INTERNATIONAL CIVIL AVIATION ORGANIZATION

SECOND MEETING OF THE
AERONAUTICAL TELECOMMUNICATION PLANNING TASK FORCE
(ATN/TF/2)

(Dakar, 5 - 6 April 2005)

REPORT

Prepared by the ICAO Eastern and Southern 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
AIDC	ATS interfacility data communications
AIS	Aeronautical Information Service
ACP	Aeronautical 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
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
CPDLC	Controller pilot data link communications
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
HF	High Frequency
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IS	Intermediate System
ISO	International Organization for Standardization
ITU	International Telecommunication Union
JAA	Joint Aviation Authorities
OSI	Open Systems Interconnection
RD	Routing Domain
SARPs	Standards and Recommended Practices
SATCOM	Satellite Communication
SITA	Société Internationale de Télécommunications Aéronautiques
SSR	Secondary Surveillance Radar
TCP/IP	Transport Control Protocol/Internet Protocol
TMA	Terminal Control Area
VDL	VHF Data Link
VHF	Very High Frequency

History of the meeting

1. Duration and Venue of the Meeting

1.1 The second meeting of the Aeronautical Telecommunication Network Planning Task Force (ATN/TF/2) was held in Dakar, Senegal from 5 to 6 April 2005.

2. Officers and Secretariat

2.1 Mr. Amadou Sene, Regional Technical Officer Communications, Navigation and Surveillance (RO/CNS) of ICAO Eastern and Southern Office, Nairobi , was the Secretary of the Task Force. He was assisted by Mr. Prosper Zo'o – Minto'o and Mrs. Mary A. Obeng, RO/CNS, both from the ICAO Western and Central Office, Dakar. The Secretariat acted the moderator of the meeting.

3. Attendance

3.1 The meeting was attended by 40 delegates from 16 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 terms of reference and work programme of the ATN Planning Task Force

Agenda Item 2 : Description of the AFI ATN topology

Agenda Item 3 : Description of ATN ground/ground applications

Agenda Item 4 : Formulation of proposals to achieve VSAT networks interoperability

Agenda Item 5 : Future work programme and composition of the ATN Planning Task Force

Agenda Item 6: 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 ICAO will initiate further action in accordance with established procedures.

6.3 **Draft Decisions**

6.3.1 Draft Decisions deal with matters of concern to the Communications, Navigation and Surveillance Sub-group (CNS/SG) and the ATN Planning Task Force.

6.4 **List of Draft Conclusions**

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2/2:	Draft AFI ATN routing architecture	2-1
2/4:	Implementation of the AIDC application	3-1
2/5	Interoperability of VSAT networks	4-2

6.5 **List of Draft Decisions**

No.	**Title**	**Page**
2/1:	Membership in the ATN Planning Task Force	1-2

Appendices to the Report of the Second Meeting of the Aeronautical Telecommunication Planning Task Force (ATN/TF/2)

Agenda Item	Appendix	Title
Introduction	A	List of Participants
1	1A	Terms of reference, work programme and composition of the ATN Planning Task Force
2	2A	Draft of AFI AFTN routing architecture plan
2	2B	AFI ATN Backbone BIS and BIS circuits implementation
2	2C	Chart of draft AFI ATN architecture
2	2D	Draft AFI ATN NSAP addressing plan
5	5A	Future work programme and composition of the ATN Planning Task Force

Appendices to the Report of the Second Meeting of the Aeronautical Telecommunication Planning Task Force (ATN/TF/2)

INTERNATIONAL CIVIL AVIATION ORGANIZATION
WESTERN AND CENTRAL AFRICAN OFFICE

APPENDIX A
APPENDICE A

Second Meeting of the ATN Planning Task Force
(Dakar, 5-6 April 2005)

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Agenda Item 1: Review of the terms of reference, work programme and composition of the ATN Planning Task Force

1.1 The AFI ATN Planning Task Force noted that the COM/SG/6 Meeting (Nairobi, 24-26 September 2002) reviewed the report of the first meeting of the Task Force and noted that its work was not yet completed. The COM/SG then adopted new terms of reference and work programme for the ATN Planning Task Force, which are shown at **Appendix 1A** to this report.

1.2 The meeting was of the view that each task will encompass the generation of several documents. Based on the experience of the ASIA/Pacific Region, the following paragraphs show the sub-tasks to be achieved in order to complete the elements of the work programme.

Note: A glossary of terms is provided at Appendix 1B to this report.

Task 1: Develop ATN routing architecture

1.3 This task will involve the drafting of the following documents:

a) ATN Routing Architecture
b) ATN ground/ground Transition Plan
c) FASID ATN Router Plan
d) ATN IDRP Routing policy
e) ATN ground/ground interface control document (G/G ICD)
f) ATN air/ground interface control document (A/G ICD)

Tasks 2 and 4: ATN applications (AMHS, AIDC)

1.4 These tasks will involve the drafting of the following documents:

a) AMHS Naming Plan
b) AMHS ICD
c) FASID AMHS Routing Plan
d) AMHS Message Transfer Agent Routing Policy
e) AMHS Address Registration Form
f) FASID AIDC Circuit Plan

Task 3: Develop ATN addressing plan

1.5 These tasks will involve the drafting of the following documents:

a) ATN NSAP Addressing Plan
b) ATN NSAP Registration Form

Task 5: Develop guidance material

1.6 These tasks will involve the drafting of the following documents:

a) Guidance on ground elements ATN Transition
b) Overview of the ATN

1.7 The meeting noted that the Manual of Technical Provisions for the Aeronautical Telecommunication Network (ICAO Doc 9705 – AN/956), Third Edition, includes additional provisions required for ATN implementation:

a) ATN System Management
b) ATN Directory Service
c) ATN Security Service

1.8 These provisions will also require their future addition to the tasks list of the Task Force and, ultimately, the development of appropriate documentation for guidance to implementation of the ATN in the AFI Region.

1.9 Based on the above, the meeting decided to address the following sub-tasks, on the understanding that the remaining sub-tasks would be addressed in subsequent meetings:
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- ATN Routing Architecture
- ATN Ground/Ground Transition Plan
- FASID ATN Router Plan; and
- ATN NSAP Addressing Plan.

1.10 The meeting agreed to the request of Cameroon, DR Congo, Ghana, Mauritius and Morocco to be members of the AFI ATN Planning Task Force. The following draft decision was adopted.

Draft Decision 2/1: Membership in the AFI ATN Planning Task Force

That Cameroon, DR Congo, Ghana, Mauritius and Morocco be members of the AFI ATN Planning Task Force.

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.

Glossary of terms

Addressing plan – A plan that provides common address syntax and management of global addresses for the unambiguous identification of all end and intermediate systems.

Boundary Intermediate System (BIS) – An intermediate system that is able to relay data between two separate routing or administrative domain.

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

Intermediate Systems (IS): a system (router) that performs relaying and routing functions and comprises the lower three layers of the OSI reference model.

Naming plan – A plan that provides common naming conventions and designations for the unambiguous identification of all end systems and intermediate systems.

Network service access point (NSAP) – Point within the ISO protocol architecture at which global end-users my be uniquely addressed on an end-to-end basis.

NSAP address – A hierarchically organized global address, supporting international, geographical and telephony-oriented formats by way of an address format identifier located within the protocol header.

Routing policy – A set of rules that control the selection of routes and the distribution of routing information by BISs. These rules are based on policy criteria rather on performance metrics such as hop count, capacity, transit delay, cost, etc., which are usually applied for routing.

Acronyms used:

AIDC	-	ATS inter-facility data communications
AMHS	-	ATS message handling system
BIS	-	Boundary Intermediate System
ES	-	End System
FASID	-	Facilities and Services Implementation Document
IDRP	-	Inter-Domain Routing Protocol
IS	-	Intermediate System
ISO	-	International Organization for Standardization
OSI	-	Open Systems Interconnection reference model

Agenda Item 2: Description of the AFI ATN topology

2.1 ATN routing architecture

2.1.1 The Task Force reviewed a revised draft of an initial Plan for the routing ATN routing architecture within the AFI Region, which was presented by the Secretariat at the first meeting.

2.1.2 The proposed routing architecture, which relies on the existing AFTN network, is composed of:

a) A backbone network of 11 centres 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.

2.1.3 The meeting, after discussions, reduced the number of backbone centres to 6 and agreed on the draft AFI ATN Architecture described in **Appendix 2A.**

2.1.4 The description of the ground-ground ATN architecture will comprise a table for the Backbone BIS interconnections and the routing domain BIS connections to the backbone in the AFI Region.

2.2 Description of the ATN ground-ground network

2.2.1 The proposed ATN Backbone BIS and BIS circuits implementation Table is shown at **Appendix 2B** to this part of the Report. **Appendix 2C** shows a chart of the ground-ground ATN network for the AFI region. The table will be the basis for development of the AFI ATN Transition Plan. The following Draft Conclusion was adopted:

Draft Conclusion 2/2: Draft AFI ATN routing architecture

That the draft ATN routing architecture as described at Appendices 2A, 2B and 2C be circulated to States for comments and completion of the tables.

2.3 ATN addressing plan for the AFI Region

2.3.1 The meeting was advised that based upon the ATN SARPs as published in ICAO Annex 10 and ICAO Doc. 9705, the Regions are advised to develop naming and addressing plans. These Regional Plans may be used to guide States in the assignment and registration of addresses such as Network Service Access Point (NSAP) Addresses. In this regard, the Task Force reviewed a draft NSAP ATN addressing plan, which is shown at **Appendix 2D**.

2.3.2 The objectives of the document are to provide:

- Guidance in the specification of NSAP addresses; and
- Guidance in the specification of routing domain identifiers (RDI) for Routing Domains (RD) and Routing Domain Confederations (RDC).

2.3.3 In providing guidance on the specification of NSAP addresses, each NSAP address field is described with the recommendations on how the field may be used. This is important so that consistency in the use of NSAP addresses is obtained and efficiency in routing is maintained.

2.3.4 The meeting reviewed in detail the proposed addressing structure and agreed with the recommendations contained in the document for an efficient ATN routing in the AFI region. However, the Task Force felt that more guidance was needed on the assignment of the ARS, LOC and SYS fields of the NSAP address, in the form of examples and a flow chart. A working group (of members from Ghana, South Africa, Tunisia and ASECNA, ICAO) was established to prepare the additional guidance. The following draft Decision was formulated:

Decision 2/3: Guidance material on NSAP addressing

That the Working Group draft guidance material on the assignment of the ARS, LOC and SYS fields of the NSAP address.

Note: The Working Group is composed of designated members from Ghana, South Africa, Tunisia and ASECNA, ICAO

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International Civil Aviation Organization

Second Meeting of the AFI ATN Planning Task Force

Dakar, 5 - 6 April 2005

DRAFT AFI ATN ROUTING ARCHITECTURE PLAN

Summary

This document presents the draft ATN Regional Architecture Plan.

Executive Summary

This document provides technical guidance on the planning and implementation of 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.

1 INTRODUCTION

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

1.1 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.

Domain*:* a set of end systems and intermediate systems that operate the same routing procedures and that are wholly contained in a single administrative domain.

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.

1.2 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

2 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 under a single administrative authority) 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 may agree to join together, because of the mutual trust between their administrations. They form then a routing domain confederation (RDC).

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.

2.1 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.

2.2 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 receiving 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.

2.3 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.

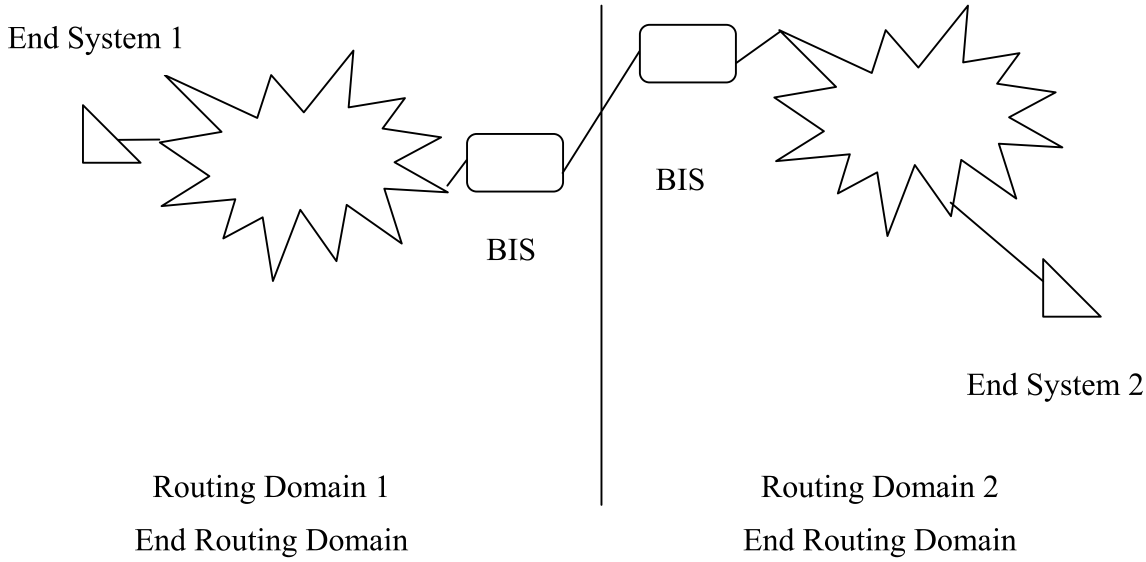


Figure 1 – End Routing Domains

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.

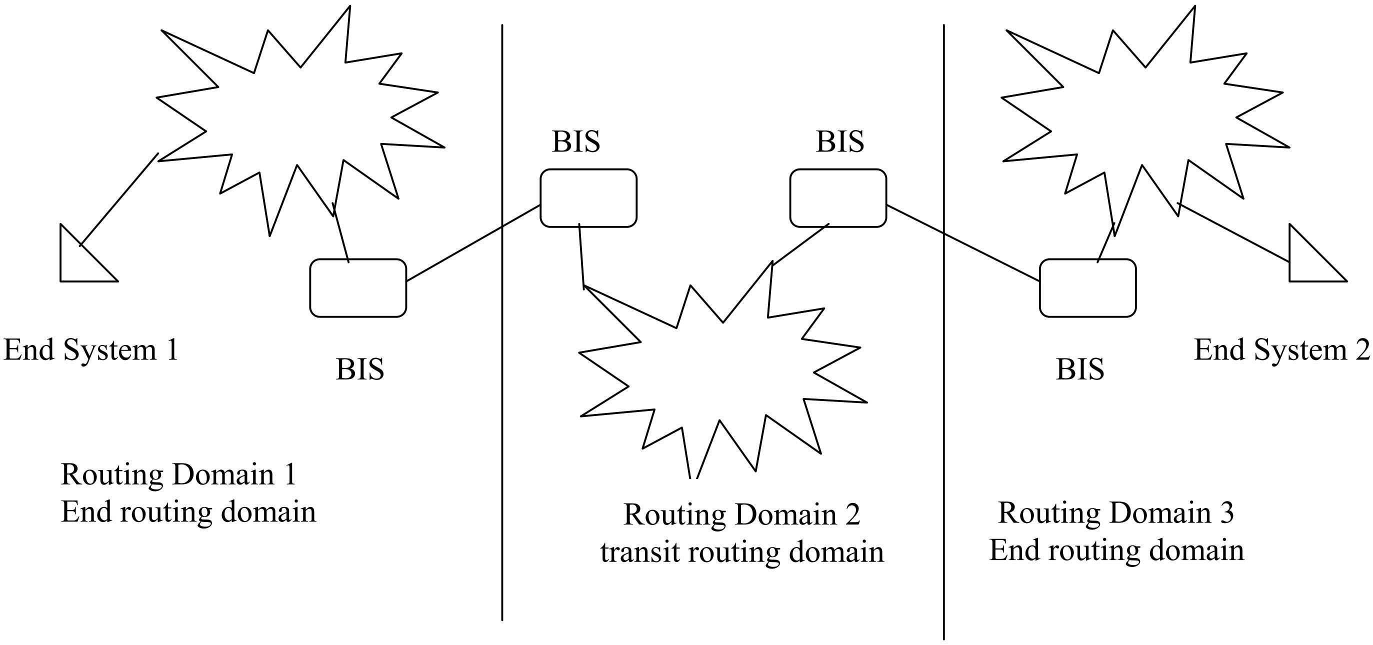


Figure 2 – Transit Routing Domains

2.4 Routing Domain Construction

Based on the above, a routing domain consists of at least one inter-domain router (BIS).

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.

3 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 routers are internal State issues and outside the scope of this document.

3.1 Boundary Intermediate System Overview

Boundary Intermediate Systems comprise the interfaces between sub-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.

3.2 Router Types

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

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

3.2.1 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 outside 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.

3.2.2 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.

4 AFI REGIONAL ROUTING ARCHITECTURE

The AFI Regional routing architecture is based upon several concepts:

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

The routing architecture can be divided into several distinct parts:

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

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

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

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

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

4.1 AFI Regional Backbone

The definition of a Regional Backbone is based upon a high availability core network of ATN routers supporting, in due course, ATN mobile routing for the AFI Region.

The rationale for defining Regional backbone sites is based upon the identification of routing domains or RDCs that are capable of concentrating ATN traffic and routing it efficiently in the region or to other regions. This may be based on existing main AFTN sites and on the flow of both AFTN traffic and possible future air-ground traffic. The latter could be based on the ATM routing areas of the AFI CNS/ATM plan.

The architecture and communication requirements define a routing plan that incorporates alternate routing and communication paths so that no single backbone router failure can isolate major parts of the Region.

The initial AFI BBISs sites are defined in the following table**,** based on the expected traffic flows. Additional backbone sites will need to be identified in the future for increased reliability of the interconnections between the networks.

Item	ATN backbone router site	State (Domain)
1	Algiers	Algeria (Algeria)
2	Cairo	Egypt (Egypt)
3	Dakar	Senegal (ASECNA)
4	Johannesburg	South Africa (South Africa)
5	Nairobi	Kenya (Kenya)
6	N’djamena	Chad (ASECNA)

Table 4.1 - Definition of initial AFI ATN Backbone router sites

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

4.1.1 AFI Backbone router requirements

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

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

4.1.1.1 Availability

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

4.1.1.2 Reliability

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

4.1.1.3 Capacity

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

4.1.1.4 Alternative routing

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

4.1.1.5 Routing policies

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

4.2 Inter-Regional Backbone

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

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

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

Centre (Domain)	Region served
Algiers (Algeria)	Europe
Cairo (Egypt)	Europe, Middle East
Dakar (ASECNA)	South America
Johannesburg (South Africa)	Asia/Pacific, South America
Nairobi (Kenya)	Asia

Table 4.2 - Centres with circuits to other ICAO Regions

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

4.2.1 Long Term Implementation

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

4.2.2 Initial Implementation

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

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

For connecting to Europe, there should be three (3) Inter-Regional BBISs.

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

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

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

4.2.3 Transition Issues

The transition issues relation to the regional architecture are found in the ATN transition plan.

4.2.4 End BISs

It is assumed that naming and addressing (and routing domain definition) will be done on a Regional basis. Further, for areas within the Region that may utilize an End BIS serving more than one State, the naming structure will be based on the Regional NSAP format defined in Doc. 9705. Further, States may choose to either implement the Regional (or Sub-Regional) NSAP format or the State NSAP format based on whether it installs a BIS.

4.3 Routing Domains

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

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

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

Routing to the backbone and between backbone routers will be controlled through IDRP policies.

Each State will be responsible for the designation of routing policies for its End Systems and End BISs. Individual States will also be responsible for establishing routing policies for routing to its designated BBIS.

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

5 ATN Transition

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

5.1 Initial Regional Implementation

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

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

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

Regional ATN Implementation

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

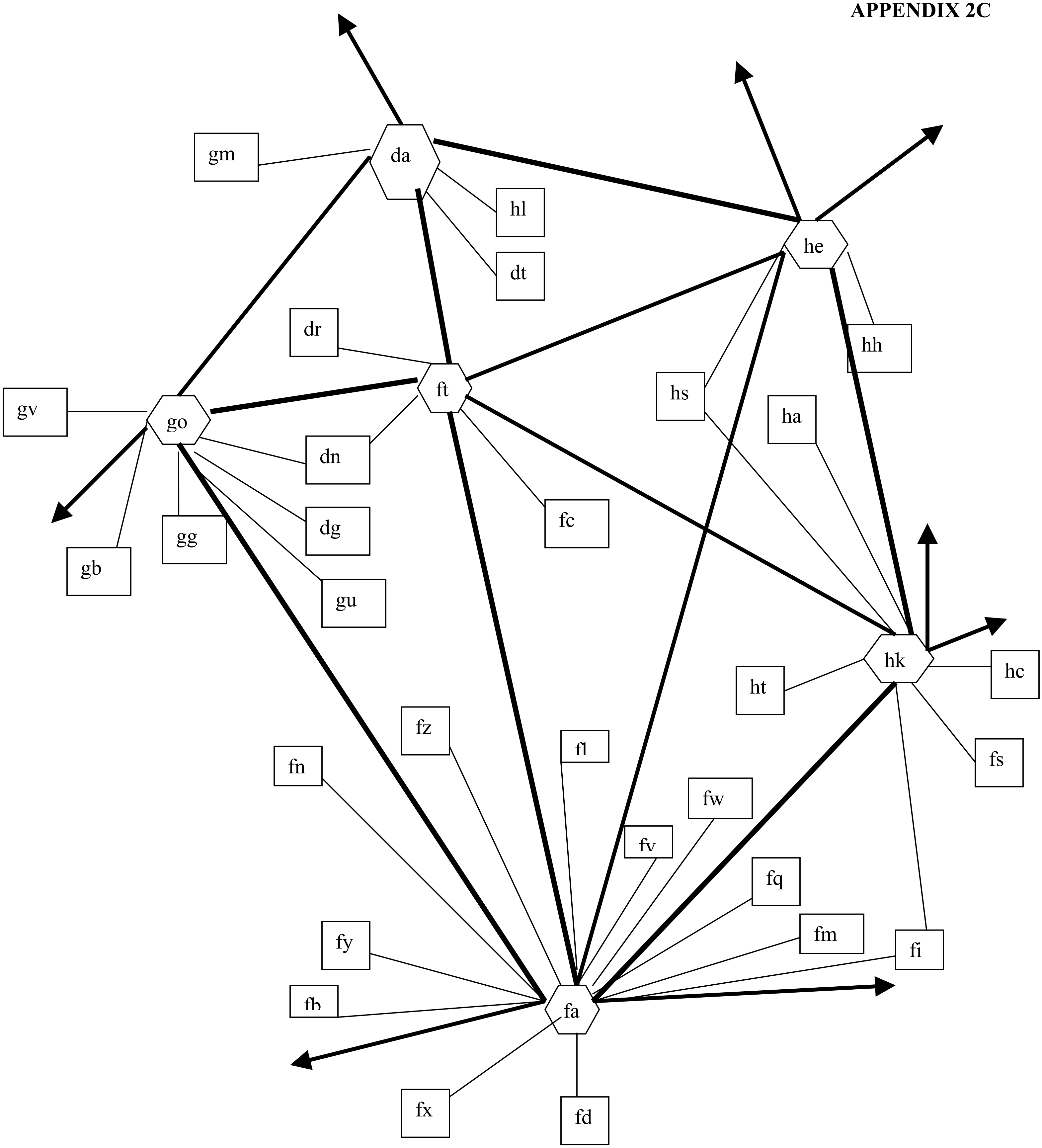
AFI ATN BACKBONE BIS AND BIS CIRCUITS IMPLEMENTATION

State/Locations	ATN connection		Target Date of Implementation		Trunk Type	Comments
	Speed	Protocol	Circuit	BIS		
1	2	3	4	5	6	7
Algeria						
Algiers BBIS						
Cairo BBIS	64 Kbps	X.25			Intra-regional	Upgrade circuit
Dakar BBIS	64 Kbps	X.25			Intra-regional	Upgrade circuit
N'Djamena BBIS	64 Kbps	X.25			Intra-regional	Upgrade circuit
Casablanca	9600 bps	X.25			Intra-regional	Upgrade circuit
Tunis	9600 bps	X.25			Intra-regional	Intra-regional
Tripoli	9600 bps	X.25			Intra-regional	Upgrade circuit
EUR	64 Kbps	X.25			Inter-regional	Upgrade circuit
Chad						
N'Djamena BBIS						
Algiers BBIS	64 Kbps	X.25			Intra-regional	New circuit
Cairo BBIS	64 Kbps	X.25			Intra-regional	New circuit
Dakar BBIS	64 Kbps	X.25			Intra-regional	New circuit
Johannesburg BBIS	64 Kbps	X.25			Intra-regional	New circuit
Nairobi BBIS	64 Kbps	X.25			Intra-regional	New circuit
Kano	9600 bps	X.25			Intra-regional	New circuit
Brazzaville	9600 bps	X.25			Intra-regional	Upgrade circuit
Egypt						
Cairo BBIS						
Algiers BBIS	64 Kbps	X.25			Intra-regional	New circuit
Nairobi BBIS	64 Kbps	X.25			Intra-regional	Upgrade circuit
Johannesburg BBIS	64 Kbps	X.25			Intra-regional	New circuit
N'Djamena BBIS	64 Kbps	X.25			Intra-regional	New circuit

State/Locations	ATN connection		Target Date of Implementation		Trunk Type	Comments
	Speed	Protocol	Circuit	BIS		
1	2	3	4	5	6	7
Asmara	9600 bps	X.25			Intra-regional	New circuit
Khartoum	9600 bps	X.25			Intra-regional	Upgrade circuit
EUR	64 Kbps	X.25			Inter-regional	Upgrade circuit
MID	64 Kbps	X.25			Inter-regional	Upgrade circuit
Kenya						
Nairobi BBIS						
Cairo BBIS	64 Kbps	X.25			Intra-regional	Upgrade circuit
Johannesburg BBIS	64 Kbps	X.25			Intra-regional	Upgrade circuit
N'Djamena BBIS	64 Kbps	X.25			Intra-regional	New circuit
Addis Ababa	9600 bps	X.25			Intra-regional	Upgrade circuit
Dar es Salaam	9600 bps	X.25			Intra-regional	Upgrade circuit
Entebbe	9600 bps	X.25			Intra-regional	Upgrade circuit
Khartoum	9600 bps	X.25			Intra-regional	New circuit
Mauritius	9600 bps	X.25			Intra-regional	Upgrade circuit
Mogadishu	9600 bps	X.25			Intra-regional	Upgrade circuit
Seychelles	9600 bps	X.25			Intra-regional	Upgrade circuit
ASIA/PAC[1]	19.2 Kbps	X.25			Inter-regional	Upgrade circuit
MID	64 Kbps	X.25			Intra-regional	New circuit
Senegal						
Dakar BBIS						
Algiers BBIS	64 Kbps	X.25			Intra-regional	New circuit
Johannesburg BBIS	64 Kbps	X.25			Intra-regional	Upgrade circuit
N'Djamena BBIS	64 Kbps	X.25			Intra-regional	New circuit
Abidjan	9600 bps	X.25			Intra-regional	Upgrade circuit
Accra	9600 bps	X.25			Intra-regional	New circuit
Bamako	9600 bps	X.25			Intra-regional	Upgrade circuit
Banjul	9600 bps	X.25			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 connection**		**Target Date of Implementation**		**Trunk Type**	**Comments**
	Speed	**Protocol**	**Circuit**	**BIS**		
1	2	3	4	5	6	7
Bissau	9600 bps	X.25			Intra-regional	Implement circuit
Kano	9600 bps	X.25			Intra-regional	New circuit
Nouakchott	9600 bps	X.25			Intra-regional	Upgrade circuit
Roberts FIC	9600 bps	X.25			Intra-regional	Upgrade circuit
Sal	9600 bps	X.25			Intra-regional	Upgrade circuit
SAM	19.2 Kbps	X.25			Inter-regional	Upgrade circuit
South Africa						
Johannesburg BBIS						
Cairo BBIS	64 Kbps	X.25			Intra-regional	New circuit
Dakar BBIS	64 Kbps	X.25			Intra-regional	Upgrade circuit
Nairobi BBIS	64 Kbps	X.25			Intra-regional	Upgrade circuit
N'Djamena BBIS	64 Kbps	X.25			Intra-regional	New circuit
Antananarivo	9600 bps	X.25			Intra-regional	Upgrade circuit
Beira	9600 bps	X.25			Intra-regional	Upgrade circuit
Gaborone	9600 bps	X.25			Intra-regional	Upgrade circuit
Harare	9600 bps	X.25			Intra-regional	Upgrade circuit
Kinshasa	9600 bps	X.25			Intra-regional	Upgrade circuit
Lilongwe	9600 bps	X.25			Intra-regional	Upgrade circuit
Luanda	9600 bps	X.25			Intra-regional	Upgrade circuit
Lusaka	9600 bps	X.25			Intra-regional	Upgrade circuit
Manzini	9600 bps	X.25			Intra-regional	Upgrade circuit
Maseru	9600 bps	X.25			Intra-regional	Upgrade circuit
Mauritius	9600 bps	X.25			Intra-regional	Upgrade circuit
Windhoek	9600 bps	X.25			Intra-regional	Upgrade circuit
ASIA/PAC	64 Kbps	X.25			Inter-regional	Implemented
SAM	64 Kbps	X.25			Inter-regional	Implement circuit



Draft AFI ATN Architecture

APPENDIX 2D

International Civil Aviation Organization

Second Meeting of the AFI ATN Planning Task Force

Dakar, 5 - 6 April 2005

DRAFT AFI ATN ADDRESSING PLAN

(Ver.0.0)

Summary

This document presents the draft AFI ATN addressing plan.

Executive Summary

This document provides technical guidance on the Planning and Implementation of the transition of ground communications to Aeronautical Telecommunication Network (ATN) within the AFI region.

The material presented here is technical in nature, and the description is detailed.

The material is intended for Regional Planning. Although the plan itself is mainly left to the States for planning and implementation, it is hard to differentiate the regional planning from State planning.

Background

Based upon the ATN SARPs as published in ICAO Annex 10 and ICAO Doc. 9705, the Regions are advised to develop naming and addressing plans. These Regional Plans may be used to guide States in the assignment and registration of addresses such as Network Service Access Point (NSAP) Addresses.

At its first meeting, the AFI ATN Task Force added to its tasks list the development a draft NSAP addressing plan. This document presents the first draft.

Overview

This document presents recommendations for the assignment of NSAP addresses within the Region. Each field of the NSAP address is presented with the recommended method of assigning values. Fields which are purely local State matters are identified.

1 Introduction

This paper presents the Network Service Access Point (NSAP) address assignment conventions for use in the AFI Region.

1.1 Objectives

The objectives of the document are to provide:

- Guidance in the specification of NSAP addresses,
- Guidance in the specification of routing domain identifiers (RDI) for Routing Domains (RD) and Routing Domain Confederations (RDC).

In providing guidance on the specification of NSAP addresses, each NSAP address field is described with the recommendations on how the field may be used. This is important so that consistency in the use of NSAP addresses is obtained and efficiency in routing is maintained.

The guidance on the specification of RD and RDC identifiers is a continuation to the specification of the NSAP address structure. By applying the rules of the address assignments to the addressing of RDs and RDCs defined herein, States will ensure the efficiency of the routing mechanisms is maintained.

1.2 Scope

The scope of the document includes:

- Describing the NSAP address format, and
- Recommending the values in the fields of the regional NSAP addresses.

The AFI Regional ATN Addressing Plan presented here will comply with the NSAP format as specified in ICAO Doc. 9705 (Reference 1).

The AFI Regional ATN Addressing Plan defines the method for assigning values to each of the fields of the NSAP address. States within the Region may choose to assign their NSAP addresses based upon the recommendations found here.

1.3 Document Structure

Section 2 presents the background information for the formulation of recommendations.

Section 3 presents the assumptions on which the recommendations are based upon.

Section 4 presents the NSAP address structure and the recommended values to be used in AFI region.

Section 5 presents the conclusions.

Section 6 presents the recommendations to AFI ATN/TF members.

1.4 Terms Used

Network Addressing Domain – A subset of the global addressing domain consisting of all the NSAP addresses allocated by one or more addressing authorities.

Network Entity (NE) – A functional portion of an internetwork router or host computer that is responsible for the operation of internetwork data transfer, routing information exchange and network layer management protocols.

Network Entity Title (NET) – The global address of a network entity.

Network Service Access Point (NSAP) Address – A hierarchically organized global address, supporting international, geographical and telephony-oriented formats by way of an address format identifier located within the protocol header. Although the top level of the NSAP address hierarchy is internationally administered by ISO, subordinate address domains are administered by appropriate local organizations.

NSAP Address Prefix – A portion of the NSAP Address used to identify groups of systems that reside in a given routing domain or confederation. An NSAP prefix may have a length that is either smaller than or the same size as the base NSAP Address.

Routing Domain (RD) – A set of End Systems and Intermediate Systems that operate the same routing policy and that are wholly contained within a single administrative domain.

Routing Domain Confederation (RDC) – A set of routing domains and/or routing domain confederations that have agreed to join together. The formation of a routing domain confederation is done by private arrangement between its members without any need for global coordination.

Routing Domain Identifier (RDI) – A generic network entity title as described in ISO/IEC 7498 and is assigned statically in accordance with ISO/IEC 8348. An RDI is not an address and cannot be used as a valid destination of an ISO/IEC 8473 PDU. However, RDIs are like ordinary NETs, assigned from the same addressing domain as NSAP addresses.

1.5 References

Reference 1 Manual of Technical Provisions for the ATN (Doc 9705-AN/956) Third Edition 2002.

Reference 2 CAMAL – Comprehensive ATN Manual (Doc 9739-AN/961)

Reference 3 ACCESS - ATN Compliant Communications European Strategy Study
Define Network topology – Addressing Plan
Addressing Plan of the European ATN Network

Reference 4 Asia/Pacific ATN Addressing Plan

Reference 5 ICAO Location Indicators – Document 7910/113

2 Background

2.1 System Level Requirements

The ATN SARPs are divided into a set of System Level Requirements. These requirements are found in the ICAO Annex 10, Volume III, and are repeated in ICAO Doc. 9705 (Reference 1), Sub-Volume 1. The System Level Requirements detail specific requirements that all ATN compliant systems must meet and form the basis for the technical specifications.

Some of the System Level Requirements may best be satisfied through Regional Planning and Regional specification of procedures.

The following list presents the important System Level Requirements and Recommendations that form the basis of the NSAP Addressing Plan.

- System Level Requirement #11 (Annex 10) presents the basis for the definition of NSAP addresses:
  "The ATN shall provide a means to unambiguously address all ATN end and intermediate systems."
- System Level Requirement #13 (Annex 10) presents the basis for the need of Regional Planning:
  "The ATN addressing and naming plans shall allow State and organizations to assign addresses and names within their own administrative domains."

System Level Requirement #11 forms the basis for assigning at least one unique NSAP address for each end system and intermediate system. The assignment of NSAPs to systems enables the unambiguous identification of ATN components and applications.

System Level Requirement #13 forms the basis for Regional Planning in the area of NSAP address assignment. The establishment of Regional plans for assigning addresses assists States and Organizations within a Region to develop consistent address assignment procedures that will result in more efficient routing policies.

2.2 Basis for ATN Address Planning

2.2.1 Regional Planning

At the second meeting of the ATN Panel, it was recognized that the establishment of naming conventions and registration procedures were necessary for the successful deployment of the ATN. Two specific Recommendations were approved at that meeting:

Recommendation 4/1 Advice to States on ATN addressing issues

"*That ICAO advise States and international organizations to take the necessary actions for the assignment, administration, and registration of ATN names and addresses within their allocated name/address space, using the information provided*."

Recommendation 4/2 Setting up an ICAO ATN addressing process

"*That ICAO take the necessary actions to provide a facility for maintaining an up-to-date repository of ATN addresses and names registered in the Air Traffic Services*

Communication (ATSC) domain, and publish the repository entries at usual regular intervals."

2.2.2 AFI Regional Planning

The AFI ATN Task Force agreed that a consistent plan for naming and addressing is required to simplify the transition to ATN.

3 Assumptions

In developing the recommendations for the AFI Regional ATN Addressing Plan, several assumptions were made about the structure of the Region's ATN implementation. Some of these assumptions may appear unnecessary, but they tend to guide the development of the recommendations presented in Section 4.

- The AFI Regional ATN Addressing Plan will comply with the rules in ICAO Doc. 9705 (Reference 1). This means that the syntax, semantics and encoding rules of the NSAP address fields as specified in ICAO Doc. 9705 must be observed.
- There will be a number of ATN routers deployed in the Region. This assumption drives the need for multiple routing domains within the Region and the need to develop a plan that allows for efficient routing.
- The regional routing architecture will eventually include RDCs such as Island RDCs and Backbone RDCs. Therefore the AFI Regional ATN Addressing Plan must allow for the addressing of these RDCs.
- The Region will have at least one ATN router in each defined routing domain. This assumption is based on the ATN requirement for the establishment of routing domains.
- The Region will support both ground-ground and air-ground services and applications.

4 NSAP Addressing Plan

4.1 Introduction

The AFI Regional ATN Addressing Plan provides guidance to the States within the Region in assigning NSAP addresses to their ATN systems. The Plan addresses the need for consistency within the Region for address assignment.

To find a suitable ATN addressing convention that would be acceptable for use in the AFI region requires a routing architecture that minimizes routing updates and overheads within the ground ATN infrastructure for both ground-ground and air-ground services and applications.

The ATN addressing convention must allow for an addressing scheme that is:

- Practical - to provide autonomous administration of ATN addresses for States and Organizations, and

- Flexible - to allow for future expansion and/or routing re-configuration of the ground ATN infrastructure with minimal re-assigning of ATN addresses.

The recommendations proposed in the AFI Regional ATN Addressing Plan take advantage of the work performed by the European ACCESS[1] Project and the Asia/Pacific Region (References 3 and 4).

4.2 NSAP Address Format

The NSAP address format is defined in ICAO Doc. 9705 (Reference 1), Sub-Volume 5. The format is based upon the requirements specified in the base standard (ISO/IEC 8348) and incorporates the specific ATN requirements for addressing both ground and mobile systems.

The structure of the Network Service Access Point (NSAP) address is depicted in Figure 4.2-1.

20 Octets

AFI	**IDI**	**VER**	ADM	**RDF**	**ARS**	LOC	SYS	SEL

Figure 4.2-1 NSAP Address Format

The NSAP address structure contains 9 fields, which are described in Table 4.2-1.

Field Name	Field Description	Size	Syntax	Number of Characters/ Digits	Field Encoding
AFI	Authority and format Identifier	1 Octet	Decimal	2 Digits	BCD
IDI	Initial domain Identifier	2 Octets	Decimal	4 Digits	BCD
VER	Version	1 Octet	Hex	2 Digits	Binary
ADM	Administration Identifier	3 Octets	Alpha or Hex/Alpha	3 Characters 2 Digits/2 Characters	IA-5 Binary/IA-5
RDF	Routing Domain Format	1 Octet	Hex	2 Digits	Binary
ARS	Administration Region Selector	3 Octets	Hex	6 Digits	Binary

[1] ACCESS (ATN Compliant Communications European Strategy Study) is a project funded by the European Commission and jointly produced by the following companies and administrations: National Air Traffic Services (NATS), Deutsche Flugsicherung (DFS) and Service Technique de la Navigation Aerienne (STNA).

Field Name	Field Description	Size	Syntax	Number of Characters/ Digits	Field Encoding
LOC	Location	2 Octets	Hex	4 Digits	Binary
SYS	System Identifier	6 Octets	Hex	12 Digits	Binary
SEL	NSAP Selector	1 Octet	Hex	2 Digits	Binary

Table 4.2-1 - Encoding Rules for the ATN NSAP

4.3 Recommendations for NSAP Address Fields Assignments

4.3.1 The AFI and IDI Fields

The ATN Internet SARPs (Reference 1) require allocation of the following values:

- Decimal for the AFI field to indicate the type of NSAP being used. This value has been assigned the character sequence “47”.
- Decimal for the IDI field to designate ICAO. This value has been assigned the character sequence “0027”.

As recommended in Reference 1, ATN NSAP addresses and NETs will be written as the character sequence “470027+” where the “+” is used to separate the Binary Coded Decimal (BCD) fields from subsequent Hexadecimal fields.

Hence the AFI and IDI fields will be set to 470027 for fixed ATSC systems/domains and for mobile ATSC systems/domains.

4.3.2 The VER Field

The VER field is used to partition the ATN Network Addressing domain into a number of sub-ordinate Addressing Domains.

The values currently specified in Reference 1 for the VER field are summarized in Table 4.3.2-1.

VER Field Value	Network Addressing Domain	Common NSAP Address Prefix for Domain	Value to be used by States of AFI Region
[0000 0001]	Fixed AINSC	470027+01	
[0100 0001]	Mobile AINSC	470027+41	
[1000 0001]	Fixed ATSC	470027+81	470027+81 (ATSO ISs and ESs)
[1100 0001]	Mobile ATSC	470027+C1	470027+C1 (General Aviation)

Table 4.3.2-1 - Defined Values for the VER Field

4.3.3 The ADM Field

The ADM field is used to further partition the ATN Network Addressing Domain. The field designates a single State or Organization. Depending on what the VER field is set to will determine what values should be used in the ADM field.

When the VER field is set to "81" (Fixed ATSC), the ATN SARPs permits two possible ways for encoding the ADM field.

The first method recommends that the State's three character alphanumeric ISO country code is used, as defined in ISO 3166. States may choose this method; however it will provide less flexibility than the second method for the addressing of regional entities (eg regional RDCs or regional organizations that are not country specific).

The second method that is recommended for use in the AFI region is to use the first octet of the field to define the ICAO region. This would permit the reduction of the routing information that would otherwise be generated. It is recommended that the remaining two octets of the field will further identify the country, RDCs and the regional organizations that are not country specific as follows:

- For the identification of a country, it is recommended that States use the ICAO two letter location indicator (Reference 5) instead of the two character alphanumeric ISO 3166 country code. The structure of the ICAO two-letter location indicator allows for a more efficient identification of a location. For example, indicators starting with the same letter "G" designate several countries in the same local region (eg Mali, Morocco, Mauritania, Senegal etc.). The second letter will actually define the specific country within this local region (eg "GA" for Mali, "GM" for Morocco etc.). Where a country has several ICAO two letter location indicators allocated to it, the assigning authority of the ADM field will be responsible in determining the preferred location indicator to represent that country. For example, the indicators "VA", "VI", "VO", "VE" are assigned to India and one of these indicators will be selected to represent India. The encoding of the ICAO two letter location indicators will be upper case alphanumeric values[MSOffice1].
- For regional organizations that are not country specific (like ASECNA), it is recommended to allocate a lower case alphanumeric value so as there will be no conflict with the ICAO two letter location indicators.
- For the addressing of RDCs (eg Island RDCs, Backbone RDCs), in particular for those that are not country specific, it is recommended to allocate codes with the most significant bit set to 1 in the second octet. Valid values would be in the hexadecimal range [8000 – FFFF].

ICAO AFI Regional Planning Group would be the allocation authority of the ADM field.

In summary, the values allocated for the ADM field is indicated in Table 4.3.3-1.

<table>
<tr><th>VER Field Network Addressing Domain</th><th>ADM Field Values</th></tr>
<tr><td>Fixed AINSC</td><td>Derived from the set of three-character alphanumeric characters representing an IATA airline or an Aeronautical Stakeholder Designator.</td></tr>
<tr><td>Mobile AINSC</td><td>Derived from the set of three-character alphanumeric characters representing an IATA airline or an Aeronautical Stakeholder Designator.</td></tr>
<tr><td>Fixed ATSC</td><td>To allow for efficient routing information to be exchanged, it is proposed that the ICAO Regional code be used in the first octet of the ADM field followed by the ICAO two letter location indicator for countries.

The Regional codes are shown below.

Regional Codes:

[1000 0000] Africa
[1000 0001] Asia
[1000 0010] Caribbean
[1000 0011] Europe
[1000 0100] Middle East
[1000 0101] North America
[1000 0110] North Atlantic
[1000 0111] Pacific
[1000 1000] South America

For example Mali would be represented by the following hexadecimal sequence: 804741. Table 4.3.3-2 provides further examples for a selected number of countries.

Where a two letter country code is not applicable, the following rules would apply:

ICAO would assign lower case alphanumeric characters using a two letter value to organizations that wish to be based in a particular region. For example, if an organization is to be based in the AFI region and wanted to be represented by the characters ‘sa’, this would be represented by the following hexadecimal sequence: 807361

ICAO would assign regional codes for RDCs where a country code or organization code is not applicable. Values would be assigned with the most significant bit set to 1 in the second octet. For example a RDC established in the AFI region would be represented by the following hexadecimal sequence: 808100.</td></tr>
<tr><td>Mobile ATSC</td><td>As for Fixed ATSC</td></tr>
</table>

Table 4.3.3-1 - Defined Values for the ADM Field

Fixed or Mobile AFI ATSC Addressing Domain	Hexadecimal Code of the ADM Field	Comment
Algeria	804441	AFI Region + 'DA'
Morocco	80474D	AFI Region + 'GM'
Egypt	804845	AFI region + 'HE'
Senegal	80474F	AFI Region + 'GO'
Niger	804452	AFI Region + 'DR'
Nigeria	80444E	AFI Region + 'DN'
Kenya	80484B	AFI Region + 'HK'
Congo	804643	AFI Region + 'FC'
South Africa	804641	AFI Region + 'FA'

Table 4.3.3-2 – Example of Proposed ADM Value Assignment for Selected AFI Entities

4.3.4 The RDF Field

The RDF field is historical and is not used. Therefore the RDF field shall be set to [0000 0000].

4.3.5 The ARS Field

The ARS field is used to:

- Distinguish Routing Domains operated by the same State or Organization (in Fixed Network Addressing domains); and
- Identify the aircraft on which the addressed system is located (in Mobile Network Addressing Domains).

Each State or Organization identified in the ADM field will be responsible for assigning the values for the ARS field.

In accordance with the SARPs, for a Mobile Network Addressing Domain, the 24-bit ICAO Aircraft Identifier is inserted in the ARS field. However, no specific values have been specified for Fixed Network Addressing Domains.

The ARS field shall be assigned in a manner that simplifies the routing of data and makes provision for any potential lower level organizational units that could, in the future, operate an ATN Routing Domain.

The AFI Regional ATN Addressing Plan recommends the ARS field be decomposed into three subfields as shown in Figure 4.3.5-1: Network ID, Network Group ID and Domain ID.

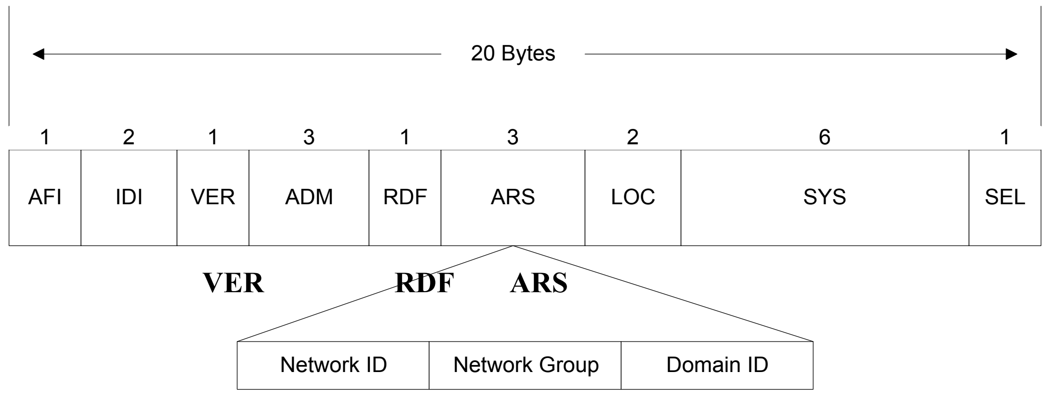


Figure 4.3.5-1 Proposed ARS Field Format

4.3.5.1 Network ID

Potential future operators of an ATN Routing Domain could be:

- A national Air Traffic Service Organization(s) (ATSO);
- A national military organization;
- A national meteorological organization; and
- An airport operator.

At present it is assumed that military organizations and meteorological organizations will not start up their own ATN Routing Domains and will be located within a national ATSO ATN Routing Domain. The same may apply to airport operators.

However in planning for the long term it is deemed necessary that provision is made available for these future possibilities.

In allowing for this possible expansion, it is recommended that the different ranges of values for the Network ID subfield be allocated to the different national organizations as follows:

- Hexadecimal values [00 – 1F] of the first octet of the ARS field be reserved for the addressing of domains and systems operated by the national ATSO.
- Hexadecimal values [20 – 3F] of the first octet of the ARS field be reserved for the addressing of domains and systems operated by the national military organization.
- Hexadecimal values [40 – 5F] of the first octet of the ARS field be reserved for the addressing of domains and systems operated by the national airport operators. (Note: this range matches the ASCII range of alphabetical upper case characters).
- Hexadecimal values [60 – 7F] of the first octet of the ARS field is reserved for the addressing of domains and systems operated by the national meteorological organization.
- Hexadecimal values [80 – FF] are reserved.

A national organization would then be able to register one or several values for the Network ID subfield within the range that has been reserved for its organization category.

In addition to the Network ID subfield being used for distinguishing the different national organizations, it is proposed that this subfield also be used for the identification of the particular role of the addressed domain. For example, setting the Network ID subfield to the hexadecimal value "01" would represent the set of operational Routing Domains of the national ATSO. Setting the Network ID subfield to hexadecimal "11" would represent the set of non-operational Routing Domains of the national ATSO. In using the Network ID subfield in this manner, allows national ATSOs to provide for a duplicate non-operational network to be used for trials and pre-operational testing. Similar arrangements could be used for the other national organizations.

4.3.5.2 Network Group ID

This subfield can be used to subdivide a ground ATN network into smaller groups. This field is unique within a particular network. This may be useful for future expansion by allowing regions to be formed within a particular network as defined by the Network ID. The formation of regions may be useful in helping contain the routing traffic exchanged within the network.

This subfield is also used to designate an RDC. RDCs can also be used to assist in the formation of regions within an Administrative Domain and they offer an additional level of flexibility when used to combine RDs into a confederation. RDCs are designed by setting the uppermost bit of this field to "1".

4.3.5.3 Domain ID

This subfield is a unique identifier assigned to each Routing Domain in the Network Group.

Table 4.3.5.3-1 shows possible examples on how the ARS field could be used. In the table two Network Groups "01" and "02" are defined. These two Network Groups can for example represent two FIRs in a country. One of the two Network Group contains two RDs and the other one contains three RDs. These two Network Groups can also address the initial RDs in a country (ie two RDs) with a planned expansion towards five RDs.

Network ID	Network Group ID	Domain ID	Comment
01	01	01 02	Network ID "01" indicates an ATSO operational network that contain two Network Groups "01" and "02". Network Group "01" contains two RDs "01" and "02". Network Group "02" contains three RDs "01", "02" and "03".
	02	01 02 03	

Table 4.3.5.3-1 – Example of ARS Value Assignment

4.3.5.4 Addressing RDCs in the ARS field

The Network ID subfield is used to segregate the addressing space of actual RDs and RDCs. When the Network ID subfield is set to "1" the second and third octets of the ARS field are assigned from the RDC addressing space (i.e., 8000-FFFF) and must be unique within that addressing domain. Otherwise, the subfields are assigned from the NSAP Address Space as described above for the Network Group ID and Domain ID subfields.

Similar principles as explained in sections 4.3.5.2 and 4.3.5.3 for the addressing of RDs can be applied to the addressing of RDCs, as required:

- The second octet of the ARS field may identify a group of RDCs.
- The third octet of the ARS field identifies RDCs.

4.3.6 The LOC Field

The LOC field is used to:

- Distinguish Routing Areas within Fixed Routing Domains, identified by the ARS field; and
- Distinguish Routing Areas and Routing domains within aircraft identified by the ARS field.

The assignment of the LOC field value is the responsibility of the State or organization that is the addressing authority for the routing domain in which the identified routing area is contained.

To assist States or organizations, it is recommended that the LOC field be decomposed into two subfields as shown in Figure 4.3.6-1: Subdomain Group ID and Subdomain ID.

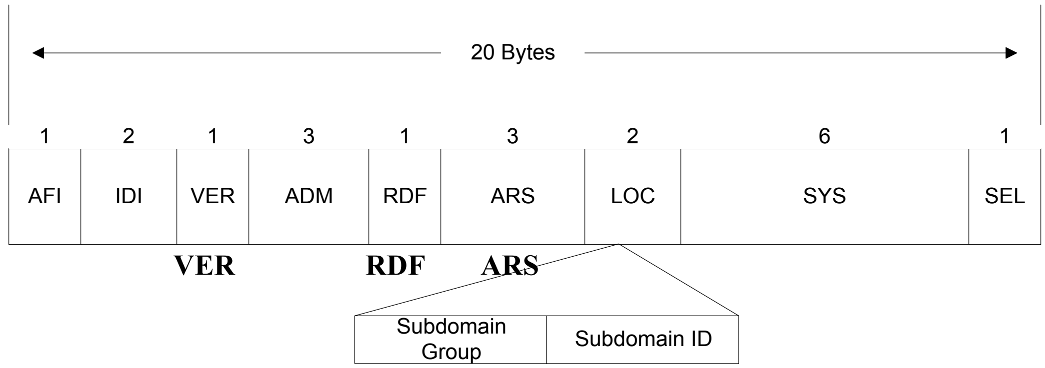


Figure 4.3.6-1 Proposed LOC Field Format

4.3.6.1 Subdomain Group ID

This subfield can be used to subdivide a domain into separate groups. For example, each control centre could be defined as a routing domain. A control centre may contain an En Route facility, Terminal facilities, and Tower facilities. Each of these facilities can be classified as a different Subdomain Group allowing addressing to be delegated to each facility, if desired. For this example, this subfield can be assigned as shown in the Table 4.3.6.1-1.

Value (hex)	Description
00	Reserved
01	No specific group. Used for RDs that do not require subdivision
02	En Route Subdomain
03 - FF	Assigned as required

Table 4.3.6.1-1 – Example of Subdomain Group ID Value Assignment

4.3.6.2 Subdomain ID

This subfield is a unique identifier assigned to each routing area within a Subdomain Group. This subfield allows multiple areas to exist within a subdomain group and must be unique within the subdomain. This subfield could be assigned as shown in the Table 4.3.6.2-1.

Value (hex)	Description
00	Reserved

Value (hex)	Description
01	No specific area. Used for Subdomains that do not require subdivision
02 – FF	Assigned as required by the Subdomain Group Addressing Authority

Table 4.3.6.2-1 – Example of Subdomain ID Value Assignment

4.3.7 The SYS Field

The SYS field is used to uniquely identify an End-System or Intermediate-System. The allocation of the SYS field value is the responsibility of the organization that is the addressing authority for the routing area that contains the identified ATN End-System or Intermediate-System.

The type of values or structure for the SYS field is for individual authorities to choose, as appropriate.

It has been suggested that the 48-bit LAN address of a device attached to an IEEE 802 local area network that is being used as an ATN ES or IS, could be used in this field. However, this may have ramification if the SYS field is tied to a subnetwork dependent information such as the physical network address (eg 48-bit LAN address) that is associated with a particular device. The problem will occur when the device is replaced by another device which will use a different 48-bit LAN address, requiring the NSAP address of the ATN ES or IS to be changed.

It is therefore recommended that the SYS field be used to identify the system without any dependency on physical information. Possible examples of this is to define whether the system is an IS or an ES, the type of function or role the system is used for (eg primary system, hot standby system, cold standby system, etc.), or the type of applications that are running on the system (eg AMHS, AIDC, ADS, CPDLC, Network Management, etc.).

A requirement found in Section 7.1.4.b.1 of ISO 10589 IS-IS states that all Level 2 ISs within a Routing Domain must have a unique SYS field value. In order to enforce this requirement related to IS-IS Level 2 addressing, it is recommended that the values assigned to the LOC subfields also be assigned to the upper two octets of the SYS field. Using this approach enables the addressing authority for each Subdomain Group the flexibility to assign addresses without conflicting with addresses of other groups within the same Routing Domain.

4.3.8 The SEL Field

The SEL field is used to identify the End-System or Intermediate-System network entity or network service user process responsible for originating or receiving Network Service Data Units (NSDUs).

Table 4.3.8-1 identifies the defined values that shall be used in this field in accordance with Reference 1.

SEL Field Value	Usage
[0000 0000]	Used for an IS network entity except in the case of an airborne IS implementing the procedures for the optional non-use of IDRP.
[0000 0001]	Used for the ISO 8073 COTP protocol in the Ground or Airborne End-Systems.
[0000 0010]	Used for the ISO 8602 CLTP protocol in the Ground or Airborne End-Systems.
[1111 1110]	Used for an IS network entity belonging to an airborne IS implementing the procedures for the optional non-use of IDRP.
[1111 1111]	Reserved

Table 4.3.8-1 - Defined Values for the SEL Field

5 Conclusions

The AFI Regional ATN Addressing Plan consists of a set of recommendations for each State to assign regional NSAP addresses in a consistent manner. Using these recommendations, it should be possible to develop efficient routing policies that limit the amount of information exchange while providing comprehensive ATN services. Further, the application of this plan will permit simplified ATN service growth with a minimum of router re-configuration.

6 Recommendations

The members of the second meeting of AFI ATN/TF are invited to review and comment on the AFI Regional ATN Addressing Plan as presented above.

Agenda Item 3: Description of ATN ground/ground applications

ATS interfacility data communications (AIDC) – Features and functional capabilities

3.1. The meeting was presented with an overview of the ATS interfacility data communications (AIDC) application that exchanges ATC information between ATS units (ATSUs) in support of ATC functions, including notification of flights approaching a flight information region (FIR) boundary, coordination of boundary-crossing conditions and transfer of control. It particularly noted that the AIDC application will use ATN to ensure that ATC data are exchanged in a reliable and timely manner between ATS units. The AIDC itself also provides several features that support reliable and timely data exchange. All exchanges of AIDC messages between ATSUs may be viewed as dialogues,. most dialogues consisting of one message. However, coordination and transfer dialogues involve multiple messages exchange sequences.

AIDC implementation in AFI

AIDC and ATS systems automation

3.2. The meeting considered the close relationship between the AIDC application and ATS systems automation, and the role of AIDC in ATN air/ground applications as far as notification, coordination and transfer dialogues between ATS units are concerned.

3.3. The meeting recalled that in accordance with the AFI CNS/ATM Implementation Plan (Doc 003), AIDC shall progressively be progressively introduced in the Region from 2005 to 2008. It noted that a number of States situated at the AFI/EUR interface (Algeria, Cape Verde, Morocco and Tunisia) have introduced or were about to introduce on-line data interchange (OLDI) procedures, an AIDC adaptation, with their EUR correspondents.

AIDC and Communication performance

3.4. The meeting acknowledged that AIDC would not be properly implemented without major improvements to the communication infrastructure, which is still affected by serious deficiencies in some areas. In this connection, it recalled APIRG Conclusion 13/72 recommending a step-by-step approach in the implementation of CNS/ATM systems in the AFI Region, starting with ATM objectives achievable with minimum CNS requirements, and by giving high priority to enhancing AFS *(ATS/DS and AFTN)* and AMS *(extended VHF radio coverage) to* support the provision of area control service and lower separation minimum. In that respect, the meeting recognized the significant efforts made by AFI States to progress extended VHF radio coverage, though the IATA In-Flight Broadcast Procedure (IFBP) was still applied in some parts of the Region due to some remaining silent zones.

3.5. The meeting adopted the following draft Conclusion.

Draft Conclusion 2/4: Implementation of the AIDC application

That, when considering the implementation of the AIDC application, States:

a) be reminded of the need for a step-by-step approach in implementing CNS/ATM systems, by giving priority to solving the deficiencies and upgrading the performance of the current communication infrastructure;

b) implement automation in their ATS systems as soon as practicable; and

c) take the necessary steps to implement an ATN infrastructure capable of supporting the AIDC application.

Agenda Item 4: Formulation of proposals to achieve VSAT networks interoperability

Development of VSAT networks in AFI and adjacent regions

4.1 The meeting noted that AFI States or groups of States have been implementing dedicated (to ATS) communication networks. Most of such dedicated ATS networks that were implemented during the last decade have been based on technology employing very small aperture terminal (VSAT) concept which provides for versatility, flexibility and ease of installation, operation and maintenance. It reviewed regional and interregional developments in VSAT networks (AFISNET, SADC, CAFSAT), including emerging networks (NAFISAT, MID VSAT), and noted that issues associated with their *interconnection* and *interoperability* were being considered in the AFI Region, a multi-vendor environment. Coordination between NAFISAT, MID VSAT and SADC/2 projects was underscored.

Consolidation of VSAT networks

4.2 The meeting recalled APIRG Conclusion 14/12 on the consolidation of existing/planned aeronautical VSAT networks supporting AFS communications, with a view to ensuring full connectivity and optimizing the ground infrastructure by using a single space segment on Intelsat new generation Satellite IS 10-02@359 degrees East, Transponder 20/20 EH.

4.3 The meeting noted the successful migration of AFISNET network onto Satellite IS 10-02 in October/November 2004, being it understood that the other VSAT networks (namely CAFSAT and SADC/2) shall be established on the same satellite/transponder in the near future. It accordingly recommended that concerned States and the Secretariat take the necessary steps with INTELSAT to have the required bandwidth secured.

Interoperability of VSAT networks

4.4 The meeting acknowledged the potential benefits and savings that would be derived from the consolidation of existing and planned VSAT networks on Satellite IS 10-02 and came to the realization that "interoperability" between these networks was necessary to achieve an integrated and seamless network.

4.5 The meeting recognized the need for a common understanding of the "*interoperability"* and "*seamlessness"* concepts with respect to the future ATM system based on the ATM operational concept, as defined by *ATMCP.* It also noted ATNP (now ACP)'s definition of *"interoperability as the ability of the ATN to provide, as a minimum, a transparent data transfer service between end systems even though the ATN comprises various subnetworks. The ability to interoperate between end systems can be extended to include commonality of upper layer protocols" (see Doc 9705).*

4.6 Following thorough discussions and taking into consideration peculiarities inherent to satellite-based systems, the meeting adopted the following draft conclusion:

Draft Conclusion 2/5: Interoperability of VSAT networks

That the States concerned:

a) **Agree to pursue the process of establishing CAFSAT, MID VSAT, NAFISAT, SADC/2 networks on Satellite IS 10-02@359°E, Transponder 20/20 EHA;**

b) **Be encouraged to take advantage of new VSAT Technology platform functionalities in terms of network spectrum usage, flexibility, quality of service management, etc.;**

c) **Make effort to achieve interoperability at baseband level where access techniques differ due to the application of emerging VSAT technologies, taking cognizance of agreed performance and quality of service requirements for the aeronautical fixed and mobile services (including data link services); and**

d) **Carry out necessary coordination on a case-by-case basis in order to anticipate end-to-end interoperability requirements prior to implementing VSAT systems.**

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 following draft decision was adopted:

Draft Decision 2/6: 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**	CNS/SG/2
1.1	Finalize backbone architecture and BIS interconnection Plan	CNS/SG/2
1.2	Draft ATN ground/ground Transition Plan	CNS/SG/2
1.3	Develop ATN router plan for inclusion in AFI FASID	CNS/SG/2
1.4	Develop ATN ground/ground interface control document (G/G ICD	CNS/SG/3
1.5	Develop ATN air/ground interface control document (A/G ICD	TBD
1.6	Finalize the ATN NSAP addressing plan	CNS/SG/2
1.7	Develop the ATN NSAP Address Registration Form	CNS/SG/2
2	**Description of the ATN ground-ground applications (AMHS, AIDC)**	CNS/SG/2
2.1	Develop the AMHS Naming Plan	CNS/SG/2
2.2	Develop the AMHS ICD	CNS/SG/2
2.3	Draft the AMHS Routing Plan for inclusion in AFI FASID	CNS/SG/3
2.4	Draft AMHS Message Transfer Agent Routing Policy	CNS/SG/3
2.5	Develop AMHS Address Registration Form	CNS/SG/3
2.6	Develop AIDC Circuit Plan for inclusion in AFI FASID	CNS/SG/3
3	**Preparation of guidance material to assist States, as necessary**	CNS/SG/2
3.1	Finalize AFI ATN Architecture Document	CNS/SG/2
3.2	Develop guidance on ground elements ATN Transition	CNS/SG/3

3.3	Overview of the ATN	CNS/SG/3
4	**Update of the guidelines on ATN in the CNS/ATM Implementation Plan (Doc 003)**	CNS/SG/2
COMPOSITION		
Algeria, Angola, Burundi, Cameroon, DR Congo, Egypt, Ethiopia, Ghana, Guinea, Kenya, Malawi, Mauritius, Morocco, Niger, Nigeria, Senegal, South Africa, Tunisia, ASECNA and IATA.		

Agenda Item 6: Any other business

Nil

------END------