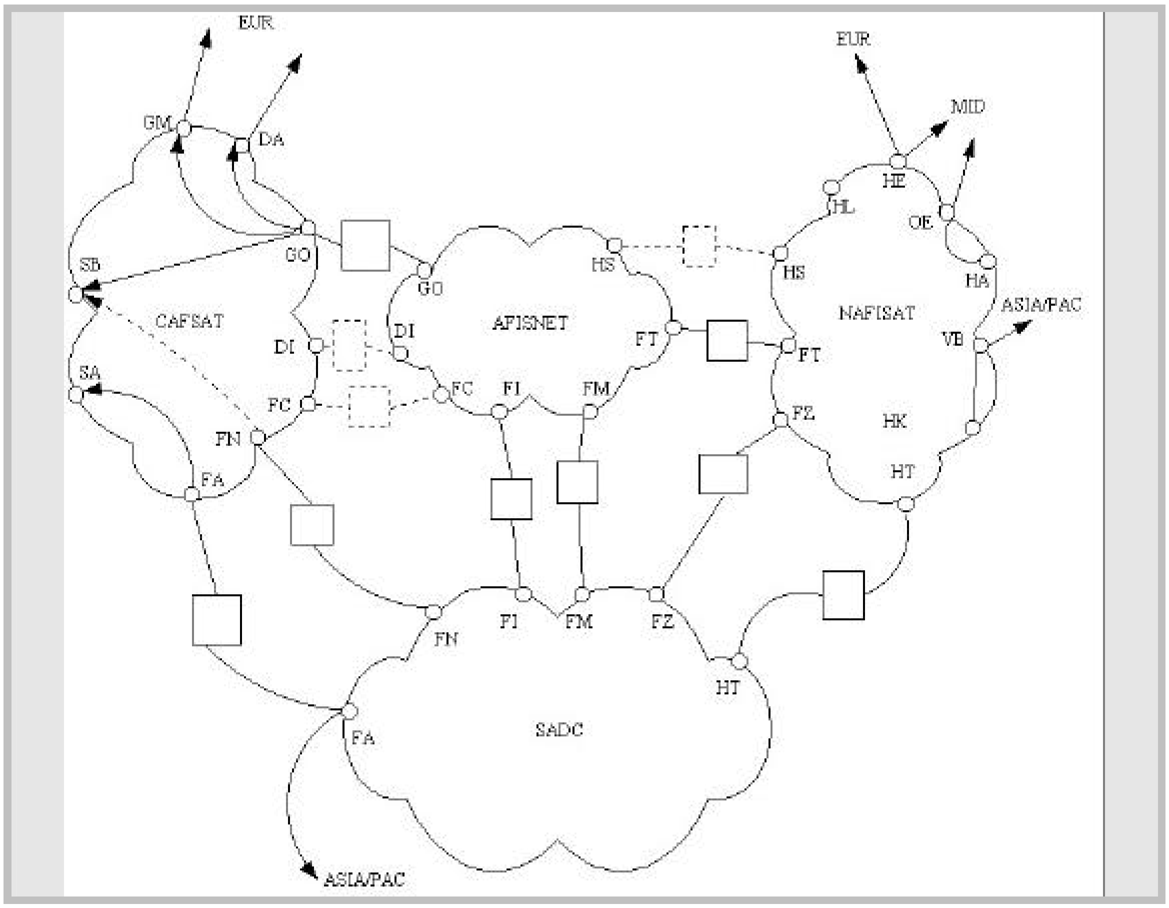
Note 4: It is possible for some States to provide transit routing from their routing domains to the routing domains of other States using BISs that are not backbone routers.

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.

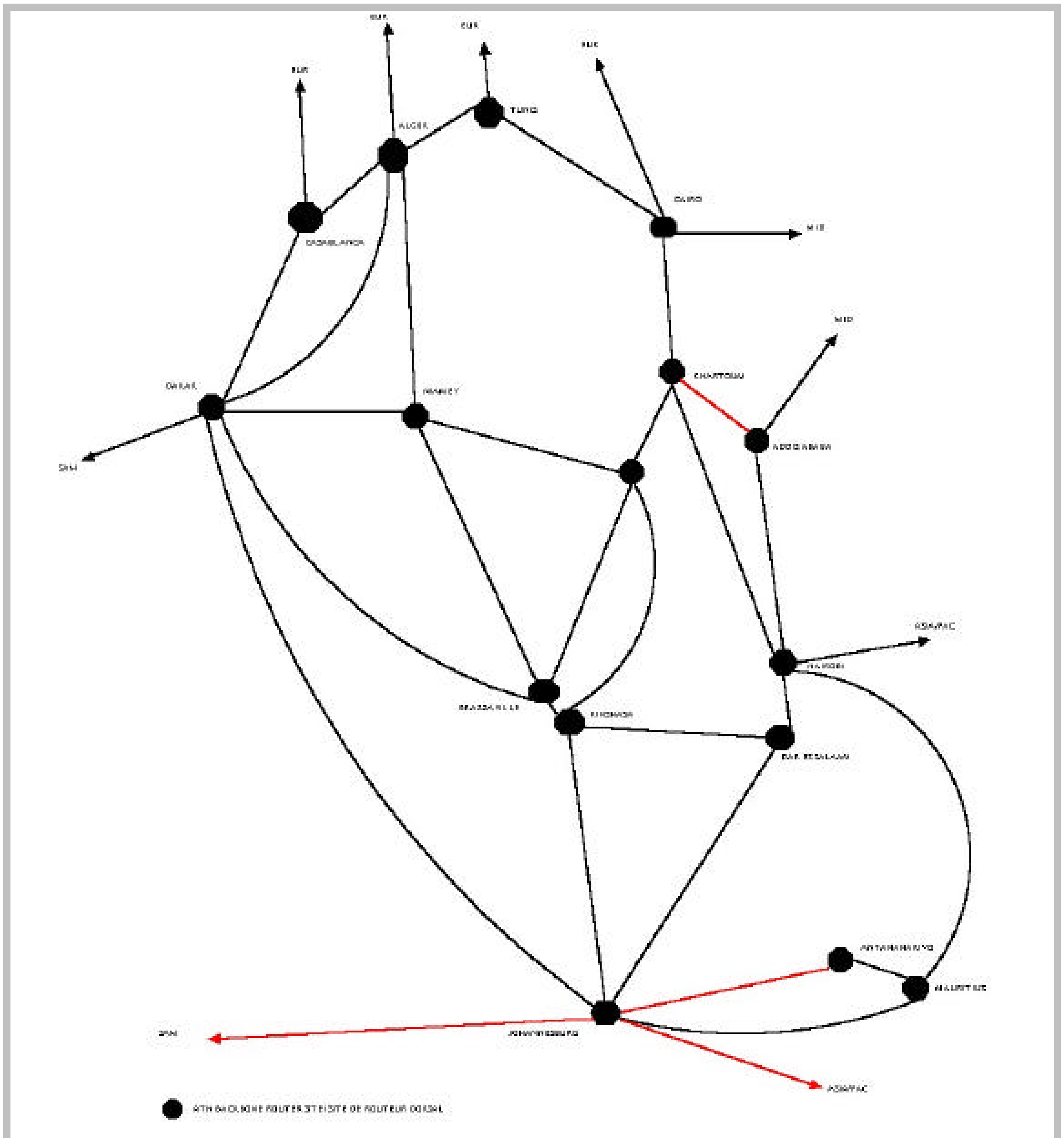
IDENTIFICATION OF AFI BACKBONE ROUTER SITES

(Subject to refinements)



AFI ATN BACKBONE

(Subject to refinements)



DRAFT AFI BACKBONE ROUTER INTERCONNECTION
PROJET D'INTERCONNECTION DE ROUTEURS DORSAUX DE LA REGION AFI

AFI ATN BACKBONE BIS AND CIRCUITS IMPLEMENTATION

State/Locations	ATN Backbone connection		Target Date of Implementation		Trunk Type	Comments
	Speed	Protocol	Circuit	BBIS		
1	2	3	4	5	6	7
Algeria						
Algiers						
Casablanca	64 Kbps				Intra-regional	Upgrade circuit
Dakar	64 Kbps				Intra-regional	New circuit
Niamey	64 Kbps				Intra-regional	Upgrade circuit
Tunis	64 Kbps				Intra-regional	Upgrade circuit
EUR	64 Kbps				Inter-regional	Upgrade circuit
Chad						
N'djamena						
Brazzaville	64 Kbps				Intra-regional	Upgrade circuit
Khartoum	64 Kbps				Intra-regional	New circuit
Kinshasa	64 Kbps				Intra-regional	New circuit
Niamey	64 Kbps				Intra-regional	Upgrade circuit
Congo						
Brazzaville						
Dakar	64 Kbps				Intra-regional	Upgrade circuit
Kinshasa	64 Kbps				Intra-regional	Upgrade circuit
N'djamena	64 Kbps				Intra-regional	Upgrade circuit
Niamey	64 Kbps				Intra-regional	Upgrade circuit
Dem. Republic of the Congo						
Kinshasa						
Brazzaville	64 Kbps				Intra-regional	Upgrade circuit
Dar es Salaam	64 Kbps				Intra-regional	New circuit
Johannesburg	64 Kbps				Intra-regional	Upgrade circuit
N'djamena	64 Kbps				Intra-regional	New circuit
Egypt						
Cairo						
Khartoum	64 Kbps				Intra-regional	Upgrade circuit
Tunis	64 Kbps				Intra-regional	Upgrade circuit
EUR	64 Kbps				Inter-regional	Upgrade circuit
MID	64 Kbps				Inter-regional	Upgrade circuit
Ethiopia						
Addis Ababa						
Khartoum	64 Kbps				Intra-regional	Upgrade circuit
Nairobi	64 Kbps				Intra-regional	Upgrade circuit
MID	19.2 Kbps				Inter-regional	Upgrade circuit
Kenya						
Nairobi						
Addis Ababa	64 Kbps				Intra-regional	Upgrade circuit
Dar es Salaam	64 Kbps				Intra-regional	Upgrade circuit
Khartoum	64 Kbps				Intra-regional	New circuit
Mauritius	64 Kbps				Intra-regional	Upgrade circuit
ASIA/PAC[1]	19.2 Kbps				Inter-regional	Upgrade circuit
Madagascar						
Antananarivo						
Johannesburg	64 Kbps				Intra-regional	Upgrade circuit
Mauritius	64 Kbps				Intra-regional	Upgrade circuit

[1] In ASIA/PAC ATN Plan, this circuit is to be upgraded by 2005 to 19.2 Kbps, X.25 protocol and the India BBIS implemented by 2005

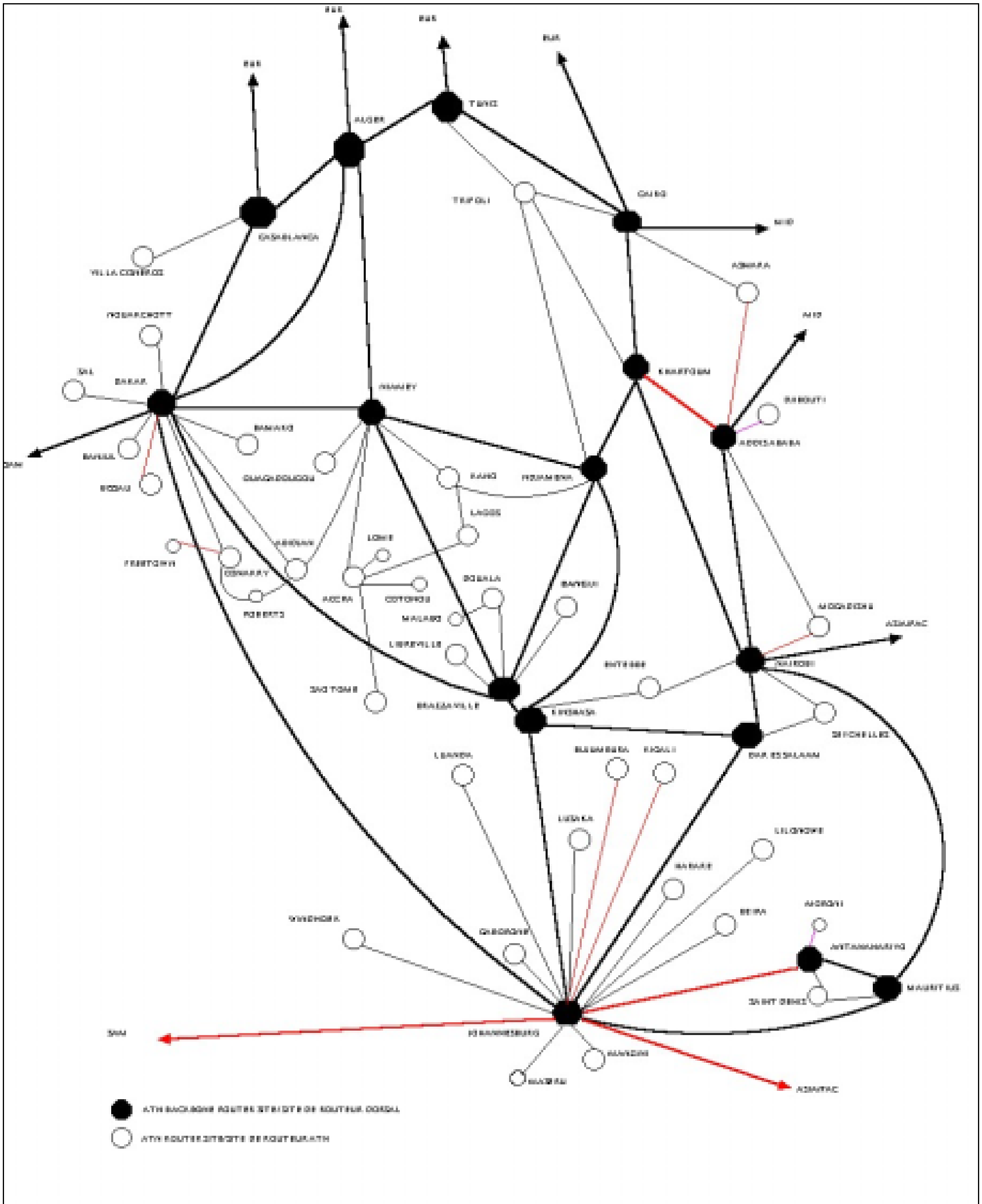
State/Locations	ATN Backbone connection		Target Date of Implementation		Trunk Type	Comments
	Speed	Protocol	Circuit	BBIS		
1	2	3	4	5	6	7
Mauritius						
Mauritius						
Antananarivo	64 Kbps				Intra-regional	Upgrade circuit
Johannesburg	64 Kbps				Intra-regional	Upgrade circuit
Nairobi	64 Kbps				Intra-regional	Upgrade circuit
Niger						
Niamey						
Algiers	64 Kbps				Intra-regional	Upgrade circuit
Brazzaville	64 Kbps				Intra-regional	Upgrade circuit
Dakar	64 Kbps				Intra-regional	Upgrade circuit
N'djamena	64 Kbps				Intra-regional	Upgrade circuit
Morocco						
Casablanca						
Algiers	64 Kbps				Intra-regional	Upgrade circuit
Dakar	64 Kbps				Intra-regional	Upgrade circuit
EUR	64 Kbps				Inter-regional	Upgrade circuit
Senegal						
Dakar						
Algiers	64 Kbps				Intra-regional	New circuit
Brazzaville	64 Kbps				Intra-regional	Upgrade circuit
Casablanca	64 Kbps				Intra-regional	Upgrade circuit
Johannesburg	64 Kbps				Intra-regional	Upgrade circuit
Niamey	64 Kbps				Intra-regional	Upgrade circuit
SAM	19.2 Kbps				Inter-regional	Upgrade circuit
South Africa						
Johannesburg						
Antananarivo	64 Kbps				Intra-regional	Upgrade circuit
Dakar	64 Kbps				Intra-regional	Upgrade circuit
Dar es Salaam	64 Kbps				Intra-regional	Upgrade circuit
Kinshasa	64 Kbps				Intra-regional	Upgrade circuit
Mauritius	64 Kbps				Intra-regional	Upgrade circuit
ASIA/PAC[2]	19.2 Kbps				Inter-regional	Upgrade circuit
SAM	19.2 Kbps				Inter-regional	Upgrade circuit
Sudan						
Khartoum						
Addis Ababa	64 Kbps				Intra-regional	Upgrade circuit
Cairo	64 Kbps				Intra-regional	Upgrade circuit
Nairobi	64 Kbps				Intra-regional	New circuit
N'djamena	64 Kbps				Intra-regional	New circuit
Tanzania						
Dar es Salaam						
Kinshasa	64 Kbps				Intra-regional	New circuit
Johannesburg	64 Kbps				Intra-regional	Upgrade circuit
Nairobi	64 Kbps				Intra-regional	Upgrade circuit
Tunisia						
Tunis						
Algiers	64 Kbps				Intra-regional	Upgrade circuit
Cairo	64 Kbps				Intra-regional	Upgrade circuit
EUR	64 Kbps				Inter-regional	Upgrade circuit

[2] In ASIA/PAC ATN Plan, this circuit is to be upgraded by 2003 to 19.2 Kbps, X.25 protocol and the Australia BBIS implemented by 2003.

AFI ATN BIS AND CONNECTIONS IMPLEMENTATION

Backbone BIS site/Locations	ATN connection		Target Date of Implementation		Connection Type	Comments
	Speed	**Protocol**	**Circuit**	**BIS**		
1	2	3	4	5	6	7
Chad						
N'djamena						
Kano	9600 bps				Intra-regional	New circuit
Tripoli	9600 bps				Intra-regional	New circuit
Congo						
Brazzaville						
Bangui	9600 bps				Intra-regional	Upgrade circuit
Douala	9600 bps				Intra-regional	Upgrade circuit
Libreville	9600 bps				Intra-regional	Upgrade circuit
Dem. Rep. of Congo						
Kinshasa						
Entebbe	9600 bps				Intra-regional	Upgrade circuit
Egypt						
Cairo						
Asmara	9600 bps				Intra-regional	Upgrade circuit
Tripoli	9600 bps				Intra-regional	Upgrade circuit
Ethiopia						
Addis Ababa						
Asmara	9600 bps				Intra-regional	Upgrade circuit
Djibouti	9600 bps				Intra-regional	Upgrade circuit
Mogadishu	9600 bps				Inter-regional	New circuit
Kenya						
Nairobi						
Entebbe	9600 bps				Intra-regional	Upgrade circuit
Mogadishu	9600 bps				Intra-regional	Upgrade circuit
Seychelles	9600 bps				Intra-regional	Upgrade circuit
Madagascar						
Antananarivo						
Moroni	9600 bps				Intra-regional	Upgrade circuit
Saint Denis	9600 bps				Intra-regional	New circuit
Mauritius						
Mauritius						
Saint Denis	9600 bps				Intra-regional	Upgrade circuit
Niger						
Niamey						
Abidjan	9600 bps				Intra-regional	Upgrade circuit
Accra	9600 bps				Intra-regional	Upgrade circuit
Kano	9600 bps				Intra-regional	Upgrade circuit
Ouagadougou	9600 bps				Intra-regional	Upgrade circuit
Morocco						
Casablanca						
Villa Cisneros	9600 bps				Intra-regional	Upgrade circuit
Senegal						
Dakar						
Abidjan	9600 bps				Intra-regional	Upgrade circuit
Bamako	9600 bps				Intra-regional	Upgrade circuit
Banjul	9600 bps				Intra-regional	Upgrade circuit
Bissau	9600 bps				Intra-regional	Upgrade circuit

Backbone BIS site/Locations	**ATN connection**		**Target Date of Implementation**		**Connection Type**	**Comments**
	Speed	**Protocol**	**Circuit**	**BIS**		
1	2	3	4	5	6	7
Conakry	9600 bps				Intra-regional	Upgrade circuit
Nouakchott	9600 bps				Intra-regional	Upgrade circuit
Sal	9600 bps					
South Africa						
Johannesburg						
Beira	9600 bps				Intra-regional	Upgrade circuit
Bujumbura	9600 bps				Intra-regional	Upgrade circuit
Gaborone	9600 bps				Intra-regional	Upgrade circuit
Harare	9600 bps				Intra-regional	Upgrade circuit
Kigali	9600 bps				Intra-regional	Upgrade circuit
Lilongwe	9600 bps				Intra-regional	Upgrade circuit
Luanda	9600 bps				Intra-regional	Upgrade circuit
Lusaka	9600 bps				Intra-regional	Upgrade circuit
Manzini	9600 bps				Intra-regional	Upgrade circuit
Maseru	9600 bps				Intra-regional	Upgrade circuit
Windhoek	9600 bps				Intra-regional	Upgrade circuit
Sudan						
Khartoum						
Tripoli	9600 bps				Intra-regional	New circuit
Tanzania						
Dar es Salaam						
Seychelles	9600 bps				Intra-regional	New circuit
Tunisia						
Tunis						
Tripoli	9600 bps				Intra-regional	Upgrade circuit
TRANSIT BISs						
Cameroon						
Douala						
Malabo	9600 bps				Intra-regional	Upgrade circuit
Côte d'Ivoire						
Abidjan						
Robertsfield	9600 bps				Intra-regional	New circuit
Ghana						
Accra						
Cotonou	9600 bps				Intra-regional	Upgrade circuit
Lagos	9600 bps				Intra-regional	New circuit
Lome	9600 bps				Intra-regional	Upgrade circuit
Sao Tome	9600 bps				Intra-regional	New circuit
Guinea						
Conakry						
Freetown	9600 bps				Intra-regional	Upgrade circuit
Robertsfield	9600 bps				Intra-regional	Upgrade circuit
Nigeria						
Kano						
Lagos	9600 bps				Intra-regional	Upgrade circuit



DRAFT AFI ATN ROUTER INTERCONNECTION
PROJET D'INTERCONNECTION DE ROUTEURS ATN DE LA REGION AFI

Agenda Item 5 : Future work programme

5.1 Under this Agenda Item, the meeting adopted the future work programme and composition of the ATN Planning Task Force. The meeting noted Gambia's intention to join the Task Force and formulated the following draft Decisions:

Draft Decision 1/15: Membership in the ATN Planning Task Force

That The Gambia be included in the composition of the ATN Planning Task Force.

Draft Decision 1/16: Future work programme and composition of the ATN Planning Task Force

That the future work programme and composition of the ATN Planning Task Force be as defined at Appendix 5A to this part of the Report.

TERMS OF REFERENCE, WORK PROGRAMME AND COMPOSITION OF THE AFI AERONAUTICAL TELECOMMUNICATION NETWORK PLANNING TASK FORCE (ATN/TF)		
TERMS OF REFERENCE To plan for the implementation of the aeronautical telecommunication network (ATN) in the AFI Region in order to meet CNS/ATM system performance requirements and capacity.		
WORK PROGRAMME		
TASK No.	**SUBJECT**	**TARGET DATE**
1	Refinement of the ATN routing architecture	APIRG/15
2	Description of the ATN ground-ground applications (AMHS, AIDC)	APIRG/15
3	Preparation of an ATN addressing plan	APIRG/15
4	Preparation of an AMHS naming and addressing plan	APIRG/15
5	Preparation of guidance material to assist States, as necessary	APIRG/15
6	Update of the guidelines on ATN in the CNS/ATM Implementation Plan (Doc 003)	APIRG/15
7	Formulation of proposals to achieve the interoperability of existing VSAT networks	APIRG/15
COMPOSITION		
Algeria, Angola, Burundi, Egypt, Ethiopia, Guinea, Kenya, Malawi, *Niger, Nigeria, Senegal, South Africa, Tunisia, ASECNA and IATA.*		