DRAFT AFI AMHS IMPLEMENTATION PLAN

SUMMARY:
This document presents the draft AMHS Implementation Plan in AFI Region.

Team Leader: Rwanda

Team members: Angola, Ethiopia, Kenya, Mozambique, Rwanda, Sudan, Zimbabwe and ASECNA

References:

- *Report of the Second Meeting of AFI ATN Planning Task Force*
- *AFI Air Navigation Plan, FASID (CNS)*

ICAO Annex 10 (Vol. 2 and Vol.3)

I. Draft AFI ATN Architecture From AFI ATN Planning Task Force

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. AFI Region Backbone of the network contains 6 Backbone Boundary Intermediate System (BBIS) hubs located in Algeria, Egypt, Senegal, Tchad, Kenya and South Africa. Boundary Intermediate Systems (BIS) are connected to one or more BBIS hubs.

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. ATN 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

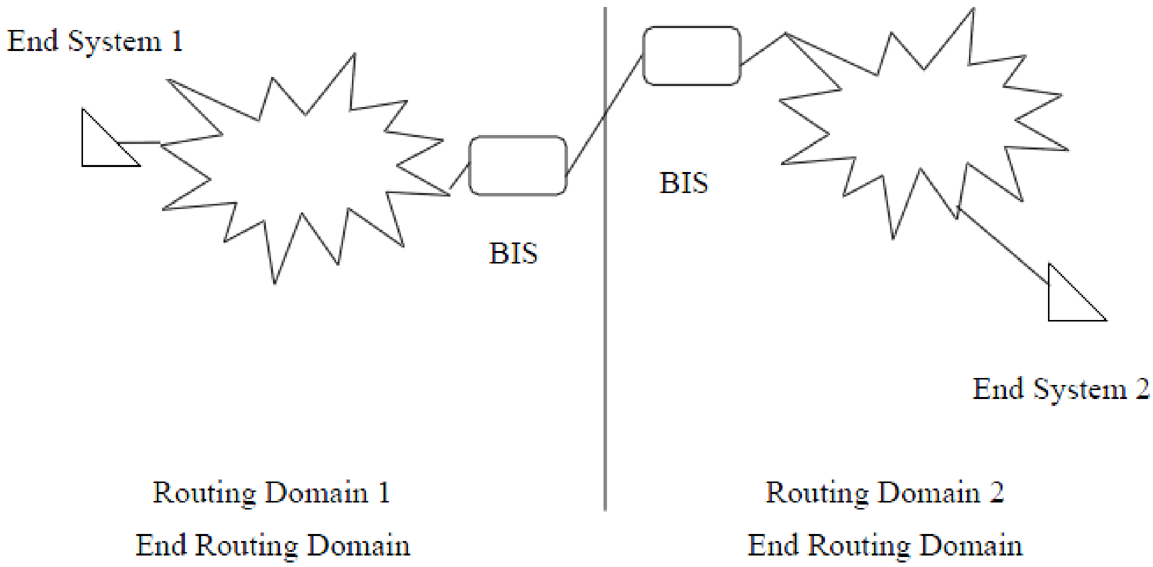

Figure 1 – End Routing Domains

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.

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ATN Routing Architecture (Draft 2.0)

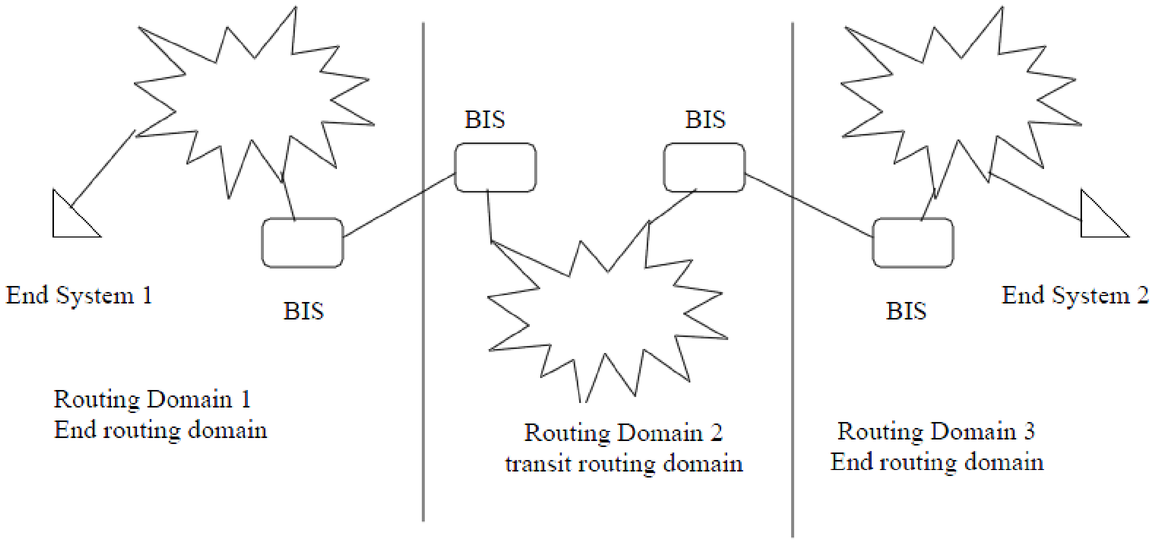


Figure 2 – Transit Routing Domains

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.

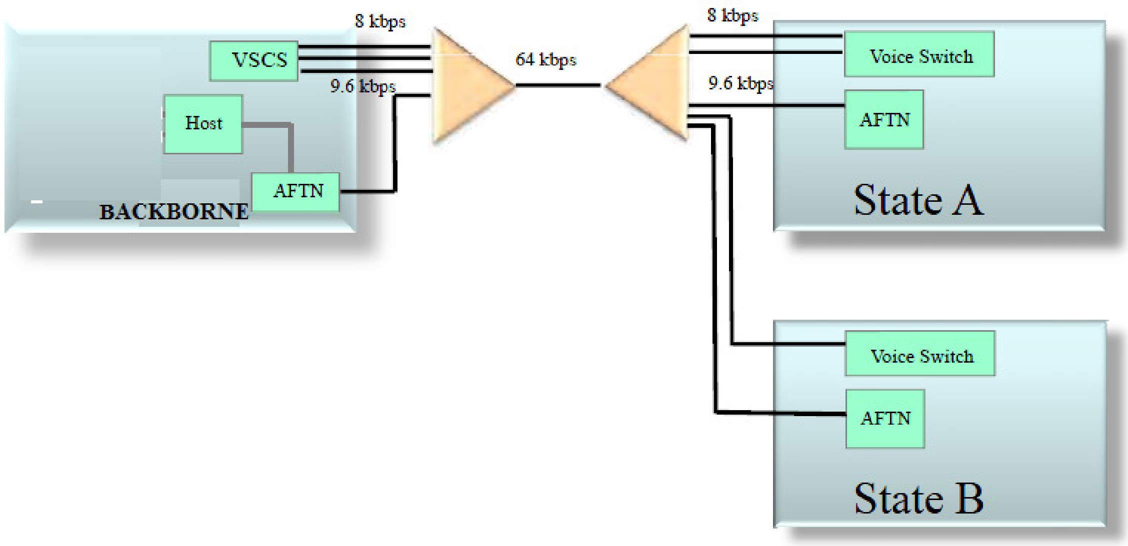
4.1 AFI Regional Backbone

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.

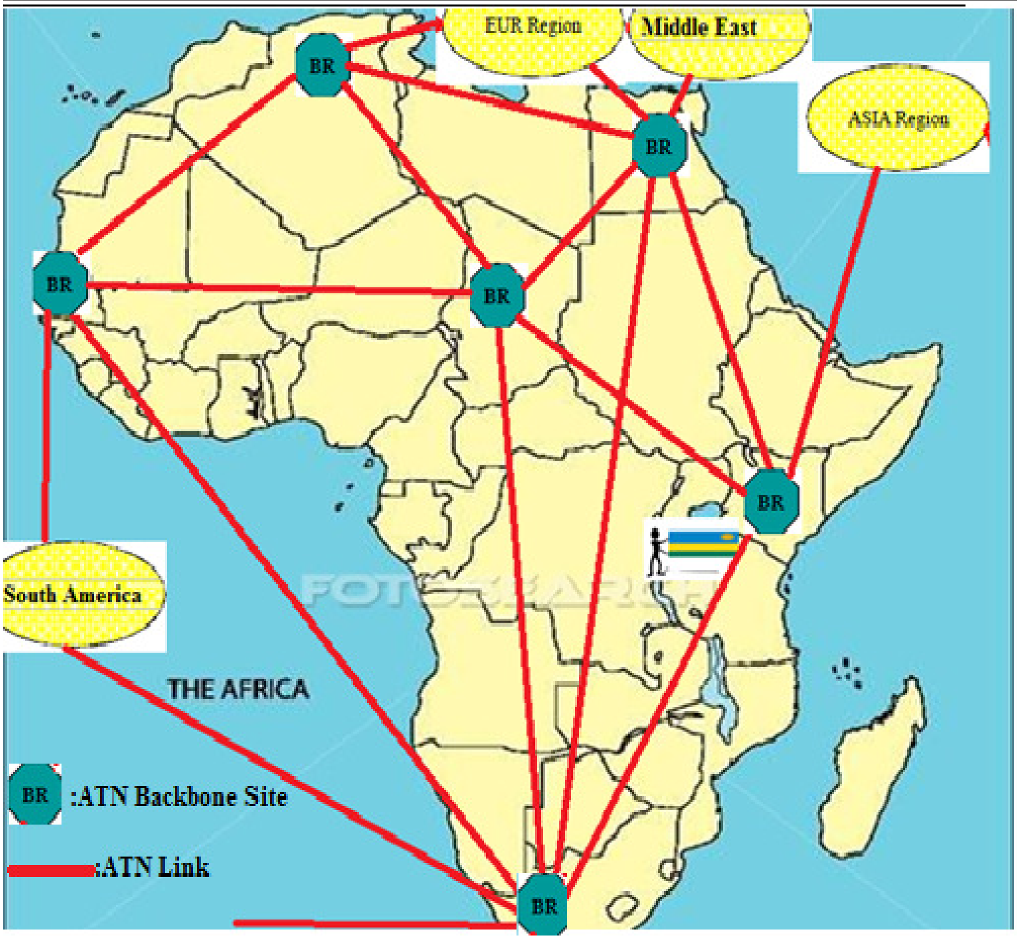
To re-state from the previous section, the Inter-Regional BBISs provide communication from routers within the AFI Region to routers in other regions. These Inter-Regional BBISs provide vital communications across regions and therefore need to have redundant communication paths and high availability.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

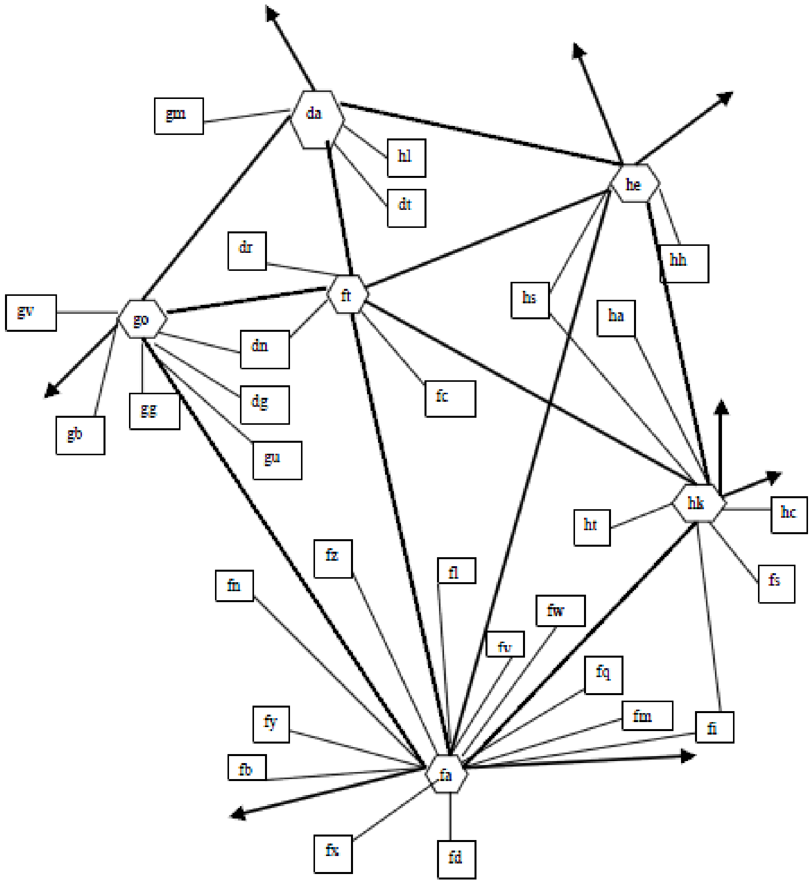
Based upon the current AFTN network environment, the following locations have been identified to initially serve centres outside the AFI Region:

AFI REGION ATN Backbone Architecture

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)

Definition of initial AFI ATN Backbone router sites

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II. DRAFT AFI ATN NETWORK SERVICE ACCESS POINT ADDRESSING PLAN

Summary

This document presents the draft AFI ATN Network Service Access Point Addressing Plan

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 AFI Regionpean Strategy Study Define Network topology – Addressing Plan Addressing Plan of the AFI Regionpean 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.

3. BASIS FOR ATN ADDRESS PLANNING

3.1 AFI 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."

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

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.

3.2. NSAP ADDRESSING PLAN

3.2.1 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

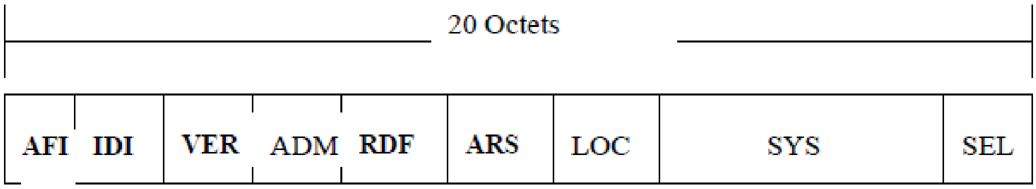
• Flexible - to allow for future expansion and/or routing re-configuration of the ground ATN infrastructure with minimal re-assigning of ATN addresses.

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

3.2.2 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 NSAP Address Format



The NSAP address structure contains 9 fields

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

4. AFI AMHS ROUTING PLAN

4.1 Available routing mechanisms

4.1.1 AMHS uses the routing mechanisms of its X.400 base standards. X.400 routing is static by nature, it uses the address attributes forming O/R addresses to determine the next hop towards which the message must be routed:

· local delivery,
· AFTN/AMHS gateway (MTCU), or
· adjacent MTA inside the AMHS Management Domain of the current MTA,
· adjacent MTA in a different AMHS Management Domain.

4.1.2 Conceptually, X.400 routing tables are made of records associating a potential combination of address attribute values to a next hop. For each message, the route record with the best match for each AMHS recipient's address attributes is looked for in the routing table, to determine where the message is to

be routed. In case of a message with multiple recipients and different routes, the message is “expanded” or “split” into several messages, according to the various destinations.
4.1.3 This section focuses on international AMHS routing, i.e. inter-domain routing.
4.1.4 Unlike in AFTN, where any substring from 1 to 7 characters may be used to determine a route, X.400 address attribute values are generally considered “as a whole” when looking for a best match. Some X.400 implementations may implement substring matching but this is not a standard feature.
4.1.5 Inter-domain routing, from an international MTA in an AMHS MD to an international
MTA in another AMHS MD, should therefore use only entire address attribute values. The attributes Country-name, ADMD-name, PRMD-name and potentially Organization-name, usually represented by their initials C, A, P and O are sufficient for Inter-domain routing.
Organization-name must be used only in specific cases, when destinations are located in
AMHS MDs with multiple International MTAs, and having implemented the CAAS Addressing Scheme.
4.1.6 It may be noted that ISO/IEC 10021-10 (2003) [23], which is aligned on ITU-T Recommendation X.412 (1999), “INFORMATION TECHNOLOGY – MESSAGE HANDLING SYSTEMS (MHS) – MHS ROUTING” describes an X.400/MHS Routing functionality based on Directory Services. There is no requirement to implement this feature
in AMHS, including when the Extended ATS Message Handling Service is deployed.

4.1.2 X.400 re-routing mechanisms

4.1.2.1 Based on the general routing principles described above, re-routing consists in the definition of an alternative route to the intended destination, if for any reason there is a transfer-failure or delivery-failure to the initially determined next hop.
4.1.2.2 Re-routing may be either manual or automatic. In the first case, the MTA operator, in view of the transfer-failures, modifies temporarily (or definitively) the routing tables to specify an alternative next hop. The main requirements placed on the software by manual rerouting are related to:
· the ease of reconfiguration;

· the immediate applicability of the modification: it is preferable that the routing be modifiable on line, or require only a fast restart or parameter load.

4.1.2.3 Regarding automatic re-routing, although not prevented by the X.400 base standards, nor by the way they are designed, this feature was initially not a standard practice in X.400 products. The main reasons were the following:

1. MHS/X.400 was initially designed for messaging traffic with relatively low transfer time requirements, clearly non-real time, where it was possible to “wait” for the availability of a connection to the intended MTA, in case such a connection was not immediately available;
2. In this context, the usual practice in the store-and-forward MHS/X.400 is to store a message, and, in case of transfer failure to the next MTA, to perform a pre-defined number of “retry” towards this same MTA (based on timers), before a non-deliveryreport is sent back to the message-originator (or to the originating-MTA).

4.1.2.4 However, due to the adoption of X.400 by communities with more stringent transfer time and availability requirements (Defence, Air Traffic Services), it should be possible to obtain from X.400 software manufacturers automatic re-routing mechanisms.

4.1.2.5 The principle of such re-routing would be that, after the number of retries to the main route to the next MTA, an alternative route already specified in the routing table would be used. It is important that those responsible for system operation be aware that this re-routing facility is activated.

4.1.2.6 Care should be taken about a possible interaction with X.400 timers when such a mechanism is used. For example, if no alternative route is specified, a MTA will retry to transfer until the expiry the MTA and MTS timers, before a NDR is generated. If an alternative route is defined, then a time allocation should be kept to use the alternative route before the timers expire. This should be considered in conjunction with the re-routing mechanisms at the underlying network level: timers and re-routing mechanisms at the underlying network level have to be shorter than timers and re-routing mechanisms at the AMHS level. The reason for this is that most of the time the unavailability of a P1 association is going to be caused by a transitional problem in the underlying network.

4.2 AFI AMHS Addressing PLAN

4.2.1 Introduction

4.2.1.1 This section aims at the production of the AMHS Addressing Plan for all the potential AMHS users in the AFI REGION Region. This Plan should define the AMHS users addressing in an intuitive way and it should be comprehensible and meaningful to the human user and independent of the use (or not) of any type of Directory service such as X.500.

3.2.1.2 The Addressing Plan should also provide the rules to extend the addressing defined to other ANSPs (or not yet identified users).

4.2.2 Requirements

4.2.2.1 The AMHS addressing scheme should meet all of the following requirements:

· The addressing scheme should be as uniform as possible across all AMHS implementations in different Regions (as it is currently the case for AFTN addresses);

· The same addressing scheme should be maintained when indirect AMHS users (i.e.
AFTN users or CIDIN users) migrate to AMHS. This implies that the AMHS addressing scheme is pre-defined and published before actual operation of the newly implemented AMHS;

· The addressing scheme should be independent of any constraints that may be imposed by Management Domains (MDs) in the Global MHS (i.e. the non-AMHS services operating globally as commercial services) or by national regulations that may vary from Region to Region; and

· The addressing scheme should allow for the interchange messages with MDs in the Global MHS.

4.2.3 AMHS Addressing structure

Each MHS address consists of a set of MHS standard components referred to as address attributes.

4.2.3.1 High level MHS address attributes

3.2.3.1.1 The high level MHS attributes identify an MHS Management Domain as specified in ISO/IEC 10021-2, Section 18.3 [22]. They are determined by the structuring of Management Domains of the MHS Region/organisation to which the address belongs. Each attribute must be registered with an appropriate registration authority to ensure that all addresses remain unambiguous. They are as follows:

· **Country (C) Name:** this is mandatory, and the possible range of values of the attribute is drawn from the ISO 3166 register of country names. The register contains a special value
'XX', allocated for the purposes of international organizations (i.e. those that are established by international treaty) which do not ‘reside’ within any particular country;

· **Administrative Management Domain (ADMD) Name:** this is mandatory, and its value is the name of an MHS Service provider in the context of a particular country. ADMD
Names must be registered by a national registration authority. ADMDs registered under the 'XX' country must obtain that registration from the Telecommunication Standardization Sector of the International Telecommunication Union (ITU-T);

· **Private Management Domain (PRMD) Name:** this is optional, and its value is the name of an MHS service usually operated by a private organization. PRMD names must be registered either with their respective ADMDs, or with a national register of PRMDs.

For example, the high level address of a PRMD in the United Kingdom might be:
C = GB; ADMD = BT; PRMD = British Gas;

4.2.3.1 Low level MHS address attributes

They are as follows:

· **Organization name:** the organization name is the most significant naming attribute of the O/R address. Many organizations will operate as sub-naming authorities, allocating name space below their organization name attribute. The function of the domain names, both
Administrative and Private, is to provide a relaying mechanism for delivery of the message to the intended destination. Relaying to the intended destination is made easier by the combination of a unique Organization Name within a unique PRMD name, thus ensuring that all MHS organizations are uniquely identified.

· **Organizational unit name:** the organizational unit (OU) names are used within the context of a hierarchical addressing structure as identified by the organization name attribute, and should be used to identify meaningful subdivisions of that namespace. The

X.400 O/R address allows for up to 4 occurrences of the OU name attribute to be specified, each up to 32 characters in length, in descending order of significance within the organizational hierarchy.

The other *OU name* (*OU2-4*) attributes can be used to further subdivide the namespace represented by the *OU1* attribute if necessary. Subordinate OU names should only be used if all superior OU names are in use.

· **Common Name:** The common name attribute is the preferred way of identifying distribution lists and computer applications, avoiding the (mis)use of the personal name attribute. The common name attribute can be up to 64 characters in length.

A complete list of attributes with different information concerning on the maximum length and type of allowed characters for each attribute type is provided in the following

Table:

MNEMONIC FORM ADDRESS ATTRIBUTE	CHARACTERISTICS
Country name	2 alpha or 3 numeric
ADMD name	16 PrintableString
PRMD name	16 PrintableString
Organisation name	64 PrintableString
Organisational unit name	32 PrintableString
Common name	64 PrintableString

Table: Mnemonic O/R address attributes maximum length and types

4.2.4. AMHS Addressing Schemes

4.2.4.1. XF-Addressing Scheme

4.2.4.1.1 The AMHS technical specifications describe a potential AMHS addressing scheme, the XF-Address (translated), composed of the following:

- a) an AMHS Management Domain identifier;
- b) an organization-name attribute:
  - 1) as specified in ISO/IEC 10021-2, Section 18.3,
  - 2) taking the 4-character value “AFTN”, and
  - 3) encoded as a Printable String; and
- c) an organizational-unit-names attribute:
  - 1) as specified in ISO/IEC 10021-2, Section 18.3,

2) comprising a sequence of one single element, which takes the 8-character alphabetical value of the AF-Address (AFTN-form address) of the user, and

3) encoded as a Printable String.

Note 1. – An XF-Address is a particular MF-Address whose attributes identifying the user within an AMHS Management Domain (i.e. those attributes other than country-name,
administration-domain-name and private-domain-name) may be converted by an algorithmic method to and from an AF-Address. The algorithmic method requires the additional use of look-up tables which are limited, i.e. which include only a list of AMHS Management Domains rather than a list of individual users, to determine the full MF-address of the user.

Note 2. – An MF-Address (MHS-form address) is the address of an AMHS user.

3.2.4.1.2 A summary of XF-Addressing Scheme can be found in the following table:

Attribute	Attribute value	Remark
Country-name ©	C = "XX", as already obtained by ICAO from ITU-T	
ADMD-name (A)	A = "ICAO", as already registered by ICAO at ITU-T	
PRMD-name (P)	P = private-domain-name, taking the value of the one or two-letter ICAO Nationality Letters as specified in Document 7910.	Default value will be used to ensure that the attribute value is always defined (see [13]).
Organisation-name (O)	O = "AFTN", taking the 4-character value "AFTN" encoded as a Printable String.	
Organisational-unit-name (OU1)	OU1 = the 8-letter AF-address (or AFTN indicator) of the considered user.	

Table 3: XF-Addressing Scheme

Example: XF AMHS Address for the Southampton Tower
/C=XX/A=ICAO/P=EG/O=AFTN/OU1=EGHIZTZX

4.2.4.2. CAAS Addressing Scheme

The Common AMHS Addressing Scheme (CAAS) adopted by ATNP and collected in old

Doc 9705 (3rd Edition) (replaced by Doc 9880, Part II) is aligned with the addressing scheme developed in AFI Region by the SPACE Project Team and endorsed by the third meeting of the
Aeronautical Fixed Services Group (AFSG) of the AFI Region Air Navigation Planning group (EANPG).

4.2.4.2.1 High-level attributes

4.2.4.2.1.1 The following preferred high-level MD and address structure that meets all of the requirements outlined in paragraph 3.2.1 above:

· Country Name = 'XX';

· ADMD Name = ‘ICAO’;

· PRMD Name = preferred operating name assigned by each ANSP or group of ANSPs.

In this way, ICAO creates an international ADMD without addressing constraints imposed from outside ICAO and its members.

4.2.4.2.1.2 This scheme has placed two requirements on ICAO:

· To obtain from the ITU-T the registration of the name ‘ICAO’ (or some other suitable acronym agreed between ICAO/ANC and ITU-T); and

· To establish and maintain a register of PRMDs established by ANSPs that operate using the 'XX' + ‘ICAO’ address structure, in a way similar to Doc 7910 [7]and Doc 8585 [8].

Note. – This scheme does ***not*** *require ICAO itself to operate the ADMD systems since this should be delegated to the participating ANSPs.*

4.2.4.2.1.3 This registration will enable the establishment of regional AMHS services and their later interconnection, and it will provide ANSPs with a good deal of stability within which they can develop their AMHS plans.

4.2.4.2.2 Low level attributes

4.2.4.2.2.1 The CAAS addressing scheme includes the following attributes:

· Organization name (O) = Region,

· Organizational unit 1 (OU1) = Location,

· Common name (CN) = User

4.2.4.2.2.2 Consequences:

· Each ANSP will define the values for the Organization-Name attribute (O) in its Management Domain. The character set to be used for this attribute will be the set of characters allowed by the ASN.1 type "PrintableString".

· Organizational Unit 1 (OU1) will be the 4-character ICAO location indicator (as specified in ICAO Doc 7910 [7]) of the user.
· Common Name (CN) will include the 8-character AFTN address for AFTN users.

4.2.5 AFI REGION AMHS Addressing Plan

4.2.5.1 AFI REGION AMHS Addressing Scheme

4.2.5.1.1 AFI REGION AMHS Addressing Scheme was endorsed by the third meeting of the
Aeronautical Fixed Services Group (AFSG) of the AFI Region Air Navigation Planning group
(EANPG) and is fully compliant with the CAAS Addressing Scheme described above.

4.2.5.1.2 This scheme has been adopted for potential AFI REGION AMHS users, both already identified and users not currently defined.

4.2.5.1.3 This section consists of the Addressing Plan to be used by AFI REGION Organizations implementing AMHS and a database in which addresses of potential users are collected.

4.2.5.1.4 Major concepts of this AFI REGION AMHS Addressing Plan are shown as follows:

Attribute	Attribute value	Remark
Country-name (C)	C = "XX", as already obtained by ICAO from ITU-T	
ADMD-name (A)	A = "ICAO", as already registered by ICAO at ITU-T	
PRMD-name (P)	P = a name to be defined by each ANSP and registered by ICAO. Such a name will identify a State, an Organisation, or an organisation within a State.	In the absence of such a name being registered by the ANSP at ICAO, a default value will be used to ensure that the attribute value is always defined. This default value is the ICAO two letter State/territory identifier, as may be found in Doc 7910.
Organisation-name (O)	O = a value corresponding to local/national geographical information, e.g. a region or a geographical area within a State where the user is located.	The syntax and value are to be defined by the considered ANSP. The table associating such an organisation-name to each ICAO location indicator (4 characters) needs to be registered and published by ICAO.
Organisational-unit-name (OU1)	OU1 = the ICAO location indicator (4 characters) of the considered user;	
Common-name (CN)	CN = the 8-letter AF-address (or AFTN indicator) of the considered user, irrespective of whether it is a direct or indirect user.	

CAAS		XF	
C	'XX'	C	'XX'
A	'ICAO'	A	'ICAO'
P	ATSO defined	P	ATSO defined
O	ATSO defined*	O	'AFTN'
OU1	Location Indicator	OU1	AFTN addressee indicator or CIDIN Ax
CN	AFTN addressee indicator or CIDIN Ax		

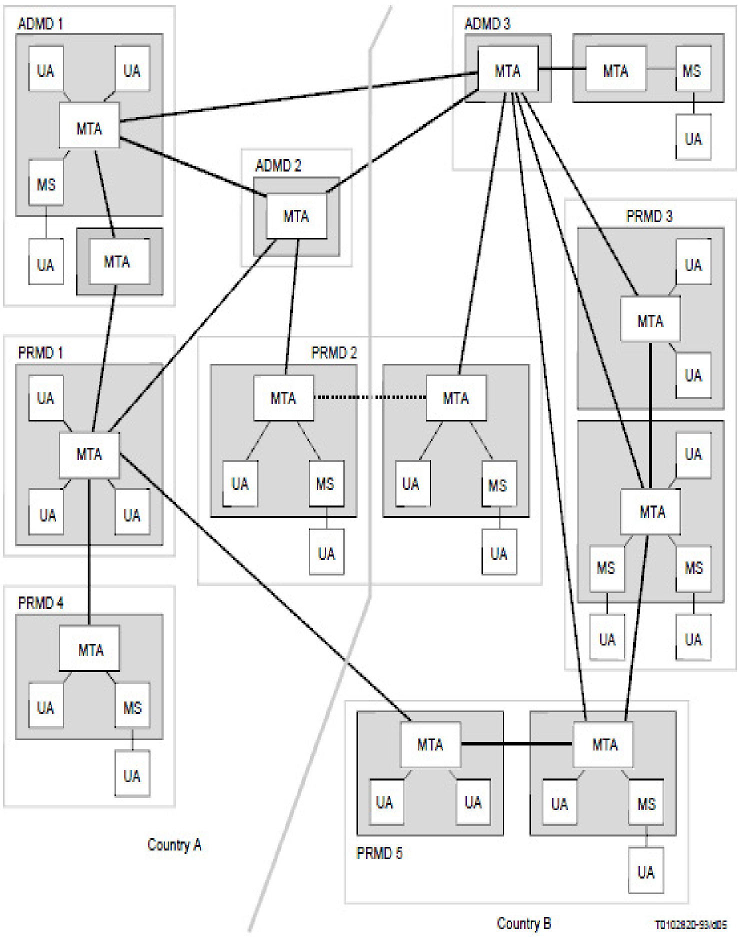


Table: AMHS Addressing Plan

Example: MF AMHS Address of Malaga's ARO (belongs to Seville region):
/C=XX/A=ICAO/P=Aena/O=LECS/OU=LEMG/CN=LEMGZPZX

4.2.5.2 Distribution lists.

4.2.5.2.1 The scheme to be used for the identification of AMHS Distribution Lists is the same as for potential AMHS users.

4.2.5.2.2 The O and OU attributes would then represent the expansion point of the distribution list.

4.2.5.3 Indirect AMHS users

4.2.5.3.1 AFI REGION AMHS Addressing Scheme shall be applicable to both direct and indirect users in the AFI REGION as soon as the scheme is published. This scheme should be published through ICAO and other appropriate bodies (e.g. the ECAC community or AFI REGIONCONTROL Member States). AFI REGION users should use the XF-address of users outside the AFI REGION until another addressing scheme (CAAS) is published by the organizations responsible for those users.

4.2.5.3.2 As soon as all ANSPs have published their addressing scheme (CAAS), there would be no more need for AFI REGION ANSPs to support XF-addresses for users within the AFI REGION.

4.2.5.4 AFI REGION AMHS Addressing Plan Database

4.2.5.4.1 It consists of the creation of a new table ("AFI REGION_AMHS_Addressing_Plan" table) in a separate Access file ("AFI REGION_AMHS_Addressing_Plan.mdb") with the following fields:

1. *'Country_ Name' field* = the value "XX".
2. *'ADMD' field* = the value "ICAO".
3. *'PRMD' field* = one of the following values: "Aena", "Germany", "CFMU", "EG", "France", ... Values are collected in [13].
4. *'Organisation_Name' field* = This attribute contains the name of the geographical location of the AMHS user in terms of REGION concept. Values are defined on a local basis. An input from different AFI REGION ANSPs is needed in order to associate each internal location indicator with the REGION. Values are collected in [13].
5. *'Organisational_Unit_1' field* = This attribute contains the name of the geographical sublocation of the AMHS user within its respective geographical location.
6. *'Common_Name' field* = This attribute contains the name or identification of the computer application or distribution list

III. DRAFT AFI AMHS IMPLEMENTATION PLAN

A. BACKGROUND

1. ICAO GLOBAL STRATEGY

•**Vision**

–Global ATM Operational Concept (Doc 9854)

–Integrated, harmonized and interoperable ATM up and beyond 2025

•**Strategy**

–Global Air Navigation Plan (Doc 9750)

–Focus on near and medium term activities

•**Activities**

–Asia and Pacific Regions Air Navigation Plan (Doc 9673)

–AFI Regional work program with time schedules

2. ATN RELATED PROVISIONS

•**ICAO SARPS –ANNEX 10 Volume 3**

–Amendment 83 (effective 20 November 2008)

•**Manual of Technical Provisions for the Aeronautical Telecommunication Network (Doc 9705)**

–ATSMHS part is obsolete and is superseded by Doc 9880

•**Comprehensive ATN Manual (Doc 9739)**

–To be withdrawn

3. DOCUMENTS ADDED

•**Manual on Detailed Specifications for ATN/OSI (Doc 9880)**

–ATSMHS moved to Doc 9880 Part IIB

•**Manual for the ATN using IPS Standards and Protocols (Doc 9896)**

–Published as 1stEdition 1 June, 2009

4. AFI REGIONAL AMHS ACTIVITIES

A. In order to provide guidance to the States on the matters relating to the implementation of Aeronautical Telecommunication Network (ATN) in the region and to ensure uniform and harmonious deployment, the AFI ATN

Planning Task Force developed guidance on ground elements ATN Transition material to be adopted by APIRG. APIRG 17 held in Ouagadougou from 2 to 8 August, 2010. revised this materials and formed an AFI ATS Message Handling System Implementation Task Force**(AFI AMHS/I/TF)** in order to coordinate and plan for the implementation of AMHS in AFI;

•Subsequently, the Air Traffic Message Handling System (AMHS) First task force meeting held at the ICAO Eastern and South African Region **(**ESAF) Head Office in Nairobi, Kenya from from 19^{td} to 20th May, adopted following AFI Region Activities:

- ✓ Review of ICAO SARPs and Guidance Material
- ✓ Conduct of a Regional Survey on AFS circuits specifications and AMHS implementation status
- ✓ Develop a draft AFI AMHS Implementation Plan
- ✓ Develop a draft AFI AMHS Manual which is a baseline document which provides information on the:

  –Introduction to the system

  –Asia and Pacific AMHS Requirements

  –System implementation –guidelines for system

  –Test and Validation of the systems

•Strategy is being reviewed periodically to consider the developments that are taking place currently

5. AMHS IMPLEMENTATION ASPECTS BEING CONSIDERED:

a) Transition steps:

AMHS Transition Plan would include the following appendices to address variety of issues:

- o AFI Region AMHS Network Status
- o Document AMHS implementation status of the States
- o AFI Region AMHS Network Backbone Trunks: Document the Telecommunication Backbone/circuits

- o AFI Region TCP/IP Routing Policy and Plan of ATN Naming & Addressing

b) Implementation trials identification: Present AMHS implementation issues.

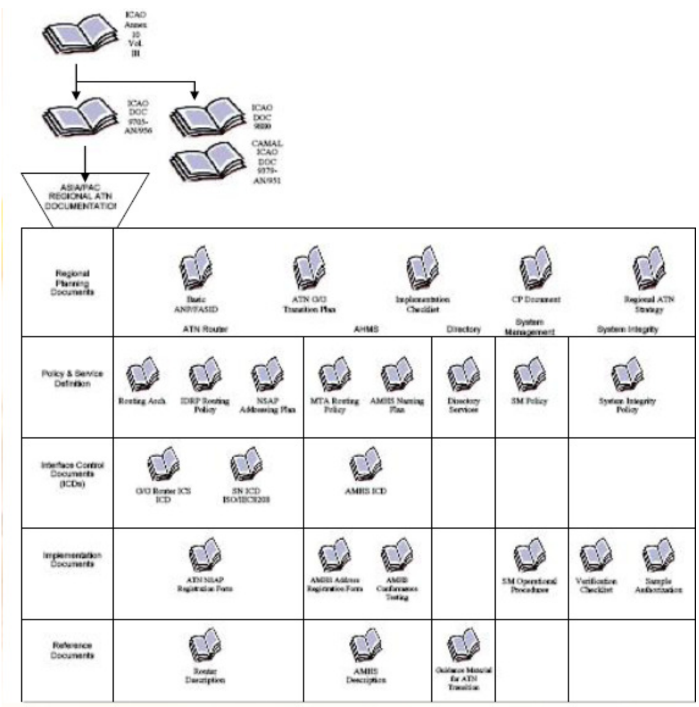
c) National Implementation:

- Centralize technical management
- Avoid the employment of different equipment providers
- Based on COTS and state-of-the-art IP Products
- Must be scalable to increases in air traffic volume

d) Implementation Documents Needed:

DOCUMENTATION TREE

e) There is a need to finalizing related ICAO documents before the States can make investment.



a) Operation Considerations:

- ✓ MTA to any MTA (via IP)

- This is the end state goal. In the interim, the regional major hub should take active role to ensure the smooth operation.
  - ✓ Dual operation of AFTN and AMHS
- Dual Operation during transition period will require regional major hubs to act quickly to prevent significant network problems.
  - ✓ Regional AMHS Management Center (AMC)
- ICAO regional office should be responsible for coordination and validation of information provided by States before distribution to the AMC. ICAO regional office should also be responsible resolving addressing scheme conflict.
  - ✓ System performance standards
- Develop System Performance Standards to address legal recording, tracking message, delivering of messages, etc.
  - ✓ AFI FASID CNS1B Table
  - ✓ AFI FASID CNS1C Table

TABLE CNS 1B - ATN ROUTER PLAN
TABLEAU CNS 1B - PLAN DES ROUTEURS ATN

Administration	Location of Router/ Emplacement du routeur	Type of router/ Type de routeur	Type of/Type d' Interconnection	Connected to router of/ Connecté au routeur de	Link Speed/ Vitesse de la liaison (bps)	Link Protocol/ Protocole de la liaison	Target date of implementation/ Date de mise en oeuvre	Remarks Observations
1	2	3	4	5	6	7	8	9

TABLE CNS 1C - AMHS ROUTING PLAN
TABLEAU CNS 1C - PLAN D'ACHEMINEMENT AMHS

Administration	Location of AMHS/ Emplacement de l'AMHS	ATSMHS Type/ Type de messagerie ATS	AMHS Pair/ AMHS correspondent	Target date of implementation/ Date de mise en oeuvre	Remarks/ Observations
1	2	3	4	5	6

B. THE GENERAL PLAN FOR THE IMPLEMENTATION OF THE ATN INFRASTRUCTURE AND ASSOCIATED ATN APPLICATIONS IN THE AFI REGION:

B.1. CONSIDERATIONS:

States shall provide implementations in compliance with Annex 10 SARPS and ICAO Manuals, and with the Plans, Policies, and AMHS Transition and Implementation guidance materials available;

- **a)** States having Backbone Boundary Intermediate Systems (BBIS) shall implement MTAs that support both ATN/OSI and ATN/IPS and Intra-Region MTA routing during the AFTN/AMHS transition period: should be based on existing AFTN routing;
- **b)** States having BBIS shall implement ATN/OSI routing with X.25 sub-network capability and optionally with IP sub-network capability for interconnection with other BBIS;
- **c)** States having BBIS that connect to States in other regions shall provide high availability connections (e.g., with redundant physical connections and IP Router IPv6). Inter-Region MTA Routing during transition period: should follow AFTN routing and slowly transition between regional backbone MTAs;
- **d)** States having Boundary Intermediate Systems (BIS) shall implement ATN/OSI MTAs, or ATN/IPS MTAs, or dual-stack MTAs;

e) States that have implemented MTAs and IP Router IPv4&6 but not among those having BBIS should be added to the existing 6 Backbone Boundary Intermediate System hubs. They are also urged to register to Air Traffic Service Message Management Center (AMC) operation before its fully AMHS operational;

f) States shall work co-operatively to assist each other on a multinational basis to implement the ATN expeditiously and to ensure system inter-operability:

- ✓ IPS-based networks
- ✓ MTA to MTA Communication
- ✓ Dual Operation of AMHS and AFTN

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

h) A regional AMHS Management Center (AMC) should be put in place. ICAO regional office should be responsible for coordination and validation of information provided by States before distribution to the AMC. ICAO regional office should also be responsible resolving addressing scheme conflict.

B.2. TRANSITION ISSUES

- Intra-Region MTA routing during the AFTN/AMHS transition period: should be based on existing AFTN routing.
- Intra-Region MTA routing at End-State Environment: MTA to any MTAs operation when MTAs in the region are fully implemented.
- Inter-Region MTA Routing during transition period: should follow AFTN routing and slowly transition between regional backbone MTAs.
- Inter-Region MTA Routing at End-State Environment: MTA to any MTAs operation when all MTAs are fully implemented and common network protocol is in place.

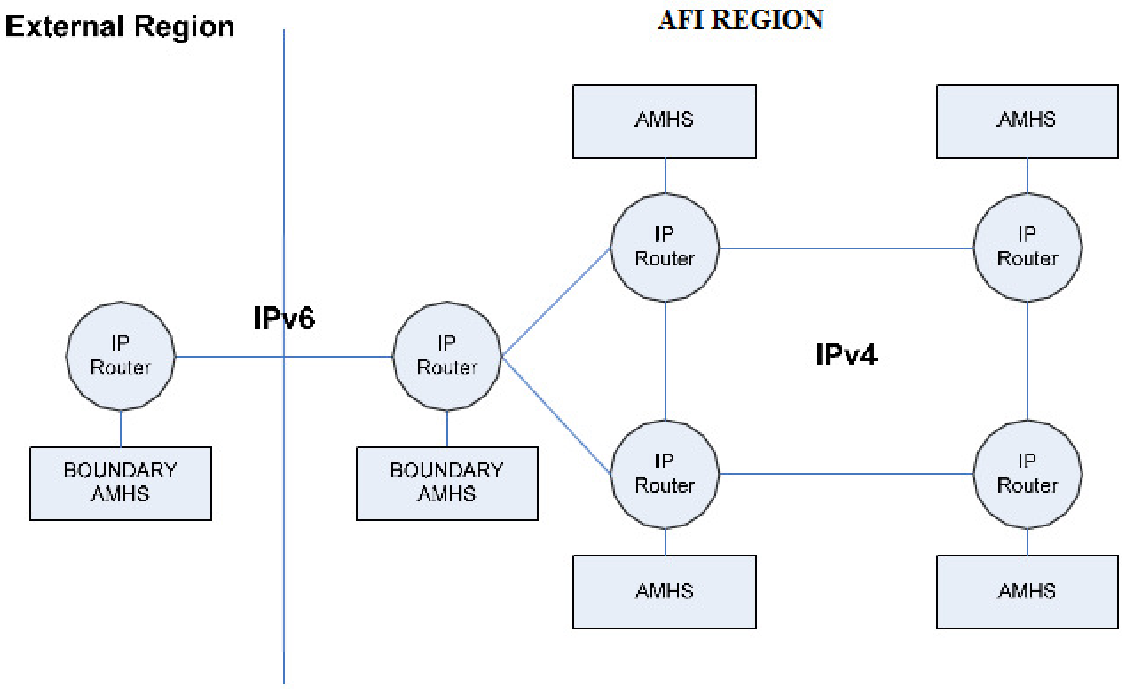


Figure: Transition Plan IPv6 to External ICAO Regional

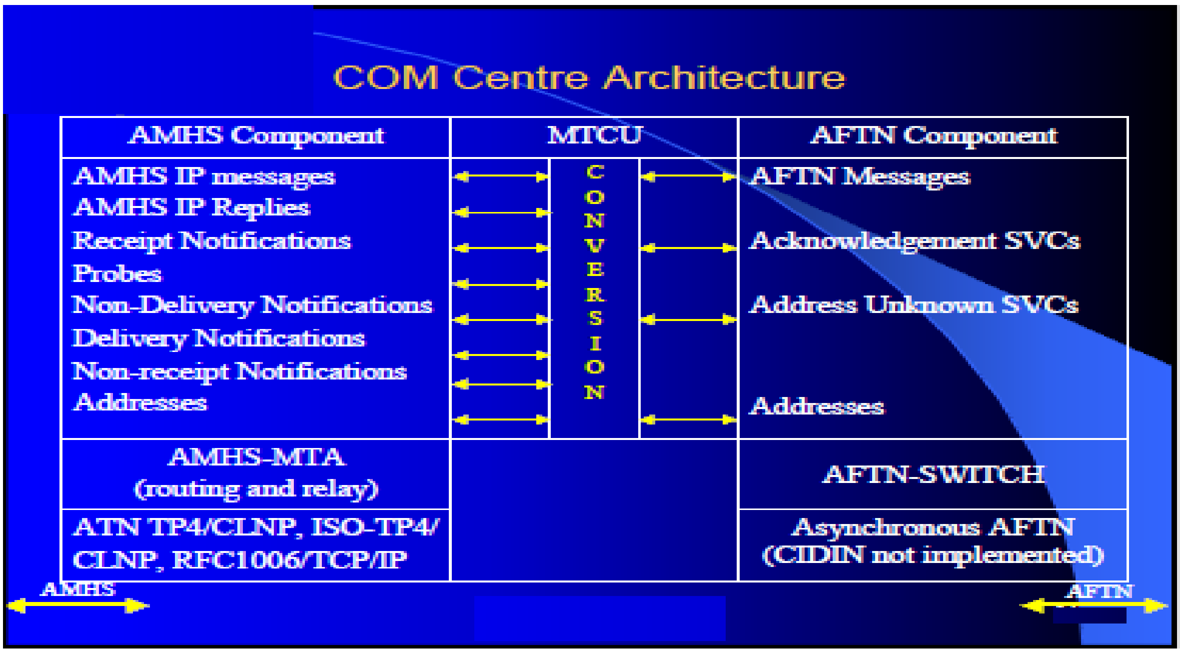


Figure: COM Center Architecture

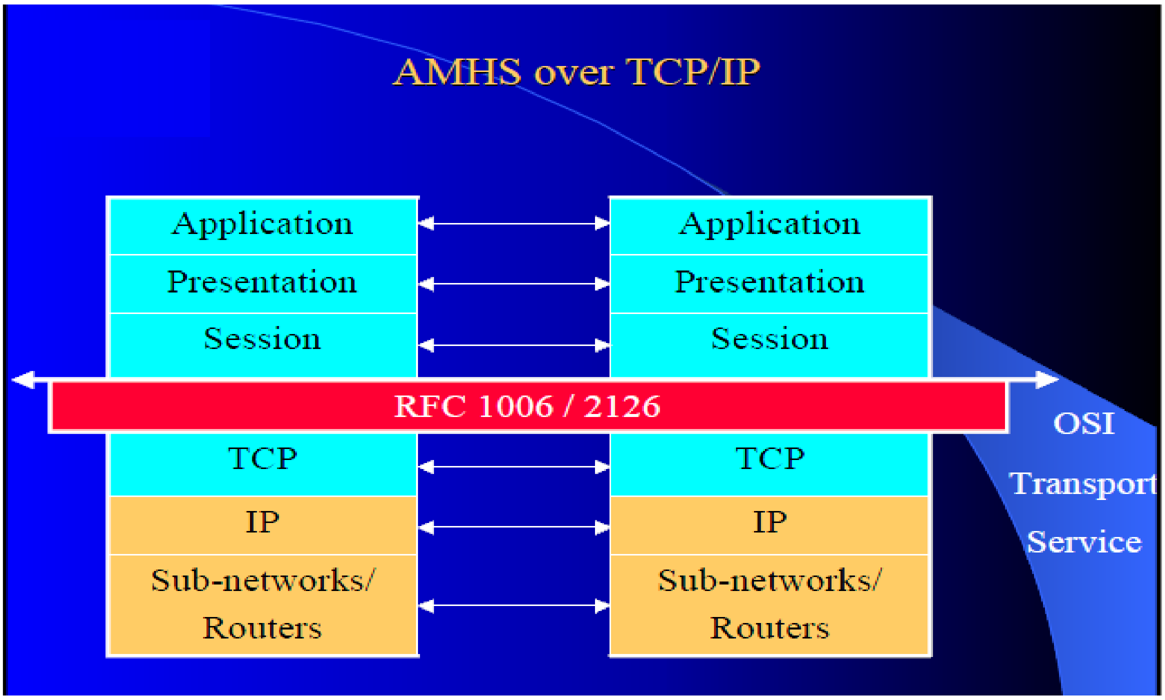


Figure: Logical and physical AMHS connectivity

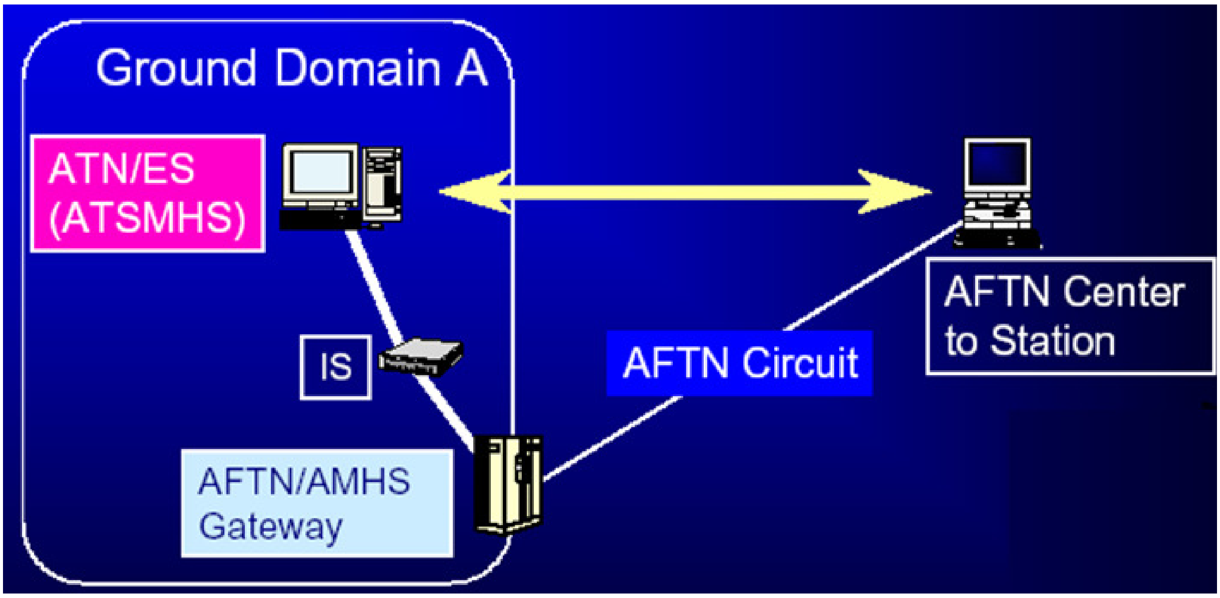


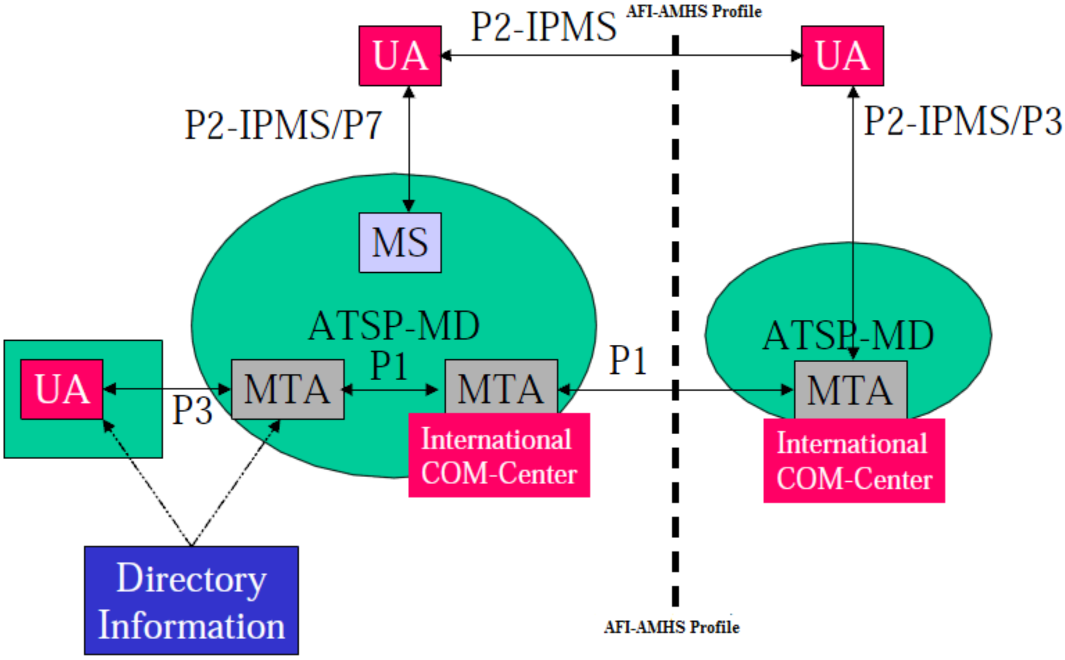
Figure: AHMS USER TO AFTN USER

AFI AMHS PROTOCOLS SCENARIOS

a) MTS Transfer Protocol (P1)

b) MTS Transfer Protocol (P2) used between MTAs&MTAs

c) MTS Access Protocol (P3)
d) MS Access Protocol (P7)



B.3. RECOMMENDED AFI AMHS TOPOLOGY

1 The objective of this section is to specify a AFI AMHS topology which meets the various objectives expressed above, taking into account the fact that they are some times contradictory.

PROPOSED EXEMPLE (Depending on State AMHS Implementation Plan):
Please complete State Implementation Plan
States should consider establishing gateways, where required to allow inter-operation between AFTN and ATH MHS