CEC TEN-T ATM Task UK/96/94

ACCESS

ATN Compliant Communications

European Strategy Study

Define Network Topology - Addressing Plan

Addressing Plan of the European ATN network

Document Reference	: ACCESS/STNA/206/WPR/015
Author	: S. Tamalet, F. Picard
Revision Number	: Version 1.0
Date	: 2 April 1998
Filename	: S015I1-0.DOC

DOCUMENT CONTROL LOG

Revision Number	Date	Description of Change
Issue 1.0	2/04/98	First Issue

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EXECUTIVE SUMMARY

There are two aspects of interest when discussing addressing in the ATN. The first is the set of administrative requirements for obtaining and allocating names or addresses; the second is the technical aspect of such assignments. This report focuses on the technical issues.

The purpose of the ACCESS work package 206 was to define the naming and addressing plan of the European ATN network based on the topology and services defined in the preceding work packages.

This document proposes addressing and naming principles for the European ATN ATSC systems and ATS applications. It provides guidelines and recommendations for the Internetwork, Transport, Upper Layer and Application addressing in European ATN ATSC systems, and for the ATS Application Naming. The naming and adressing of AINSC systems and AOC applications is outside of the scope of this report.

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1. Introduction

1.1 Scope

The 'ATN Compliant Communications European Strategy Study' (ACCESS) project that is being run under the European Commission's programme for financial aid in the field of Trans-European Transport Network (TEN-T), ATM Task UK/96/94, aims at defining the initial architecture of the ATN in EUROPE (i.e. selection of the initial applications, definitions of the initial network topology, definition of the routing organisations and of the addressing plan, etc. ..), and will propose initial solutions as regards to the security, safety/certification, network management, institutional, and other issues as well as a transition plan.

Part 1 of Access project focuses on ATN Implementation with the objectives of proposing a network architecture, solutions for network implementation issues and a plan for transition from the existing network infrastructure to the proposed ATN infrastructure.

Part 2 of the ACCESS project covers the ATSMHS Interoperability/Validation testing.

This document has been developed in the scope of Work Package 206 (entitled « Define network topology - Addressing Plan ») and represents one part of the ACCESS interim deliverable 1 in Part 1.

This task is closely related to WP_202 (Define Geographical Area and Services) and WP_203 (Define Network Topology - Routing Architecture).

1.2 Purpose of the Document

There are two aspects of interest when discussing addressing in the ATN. The first is the set of administrative requirements for obtaining and allocating names or addresses; the second is the technical aspect of such assignments. This report focuses on the technical issues.

The purpose of this work package is to define the naming and addressing plan of the European ATN network based on the topology and services defined in the preceding work packages. Although this addressing plan is believed to be suitable for all options of the European ATN Routing Organisations developed in the scope of Work Package 203, it has mainly been defined with the option 1 in mind.

The document proposes addressing and naming principles for the European ATN ATSC systems and ATS applications. It provides recommendations for the Internetwork, Transport, Upper Layer and Application addressing in European ATN ATSC systems, and for the ATS Application Naming. The naming and adressing of AINSC systems and AOC applications is outside of the scope of this report.

It is expected that in the future the ATN will be enhanced to include support for multicast and other advanced features. These future functionalities are under considerations at ATNP, and their possible impact on the ATN naming and adressing is not yet known. The requirements for addressing for these future services is outside of the scope of this document.

1.3 Geographical Area and time frame considered by the ACCESS project

The geographical area considered in ACCESS consists of the following countries: UK, Ireland, Benelux, Germany, France, Italy, Spain and Portugal. These States were chosen for the following reasons:

- **They have a direct connection to the CFMU and/or are involved in the control of North Atlantic traffic.** States connected directly to the CFMU - in 1997 - were selected because this enables the major ground/ground data flows in Europe to be included in the study. North Atlantic

Region States were selected, as this Region is likely to provide the first operational implementation of ATN services.

- **The study is representative of both Oceanic and Continental ATC**. Including the NAT Region and European States allows routing and architecture issues between boundary Regions to be studied.

With respect to the considered timeframe, it is assumed that an initial European ATN will be deployed and be operationally used during the period 2000-2005. This initial European ATN is considered in the time as the first brick to a global and mature target European ATN that would answer most of the ground-ground and air/ground ATN communication requirements currently identified. This target European ATN is assumed to be deployed in years 2005-2010 where new data link services and new communication networks will be set in operation and additional ground facilities will be equipped.

The initial ATN of year 2005 must consist of the first elements on an expandable ATN infrastructure that will actually allow, in some further implementation steps, the building of the target European ATN of the year 2010. The initial European ATN is therefore viewed as a transition step toward the target infrastructure.

As a practical approach for the definition of the initial European ATN, it is considered that ACCESS must first focus on the definition of the target European ATN and that the initial implementation will be derived in the scope of the ACCESS transition planning Work Package (WP240).

With regard to the definition of the European ATN addressing plan, the restriction of the scope of the ACCESS study does not really apply. Although this report may be limited to recommendations for the allocation of ATN addresses in the geographical area and the timeframe under study, the proposed addressing plan has been defined to suit a larger scope:

- the recommended addressing principles are compliant with the ATN addressing plan;
- the recommended addressing principles may be applied to whole Europe;
- the recommended addressing principles allow any European ATN domains (and systems) to be unambiguously identified in the scope of the World Wide ATN;
- provided that the ATN addressing plan defined in the ATN SARPs does not change, the European ATN addressing plan proposed in this document should remain valid beyond 2010.

1.4 Document Structure

This document is structured as follows :

Chapter 2 proposes the European ATN internetwork addressing plan

Chapter 3 provides guidelines for the naming and addressing of applications in European ATN systems

1.5 References

ACCESS Reference	Title
[ICA8]	Doc ICAO 9505-AN/956 - Manual of Technical Provisions for the ATN - Sub-Volume 5 - Internet Communications Service
[ICA10]	Doc ICAO 9505-AN/956 - Manual of Technical Provisions for the ATN - Sub-Volume 4 - Upper Layer Communication Services

[ICA11]	CAMAL - Comprehensive ATN Manual
[ICA12]	Doc ICAO 7910/78 - Location Indicators - ICAO - 78th Edition - May 1995.
[ICA13]	Doc ICAO 8585/94 - Designations for aircraft operating agencies, aeronautical authorities and services - 94th Edition - March 1995.
[ICA14]	Doc ICAO 9505-AN/956 - Manual of Technical Provisions for the ATN - Sub-Volume 3 - ATS Message Handling Service (ATSMHS)
[ISO2]	ISO/IEC 8824-1 - Information Technology - Abstract Syntax Notation One (ASN.1) - Specification of Basic Notation - February 1994

2. European ATN Internetwork Addressing Plan

2.1 Introduction

The ATN internetwork addressing plan (i.e. ATN NSAP addressing plan) is defined in Chapter 5.4 of [ICA8]. It specifies the structure of the ATN NSAP addresses and ATN NETs as well as the abstract syntax, semantic and encoding rules of the individual fields of these addresses.

Extensive guidance on the structure and elements of this addressing plan is given in Part 2, Chapter 6, section 6.5.2 of the Comprehensive ATN Manual (CAMAL) [ICA11]. Although, for the sake of completeness of this document, the general overview of the ATN internetwork addressing principles and concepts has been imported from the CAMAL in section 2.2 of this document, the reader is invited to refer to the CAMAL for a complete overview of the ATN Naming and Addressing principles and concepts.

Section 2.3 of this document proposes principles for the assignment of values to the various fields of the ATN internetwork addresses.

2.2 Internetwork Addressing principles and concepts

2.2.1 General

The ATN naming and addressing scheme is based on the OSI Reference Model (ISO 7498-3) which supports the principles of unique and unambiguous identification of information objects and global address standardisation which are essential features for an international, mixed-user communications system such as the ATN.

Unambiguity of ATN names and ATN addresses is achieved through the use of naming/addressing domains with firmly allocated naming/addressing authorities.

According to ISO 7498-3, naming/addressing domains may be hierarchically decomposed into subsets which are known as naming/addressing sub-domains. Each subset (sub-domain) is under the control of an individual naming/addressing authority and does not intersect with other subsets (sub-domains) administered by different naming/addressing authorities. The top of this hierarchical structure is the global OSI domain.

The ATN naming/addressing domains, i.e. the sets of all possible names/addresses of objects within the ATN, are subdomains of the global OSI naming/addressing domain. Several such ATN naming/addressing domains exist, as there are different types of ATN objects which have to be named or assigned addresses respectively.

The naming/addressing authority for the ATN naming/addressing domains is ICAO which controls and manages these domains through the ATN SARPs.

In order to facilitate the address assignment and registration in the ATN, which is expected to comprise several thousands of objects, the ATN SARPs further decompose the ATN naming/addressing domains into a set of hierarchical sub-domains. Each address sub-domain is a set of address formats and values which are administered by a single addressing authority. Each addressing authority is responsible for its own address sub-domain and may further partition it into several subordinate sub-domains and delegate authority for these sub-domains. This principle allows the establishment of sub-address spaces (i.e. the set of values within an addressing sub-domain) in a hierarchical fashion without the need to co-ordinate between sub-address spaces.

The global OSI network addressing domain (which is itself a sub-domain of the global OSI addressing domain) is partitioned into several sub-domains, one of which is the ATN NSAP address sub-domain. This sub-domain is itself decomposed into a number of subordinate addressing sub-domains in a recursive fashion. Each such sub-domain is associated with an NSAP addressing authority which is responsible for this sub-domain, and may further delegate authority for those sub-domains into which it has partitioned its own addressing subdomain. This principle allows to construct ATN addresses as a sequence of individual address fields (see Figure 1 and section 2.2.3.1), with each field corresponding to an addressing sub-domain. As these sub-domains are individually administered, the address field formats and values can be assigned without the need to co-ordinate between addressing authorities.

2.2.2 Naming and Addressing Authorities

The overall naming and addressing authority for the ATN naming/addressing domains is ICAO which controls and manages these domains through the ATN SARPs. Besides partitioning the ATN naming/addressing domains into appropriate sub-domains and specifying the syntax, semantics and encoding for these sub-domains, the ATN SARPs also directly allocate and register names/addresses within these sudomains, where appropriate or required. Furthermore, provisions have been made within the ATN SARPs which delegate full or partial responsibility for certain sub-domains (i.e. certain address fields) to organisations other than ICAO, such as IATA, regional ATS organisations and national civil aviation authorities.

Within a hierarchy of naming/addressing domains, the operation of each naming/addressing authority is independent of that of the other naming/addressing authority at the same level, subject only to any common rules established by the procedures of the parent authorities.

2.2.3 ATN Internetwork elements subject to addressing and naming

The following addressing elements exist for ATN internetwork elements:

2.2.3.1 The ATN NSAP Address

An ATN NSAP address is a 20-octet string used to uniquely identify and locate a given NSAP (i.e. a network service user) within the context of the ATN.

The ATN NSAP address format is illustrated in Figure 1. This address format starts with the Initial Domain Part (IDP) which comprises the Authority Format Identifier (AFI) and Initial Domain Identifier (IDI) fields and is followed by the Domain Specific Part (DSP).

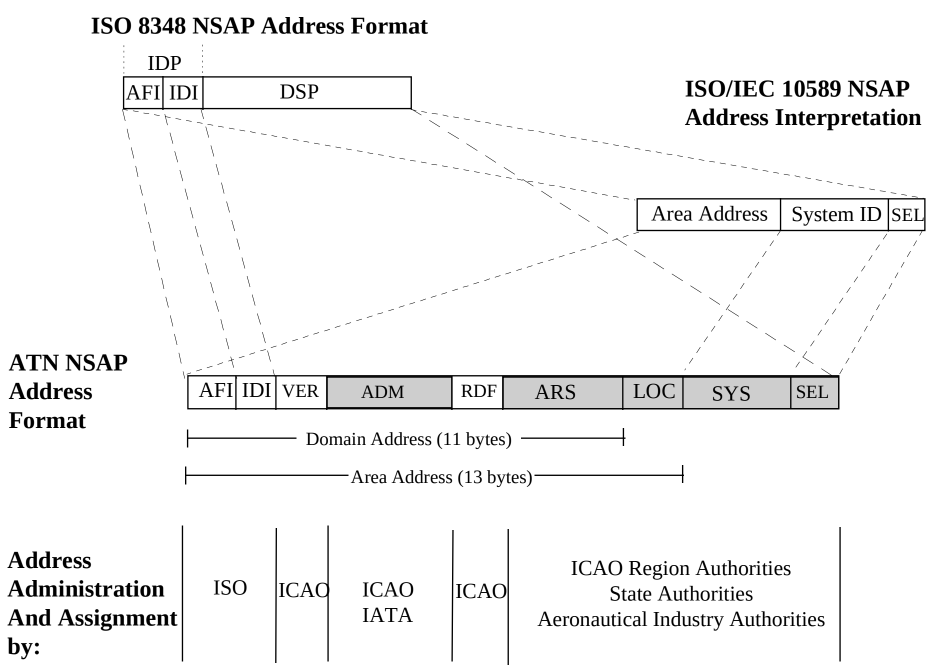

Figure 1: ATN NSAP Address Format

The (decimal) IDP value 470027 forms the common, initial part of all ATN NSAP addresses and NETs, i.e. it is the common fixed address prefix of these addresses. This address prefix defines the ATN Network Addressing Domain as a sub-domain of the Global OSI Network Addressing Domain, as depicted in Figure 1, under addressing authority of ICAO and using a binary format for the DSP.

The Domain Specific Part (DSP) of the ATN NSAP address format is structured into seven individual address fields which allow to co-ordinate the allocation of ATN NSAP addresses and NETs according to the hierarchical approach described in section 2.2.1.

The Table below outlines the ATN NSAP addressing plan. This table describes the complete ATN NSAP address format, semantics and field contents from which NSAP addresses, NETs, NSAP address prefixes and Routing Domain Identifiers (RDIs) are derived. Furthermore, the table shows the addressing and registration authorities for each of the address fields as specified in Chapter 5.4 of the ATN SARPs.

Field Name	Size (Octets)	Value / Range	Semantic	Contents	Value Assignment	Addressing Authority	Registration Authority
AFI	1	47 (decimal)	ISO 6523 ICD IDI and binary DSP format	47	Fixed	ISO	ISO/IEC 8348
IDI	2	00 27 (decimal)	ATN NSAP Address	00 27	Fixed	ISO	British Standards Institute (BSI)
VER	1	01 (hex) 41 (hex) 81 (hex) c1 (hex)	Ground AINSC NSAP Address Mobile AINSC NSAP Address Ground ATSC NSAP Address Mobile ATSC NSAP Address	01 41 81 c1	Fixed Fixed Fixed Fixed	ATN SARPs Subvolume 5	ICAO (ATN SARPs, Appendix 5, Chapter 5.4)
ADM	3	*00 00 00 - ff ff ff (hex)*	ATN Network Address (Sub-) Domain Authority	ISO Country Code, or ICAO Region Identifier, or IATA Airline or Aeronautical Stakeholder Designator	Fixed Fixed/Variable [1] Fixed	ATN SARPs Subvolume 5	ISO 3166 ATN SARPs Subvolume 5 IATA Doc xxx
RDF	1	00	Unassigned	00	Fixed	ATN SARPs Subvolume 5	ATN SARPs Subvolume 5
ARS	3	*00 00 00 - ff ff ff (hex)*	Routing Domain (in Ground Network Addressing Domains) Aircraft or Routing Domain (in Mobile Netw. Addr. Domains)	Not defined (for Ground Netw. Addressing Domains) ICAO 24-bit Aircraft Address (for Mobile Netw. Addressing Domains)	Variable Fixed	ATN SARPs Subvolume 5	ATN Network Addressing (Sub-) Domain Authority defined in ADM field ICAO
LOC	2	*00 00 - ff ff (hex)*	Routing Area (in Ground Network Addressing Domains) Routing Domain or Routing Area (in Mobile Netw. Addr. Domains)	Not defined Not defined	Variable	ATN SARPs Subvolume 5	ATN Network Addressing (Sub-) Domain Authority which contains the parent Routing Domain
SYS	6	*00 00 00 00 00 00 - ff ff ff ff ff ff (hex)*	ATN System	Not defined	Variable	ATN SARPs Subvolume 5	ATN Network Addressing (Sub-) Domain Authority which contains the parent Routing Area
N-SEL	1	*00 - ff (hex)*	Network Entity or Network Service User	fe (NE implementing optional non-use of IDRP) 00 (all other NEs) Remaining values not defined	Fixed Fixed Variable	ATN SARPs Subvolume 5	ATN SARPs Subvolume 5 ATN SARPs Subvolume 5 Locally

Table 1: ATN NSAP Address Definition

[1] When used to identify an ICAO Region, only the first octet of the ADM field contains the fixed ICAO Region Identifier, while the values of the remaining two octets are assigned by the identified ICAO Region.

2.2.3.2 The Network Entity Title

An ATN NET is a 20-octet string used to uniquely identify and locate a network layer entity of an ATN system (router or end system), and thus, in networking terms, is used to identify the system itself. Thanks to the global nature of the ATN internetwork addressing plan defined in Chapter 5.4 of the ATN SARPs, a system's NET can be used to locate it anywhere within the ATN.

The syntax of an ATN NET is equivalent to that of an ATN NSAP address. It differs from the NSAP addresses assigned to the same system only in the last octet, i.e. the network selector (N-SEL) field value.

2.2.3.3 Routing Domain and Routing Domain Confederation Identifier (RDI and RDCI)

Each Routing Domain and Routing Domain Confederation whose BIS(s) implement the IDRP protocol must have an unambiguous identifier.

An RDI or an RDCI is an identifier the syntax of which is equivalent to the one of a NSAP or of a NSAP prefix. This means that RDIs and RDCIs are octet strings of up to 20 octets, and which are assigned statically according with ISO 8348/Add 2. The RDIs are typically 11 octets long and consist of the AFI, IDI, VER, ADM, RDF and ARS fields. RDCIs are octet strings which are generally shorter than RDIs.

An RDI or RDCI identifies a routing domain or a confederation uniquely, but does not necessarily convey any information about its policies or the identities of its members. That means that an RDI or an RDCI is not necessarily the common prefix to all ATN NSAP addresses and NETs within the Routing Domain or the Routing Domain Confederation. Its main purpose is to allow the routers to determine, during IDRP connection establishment, whether the adjacent routers are members of the same Routing Domain and/or of the same Routing Domain Confederations.

With regard to the assignment of value to a RDI, the common practice is to set the RDI to the common prefix of all ATN NSAP addresses and NETs within the Routing Domain. This allows to simplify the administration and registration of internetwork addresses, and the configuration of routers.

For the same reason, the common practice for the RDCI value assignment is also to have the RDCI set to the common prefix, if any, of all ATN NSAP addresses and NETs within the confederation. However this is not always possible; a confederation can indeed group Routing Domains which do not have a common address prefix.

2.3 Proposed European ATN internetwork addressing plan

2.3.1 Introduction

The European ATN internetwork addressing plan must conform to the ATN Addressing plan specified in the ATN SARPs.

As shown in Table 1, four of the nine fields of an ATN NSAP address or NET have already fixed values allocated by the ATN SARPs. The values of the remaining five fields, marked as variable in Table 1 and highlighted by grey boxes in Figure 1, remain to be allocated. This is the main purpose of this chapter.

At the upper level, the ATN SARPs identify the following four ICAO sub-ordinate addressing Domains:

- The fixed Air Traffic Services Communications domain(ATSC fixed), i.e. the set of ground network addressing (sub-)domains administered by ATSC authorities

- The mobile Air Traffic Services Communications domain(ATSC mobile), i.e. the set of airborne network addressing (sub-)domains administered by ATSC authorities.

- The fixed Aeronautical Industry Service Communications domain(AINSC fixed)), i.e. the set of ground network addressing (sub-)domains administered by members of the Aeronautical Industry.

- The mobile Aeronautical Industry Service Communications domain(AINSC mobile), i.e. the set of airborne network addressing (sub-)domains administered by members of the Aeronautical Industry.

The allocation of values to the remaining five ATN NSAP fields depends in the first place on the membership of the addressed element to one of these ICAO sub-ordinate addressing domains.

The Table 2 below is a simplified version of Table 1, summarising the rules for the allocation of values to the different NSAP fields, depending on the ICAO sub-ordinate addressing domain to which the addressed element belongs.

Domain **field**	**ATSC-fixed**	**ATSC-mobile**	**AINSC-fixed**	**AINSC-mobile**
AFI	47	47	47	47
IDI	0027	0027	0027	0027
VER	81	C1	01	41
ADM	must be derived from the ISO country designator (ISO 3166) OR the first octet must be set to an ICAO Region identifier *and the remainder is assigned by the region*	must be derived from the ISO country designator (ISO 3166) OR the first octet must be set to an ICAO Region identifier *and the remainder is assigned by the region*	*registered with IATA by the identified organisation* *should be derived from the IATA airline or aeronautical stakeholder designator*	*registered with IATA by the identified organisation* *should be derived from the IATA airline or aeronautical stakeholder designator*
RDF	00	00	00	00
ARS	*assigned by the state/organisation identified by the ADM field*	must be the 24-bit ICAO Aircraft Identifier	*assigned by the organisation identified by the ADM field*	must be the 24-bit ICAO Aircraft Identifier
LOC	*assigned by the addressing authority of the Routing Domain identified by the ARS field*			
SYS	*assigned by the addressing authority of the Routing Area identified by the LOC field*			
SEL	00 for the NET of IS of Class 1,2,3,4,5 and 6 fe for the NET of Class 7 IS ff is reserved any other value may be assigned to NSAPs			

Table 2: Assignment of values to the ATN NSAP address fields

The section 2.3.2 below proposes additional rules for the allocation of field values to ATN internetwork addresses of European fixed or mobile ATSC systems or domains.

The definition of rules for the allocation of field values to ATN internetwork addresses of European fixed or mobile AINSC systems or domains is considered to be out of the scope of this document (this falls within the competence of IATA and the European airlines).

2.3.2 Internetwork addresses of European fixed or mobile ATSC systems or domains- proposed principles

2.3.2.1 AFI, IDI, VER and RDF fields

For compliance to the SARPs, the AFI, IDI, VER and RDF fields of the ATN internetwork addresses of European **fixed ATSC** systems or domains will be respectively set to **47**, **0027**, **81** and **00**.

The AFI, IDI, VER and RDF fields of the ATN internetwork addresses of European **mobile ATSC** systems or domains will be respectively set to **47**, **0027**, **C1** and **00**.

2.3.2.2 ADM field

2.3.2.2.1 Proposed ADM field encoding method

The ADM field is used to further break down the Ground and Mobile ATSC NSAP Addressing Domains and the Ground and Mobile AINSC Addressing Domains into a set of subordinate network addressing (sub-)domains to allow devolved administration of each resulting (sub-) domain by an ICAO Region, State, airline or aeronautical organisation. The value of the ADM field, combined with the values of the preceding fields, forms the NSAP address prefix of each such ATN NSAP addressing (sub-) domain and consequently of all NSAP addresses and NETs administered by a given ICAO Region, State, airline or aeronautical organisation.

The ADM field is three octets long.

In the case of the ATSC addressing domains, the ATN SARPs authorise two possible ways for the encoding of the ADM field:

1. the ADM field either contains the three-character alphanumeric ISO country code, as defined in ISO 3166, of the ICAO Member State responsible for the relevant addressing sub-domain, or

2. the ADM field contains the one-octet ICAO Region Identifier (equal to 83HEX for Europe), with the remaining two octets assigned within the responsibility of the identified ICAO Region, which is then responsible for the relevant addressing sub-domain.

When the first authorised ADM field encoding technique is used, each ICAO Member State is expected to be responsible for exactly one addressing sub-domain (the one corresponding to the fixed/mobile ATSC network address prefix with the ADM field set to the 3-characters ISO 3166 code of the country) and to perform the address allocation and establishment of subordinate registration authorities, if required, within this responsibility.

Alternatively, States and ATS organisations within an ICAO Region may retain the second authorised ADM encoding technique and, hence, opt to register (a subset of) their systems under the network address space associated with the relevant ICAO Region. This allows ICAO Regions to allocate ADM field values in the ATSC Network addressing Domains to States and Organisations within the ICAO Region, in a structured manner.

This second method for encoding the ADM field presents some advantages when compared to the encoding with the 3-characters ISO 3166 country code. First, it allows all fixed ATSC domains (as well as all mobile ATSC domains), within a region, to share one common NSAP address prefix: as an example, the common prefix to all fixed European ATSC domains would be, with such encoding, 4700278183, and the common prefix to all mobile European ATSC domains would be 470027C183. This permits potential routing information reduction and efficient advertisement of routing information: it makes possible to form one single route to the Region keeping the overhead of inter-regional communications down to a minimum.

The encoding with 3-characters ISO 3166 country codes does not permit the reduction of the routing information advertised by a region. This is because the ISO 3166 codes of the European countries do not have a common character prefix; the ISO 3166 codes are fixed size acronyms of the country names and follow their alphabetical ordering without any consideration of the region.

The second advantage of having the ADM field encoded with the one-octet ICAO Region Identifier at the start, is that the 2 remaining octets can be used independently by the ICAO Regions. This permits the addressing of States, but also of specific organisations within the region. This may also allow to take into account regional particularities such as the routing organisation of the regional ATN.

It is therefore recommended that the ADM field of European ATN ATSC domains be encoded with the one-octet ICAO Region Identifier, followed by the remaining two octets under the responsibility of a European body (such as the Regional ICAO office) or of a European organisation (such as Eurocontrol).

2.3.2.2.2 Proposed ADM field structuring principles

The ADM field has been proposed to be encoded with the European ICAO Region Identifier (i.e. 83HEX) as first octet.

With regard to the assignment of values to the remaining two octets of the ADM field, the addressing plan must first consider the different (sub-)domains that will be distinguished with different ADM field values.

The ADM field must at least be used to distinguish the following (sub-)domains:

- the different European States
- the different supra-national organisations (e.g. Eurocontrol, NATO)
- the supra-national Routing Domain Confederations such as the backbone RDC or any RDCs grouping several European organisations and/or several European States.

  Additionally, depending on the extent in scope that is assigned by the Regional addressing authority to the ADM field, the field could be used to distinguish the different national ATSC organisations (e.g. the French Meteorological organisation, the German military organisation, the Italian ATSO, etc...).

The addressing plan, and more particularly the assignment of value to the ADM field, must also consider the hierarchies between these sub-domains that are desirable to be reflected in the address structure. Different hierarchical models can be followed. They are presented and discussed below.

A first possible hierarchical model that could be reflected in the structure and values of the ADM field is a model « independent of the routing organisation », or « with hierarchy by sub-domain category » where every addressed sub-domain would be assigned one value, independently of the value assigned to other sub-domain. This model is illustrated by Figure 2. As an example with this model, the second octet of the ADM field could be used to indicate the sub-domain category while the third octet would be used to distinguish the different addressed sub-domains within a category.

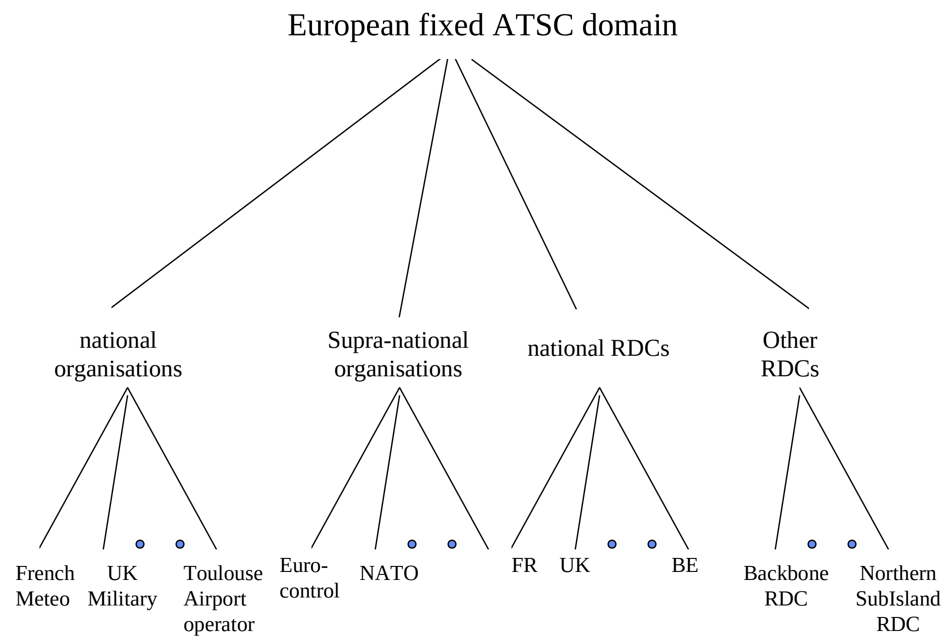

Figure 2: hierarchical addressing model independent of the routing organisation

A second possible hierarchical model that could be reflected in the structure and values of the ADM field is a model « dependent of the routing organisation » or « with explicit containment hierarchy », where every sub-domain would be addressed with consideration to its possible membership to other addressed sub-domains. Taking the routing organisation proposed as option 1 in Work Package 203 as a working basis, this model, is illustrated by Figure 3.

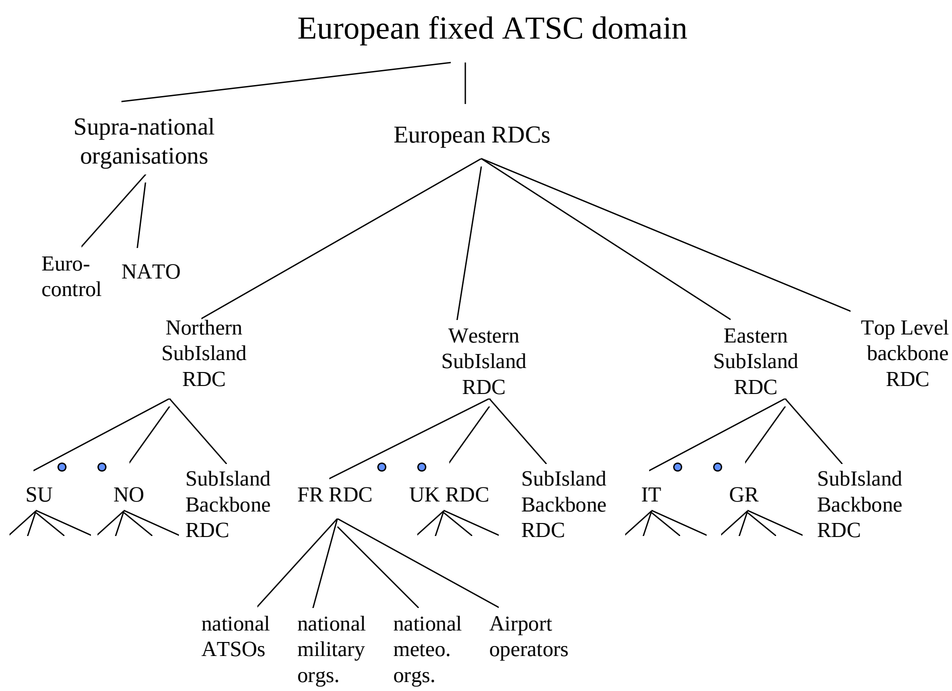

Figure 3: hierarchical addressing model dependent of the routing organisation

The advantage of the first model (illustrated by Figure 2) is its independence vis-à-vis the routing organisation. The allocation of values to the ADM field based on this model would allow the definition of an addressing plan suitable whatever the routing organisation of the European ATN, and impervious to possible evolution of this routing organisation. On the other hand, because no containment relationships are reflected with this model, its main drawback is that the RDCs will not share a common NSAP address prefix with the contained domain and consequently that no routing information reduction will be permitted at the boundary of these RDCs. As an example, the routers at the boundary of the French national RDC would have to advertise every individual route to the different French ATSC organisations instead of one unique route to ‘all French ATSC organisations’.

The second model (illustrated by Figure 3) permits the routing information reduction and the efficient advertisement of routing information. It makes possible to form single routes to all fixed or mobile ATSC systems of the different countries as well as single routes to all fixed or mobile ATSC systems within a European subregion. The drawback is that it is very dependent on the routing organisation. Every evolution of the European ATN routing organisation may consequently necessitate, with this model, a modification of the addressing plan, and therefore a reconfiguration of all impacted systems.

In view of the advantages and drawback of the two hierarchical models that can be reflected in the ADM field structure, it appears necessary to make the following recommendations:

1. The ADM field values should be allocated without consideration to the containment hierarchies of the routing organisation if those containment hierarchies are subject to change in the time

2. The ADM field structure should reflect containment hierarchies which are unlikely to change

In the category of the containment hierarchies that may evolve in the time falls the membership of a country to a European subregion. Indeed, although 3 European subregions are clearly identified for the option 1 of the European ATN routing organisation in 2010, it may be anticipated that the initial European ATN in 2005 will consist of one single subregion and that the division of the European ATN in subregions will occur in a second phase as a response to the increasing amount of ATN traffic.

On the other hand, the membership of national ATSC organisations to the national ATSC RDC does not seem to be subject to evolution in the time. This containment hierarchy is therefore proposed to be reflected in the addressing plan.

In conclusion, the hierarchical model that is proposed to be reflected in the address structure of the ADM field is the one illustrated by Figure 4.

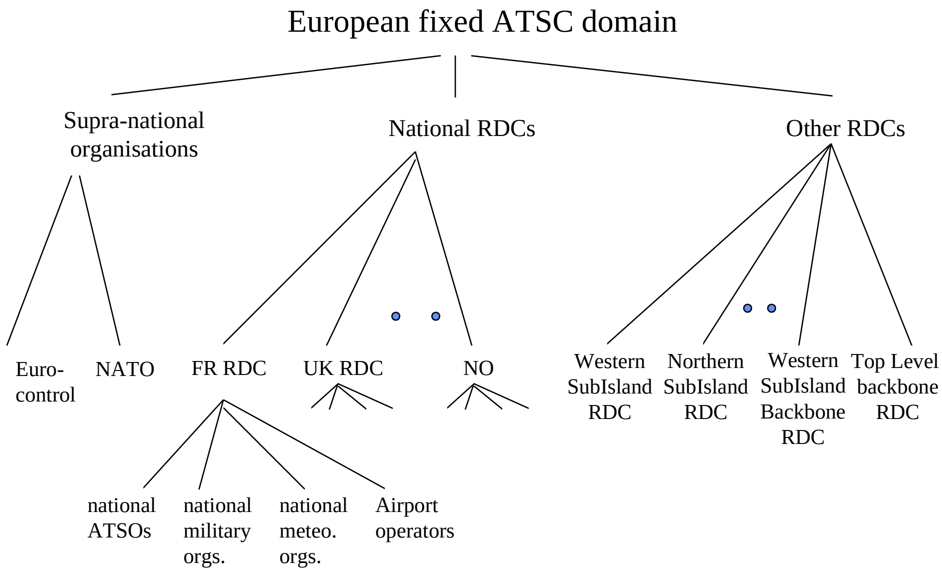

Figure 4: Hierarchical model proposed to be reflected in the address structure

2.3.2.2.3 Proposed ADM field values assignment principles

Before proposing any ADM field value assignments, the extent in scope of the ADM field remains to be specified.

The ADM field must allow the unambiguous identification of the different European States (i.e. the national RDCs), of the supra-national organisations, and of the supra-national RDCs.

On the other hand, the identification, at the ADM field level, of the national ATSC organisations is questionable. Although the two remaining octets of the ADM field allow, in principle, the identification of 65535 distinct domains, and are therefore sufficient for this purpose, it is considered that the identification (and addressing) of the national organisations fall within the responsibility of States, rather than within the responsibility of a European body or organisation. For this reason, it is proposed that national organisations be not distinguished at ADM field level, and be rather identified at ARS field level.

Having defined the scope and the hierarchical structuring principles for the ADM field of fixed and mobile ATSC internetwork addresses, principles for the assignment of values can be expressed.

Concerning the allocation of values to the 2 remaining octets of the ADM field, the following approach is proposed:

1. For the National RDCs, the two remaining octets of the ADM field are derived from the State's two character alphanumeric ISO 3166 Country Code, represented as upper case characters.

2. For the supra-national organisations, the two remaining octets of the ADM field are set to a two character alphanumeric code, registered with the European ICAO group and represented as **lower case** characters.

3. For other RDCs, the two remaining octets of the ADM field are set to a two octets numeric code in the hexadecimal range [8000-ffff], allocated by European ICAO group.

On the basis of these principles, Table 3 below proposes specific value assignment for States and organisations being in the scope of the ACCESS study and for RDCs that have been identified in the Option 1 of the European ATN Routing Organisation.

fixed or mobile European ATSC Addressing Domain	hexadecimal code of the ADM field	comment
Belgium	834245	European Region + 'BE' ('BE' is the 2-letters ISO 3166 country code of Belgium)
France	834652	European Region+'FR'
Germany	834445	European Region+'DE'
Ireland	834945	European Region+'IE'
Italy	834954	European Region+'IT'
Luxemburg	834C55	European Region+'LU'
Netherlands	834E4C	European Region+'NL'
Portugal	835054	European Region+'PT'
Spain	834583	European Region+'ES'
UK	834742	European Region+'GB'
Eurocontrol	836575	European Region+'eu'
NATO	836E61	European Region+'na'
Western subIsland RDC	838100	
Northern subIsland RDC	838200	
Eastern subIsland RDC	838300	
Western subIsland backbone RDC	8381BB	
Northern subIsland backbone RDC	8382BB	
Eastern subIsland backbone RDC	8383BB	
Top Level Backbone	8380BB	

Table 3: Proposed ADM Value Assignment for Selected European Entities

2.3.2.3 ARS field

2.3.2.3.1 General

In Ground Network Addressing Domains the purpose of the ARS field is to distinguish routing domains operated by the same State, airline or organisation. In this case, the value of the ARS field, when combined with the values of the preceding fields, identifies a network addressing sub-domain that corresponds to an ATN routing domain. Each ICAO Region, State, airline or other aeronautical organisation identified by the value in the ADM field will be responsible for establishing one or more such network addressing sub-domains according to their local routing requirements and for the assignment of appropriate ARS field values to the corresponding routing domains.

In Mobile Network Addressing Domains the purpose of the ARS field is to identify **the aircraft** on which the addressed ATN system is located. In the case of a Mobile Network Addressing Domain the ARS field value is the aircraft's ICAO 24-bit aircraft address encoded as a hexadecimal value.When the ATN systems onboard an aircraft form a single routing domain, then the ARS field also identifies the routing domain. When the systems onboard an aircraft form multiple RDs, then part of the LOC field is used to distinguish them.

2.3.2.3.2 Guidelines for the allocation of values to the ARS field of fixed ATSC internetwork addresses

Each State or organisation or RDC identified by the value in the ADM field is free to assign its own values to the ARS field. The aim of this section is therefore not to propose having fixed ARS values for all States and organisations, but to provide some guidelines and recommend some common practices for the assignment of ARS values.

The ARS field must allow the addressing of the different Routing Domains operated by the State or the organisation but must also allow the addressing of the Routing Domains of any other possible lower level organisational units of the State or the organisation.

It is therefore recommended to States and organisations that provision be made, in the assignment of ARS field values, for any potential lower level organisational units that could, in the future, operate an ATN Routing Domain.

As far as the States are concerned, the following categories of organisations have been identified as potential future operators of an ATN Routing Domain:

- The national ATSO(s)
- The national military organisation
- The national meteorological organisation(s)
- The airport operators

Note: it is recognised that during the initial phases of the European ATN deployment, it is unlikely that meteorological, or military organisations will operate their own ATN Routing Domains. The Option 1 ACCESS report on the European ATN Routing Organisation [A203] foresees that the military and meteorological systems will initially be located within the Routing Domains of the national ATSO and will therefore be addressed as systems of the national ATSO. However, in the long term, national military or meteorological ATN Routing Domains could exist; the provision of addresses for these potential future Routing Domains may then avoid later reconsideration of the address structure.

As a possible approach for the provision of ATN internet addresses to the different national organisations, it is proposed that different ranges of values for the first octet of the ARS field be allocated to the different national organisations. As an example, it proposed that:

- 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.
- 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 organisation
- 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).*
- values [60-7f] of the first octet of the ARS field be reserved for the addressing of domains and systems operated by the national meteorological organisation
- values [80-ff] be reserved

A national organisation would then be proposed to register one or several values for the first octet of the ARS field within the range that has been reserved for its organisation category, and to freely allocate values to the remaining 2 octets of the ARS field.

In addition to be used for distinguishing the different national organisations, the first octets of the ARS field is proposed to be used for the identification of the particular role of the addressed domain. It is indeed a common practice in the ATC networking environment to have, in parallel to the operational networks, duplicate non-operational networks used for the trials and the pre-operational experiments. This double networking environment approach is likely to be followed for the ATN infrastructure of the national ATSOs (and possibly of other national organisations) and the first octet of the ARS field appears to be hierarchically well suited for distinguishing operational domains from other non-operational domains.

The remaining 2 octets of the ARS field should then be used to further distinguish between the Routing Domains of the same national organisation and of the same operational nature. The recommendation concerning the allocation of these 2 octets is to anticipate the possible evolution of the routing organisation and to allocate different values of the ARS field to different zones if these zones are perceived as subject to become independent Routing Domains in a further re-structuring of the routing organisation.

This recommendation requires some explanations, and is proposed to be illustrated by an example. Consider the French ATSO, and assume that its initial ATN infrastructure is planned to consist of one single RD covering the whole French territory. Assume then that this initial French ATN topology is expected to evolve toward a new routing organisation consisting of five RDs, one RD being formed around each of the five French ACCs and covering the related FIR.

A first solution for addressing the initial single French Routing Domain, would be to simply assign a single ARS field value for the identification of this Routing Domain. As an example, the ARS field value 000001 could be assigned. This would result in having all French ATN ESs and ISs within this RD configured with addresses the common prefix of which would be something like: 4700278183465200000001. At the time of the French ATN routing reorganisation, it would be necessary to allocate different ARS values to the new five different RDs. As an example, we may assume that these five different RDs could be respectively identified by the following ARS field values 00000a, 00000b, 00000c, 00000d and 00000e. One of the impact of the routing reorganisation, would consequently be the necessity to reconfigure every French ATN ESs and ISs, to have their internetwork address prefixes changed from 4700278183465200000001 to respectively 470027818346520000000a, 470027818346520000000b, 470027818346520000000c, 470027818346520000000d and 470027818346520000000e.

The purpose of the recommendation, with this example would have been to invite the French ATSO addressing authority to assign directly at the initial stage of the French ATN network, different ARS field values to the five different zones covering the French FIRs. As an example, the application of this recommendation could have resulted in having directly form the start, one of the following five different prefixes respectively used in each FIR for the addressing of the French ATN ESs and ISs: 4700278183465200000001, 4700278183465200000002, 4700278183465200000003, 4700278183465200000004 and 4700278183465200000005. In the initial period where the French ATN consists of one single RD used in an operational context, the 9-octets-long prefix 470027818346520000 which is common to these five 11-octets-long prefixes could then have been used as the Routing Domain Identifier and as the routing information advertised to adjacent Routing Domain (so meeting the requirements for information reduction). Then, at the time of the routing re-organisation with 5 routing domains, it would not be necessary to reconfigure every French ESs and ISs. The only change to be applied to the addressing would be to change the French RDI length from ten to eleven octets.

2.3.2.3.3 Proposed ARS field values assignment

On the basis of the recommendations expressed in the previous section, this section proposes a specific common approach for the assignment of ARS values by States. This is to be considered as a reference example, which could be looked at as a basis, and re-engineered taking into account the national particularities.

The States are proposed to reserve ranges of values of the first octet of the ARS field to the different national organisations as illustrated by the example of the previous section. It is proposed that the range matching the ASCII range of alphabetical upper case characters (i.e. [40-5F]) be allocated to airport operators.

It is proposed that national ATSOs, military organisations and meteorological organisations identify with each value of the first octet of the ARS field, a different set of Routing Domains as well as the operational nature of this set of Routing Domains. The following specific allocations are proposed for the value of the first octet of the ARS field:

- 01 for the set of operational Routing Domains of the national ATSO
- 11 for the set of non-operational Routing Domains of the national ATSO
- 21 for the set of operational Routing Domains of the national military organisation
- 31 for the set of non-operational Routing Domains of the national military organisation
- 61 for the set of operational Routing Domains of the national meteorological organisation
- 71 for the set of non-operational Routing Domains of the national meteorological organisation

It is proposed that the 2 remaining octets of the ARS field be used to contain a two alphabetical characters code identifying one particular zone, in the ATN topology of the organisation. As far as the ATSOs are concerned, it is proposed that this 2 alphabetical characters code be used to identify a FIR. Considering that the 4-letter ICAO location indicators are well known codes in the aeronautical community and that the 2 last characters identify unambiguously a FIR or ACC in the context of a given country, it is proposed that these 2 last characters of the 4-letter ICAO location indicators associated with each FIR or ACC be used as value for the 2 last characters of the ARS field. The table 4 below illustrates this proposal.

Country/organisation	FIR/ACC	proposed ARS field value	comment
Belgium	Brussels	014255	ATSO+operational+’BU’
France	Brest	015252	ATSO+operational+’’RR’
	Bordeaux	014242	ATSO+operational+’BB’
	Aix	014D4D	ATSO+operational+’MM’
	Paris	014646	ATSO+operational+’FF’
	Reims	014545	ATSO+operational+’EE’
Germany	Berlin	014242	ATSO+operational+’BB’
	Bremen	015757	ATSO+operational+’WW’
	Dusseldorf	014C4C	ATSO+operational+’LL’
	Frankfurt	014646	ATSO+operational+’FF’
	Karlsruhe	01544B	ATSO+operational+’’TK’
	Munchen	014D4D	ATSO+operational+’MM’
Ireland	Dublin	014442	ATSO+operational+’DB’
	Shannon	01534E	ATSO+operational+’SN
Italy	Brindisi	014242	ATSO+operational+’BB’
	Milan	014D4D	ATSO+operational+’MM’
	Rome	015252	ATSO+operational+’RR’
	Padua	015050	ATSO+operational+’PP’
Netherlands	Amsterdam	041411	ATSO+operational+’AA’
Portugal	Lisbon	015043	ATSO+operational+’PC’
Spain	Barcelona	014342	ATSO+operational+’CB’
	Canarias	014343	ATSO+operational+’CC’

	Madrid	01434D	ATSO+operational+'CM'
	Palma	014350	ATSO+operational+''CP'
	Seville	014353	ATSO+operational+'CS'
UK	London	015454	ATSO+operational+'TT'
	Manchester	014343	ATSO+operational+'CC'
	Scottish	015058	ATSO+operational+'PX'
Eurocontrol	Maastricht	014459	ATSO+operational+'DY'

Table 4: Proposed ARS Value Assignment for Fixed ATSO Entities

For the Airport operators, it is proposed that the ARS field value be derived from the three-character alphanumeric international code of the airports (e.g. 'CDG' for Paris-CDG Airport operator)

When used to identify a mobile ATSC Routing Domains, the ARS field will be set to the 24-bit ICAO Aircraft Identifier as specified in the ATN SARPs.

2.3.2.4 LOC field

In Ground Network Addressing Domains (i.e. for the ATN NSAP address prefixes 47 0027 01 and 47 0027 81) the purpose of the LOC field is to distinguish routing areas within the same routing domain. In Mobile Network Addressing Domains (i.e. for the ATN NSAP address prefixes 47 0027 41 and 47 0027 c1) the purpose of the LOC field is to distinguish routing areas within the same routing domain, if only one routing domain exists onboard the aircraft. When more than one RD is located on a single aircraft, the LOC field distinguishes each such RD and the routing areas contained within them.

The assignment of the LOC field value is under the responsibility of the organisation which constitutes the addressing authority for the routing domain in which the identified routing area is contained. The assignment of the LOC field value is entirely a matter local to the organisation and mainly depends on the intra routing domain organisation; it is therefore difficult to recommend a common approach.

A routing area corresponds generally to one site, although it may happen that several areas are formed in one site or that one single area covers several sites.

The LOC field value must unambiguously identify an area in the context of one Routing Domain, but does not necessarily need to be unambiguous in the context of a group of Routing Domains. That means that an organisation operating several Routing Domains may assign the same LOC field value (e.g. 0001) to 2 different areas if these areas belong to different routing domains. However, it is generally preferred to assign well known sites/areas identifiers that are unambiguous in the context of the whole organisation rather than being only unambiguous in the context of a particular Routing Domain. Another common practice is to allocate different ranges of values to different categories of sites/areas. As an example, an ATSO may be willing to assign different ranges of LOC field values to en-route ACC areas, TMA and airports areas, technical services areas, and other areas.

2.3.2.5 SYS field

The SYS field is used to uniquely identify an ATN end or intermediate system within a given routing area. The assignment of the SYS field value is under the responsibility of the organisation which constitutes the addressing authority for the routing area in which the identified ATN system is contained.

The SYS field should be assigned a meaningful value within the context of the given routing area. For example, if the ATN system is attached to an IEEE 802 local area network, then a common approach is to use the LAN address of the system as the value of the SYS field. However this is generally not considered as being a good practice: one important criterion in selecting a Network address format is indeed the likely future stability of the resultant Network address, and this stability is best achieved by allocating a Network address which does not contain any subnetwork dependent information; use of physical subnetwork addresses in the SYS field, may mean that the NSAP address will have to be changed, if the hardware supporting the addressed system is replaced (e.g. replacement of an ethernet card or of the whole computer),

In addition to constitute the unique identifier of a system within a routing area, the 6 octets of the SYS field may be used to encode different information on the system. Possible examples of the information that can be encoded in the SYS field are:

- Whether the system is an IS or an ES
- The class (1 to 7) of an IS.
- The standby role of the system (primary system, Hot standby system, cold standby system)
- The type of the applications running on the system (e.g. Network Management station, AMHS User Agent, Air/Ground application server, etc...)

2.3.2.6 SEL field

The N-SEL field is used to identify either a network layer entity (such as the IDRP protocol machine) or a network service user within the context of a given ATN system. The assignment of the N-SEL field value is a matter local to the administrator of the ATN system, except for the cases of the NET of an intermediate system. For these cases, Chapter 5.4 of the Manual of Technical Provisions for the ATN has assigned appropriate N-SEL field values:

- 00 must be used as selector value for the NET of all ATN ISs, except for the case of airborne ISs implementing the procedures for the optional non-use of IDRP
- FE must be used as selector value for the NET of all airborne ISs implementing the procedures for the optional non-use of IDRP
- the value FF is reserved and must not be allocated.

3. Guidelines for the naming and addressing of applications in European ATN systems

3.1 Introduction

In addition to the internetwork addressing plan which defines the way the network addresses of the ATN systems should be built, the way ATN application names and addresses should be assigned must be considered in the European ATN Addressing and Naming Plan.

An addressing and naming framework has been well defined in the ATN SARPs leading to the definition of the structure of application names and addresses for ATN applications. The ATN Comprehensive Manual document (CAMAL, ref) provides in addition some guidelines on how this structure has to be used.

Section 3.2 introduces the main concepts which are presented in these two ICAO documents to fulfil the needs for naming and addressing application objects in the ATN environment. Two kinds of ATN applications have been clearly distinguished, the AMHS application and the other ATN applications, since they are integrated in two separate upper layer architectures.

Section 3.3 reviews the few areas of the ATN application naming and addressing scheme where regional or local decisions may be taken.

3.2 Application Naming and Addressing Principles and Concepts

3.2.1 General

ATN is based on the OSI Basic Reference Model which defines the fundamental components of a open communication system such as the end systems, the application processes and the application entities. Figure 3-1 provides a simplified view of these components in the upper layer architecture of an end system based on the assumptions made for the air-ground applications (e.g. both Presentation and Session selectors are empty).

An **End System** is defined as a real system (i.e. a set of one or more computers, the associated software, peripherals, terminals, human operators, etc…) being the ultimate source or destination of data involved in the communication function.

In a given end system, **Application Processes** (APs) are the elements which perform the information processing for a particular application.

Application processes in different end systems may need to co-operate in order to perform information processing for a particular application. For this purpose they include and make use of communication capabilities which are conceptualised as **Application Entities** (AEs).

Naming and addressing of these components are essential to the success of the communication system. In particular, it is a basic requirement that an end system, however complex its internal structure may be, shows a simple naming and addressing structure to the communication environment, so that it may be easily accessible by any other end system. This applies of course to the ATN communication system.

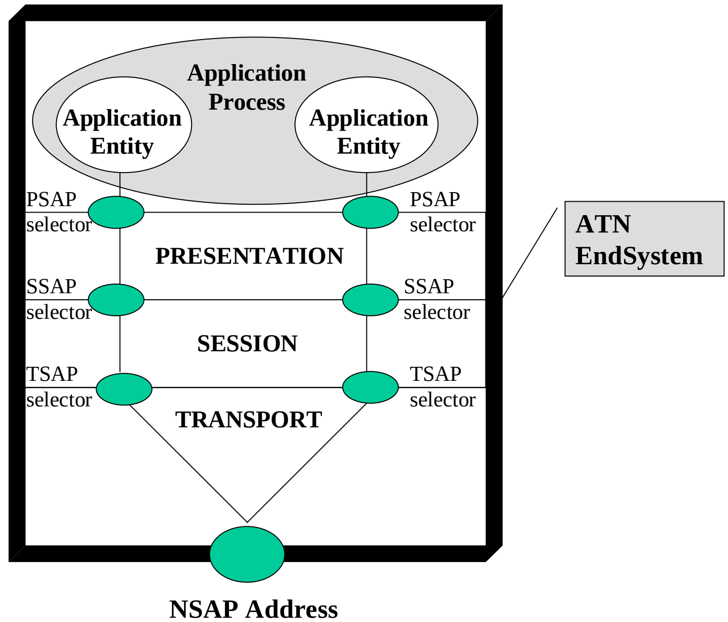

Figure 3-1: Overview of the Upper Layer Architecture of an ATN End System

The global scheme defined for naming ATN application entities and application processes is illustrated in Figure 3-2. This scheme allows in addition to identify unambiguously the version number of the CNS/ATM-1 application.

The next section explains how to interpret this naming scheme.

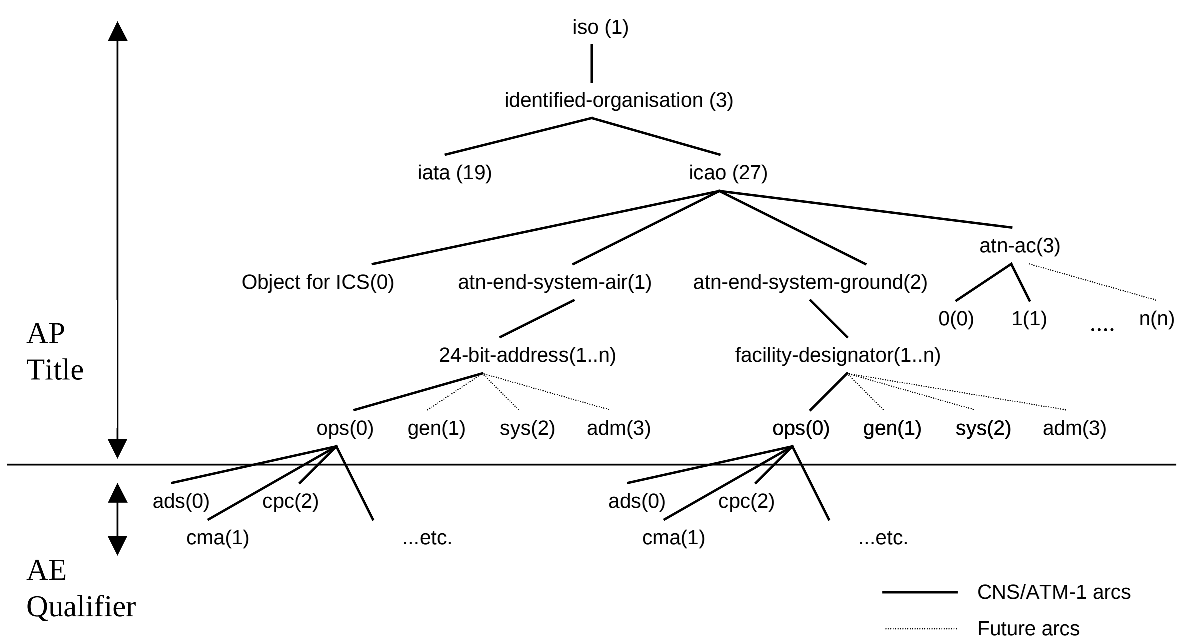

Figure 3-2: ATN Naming Hierarchy

3.2.2 ATN End Systems

A single end system is named by one and only one **system-title**. A system-title is a layer independent name, i.e. the same identifier is used within various layers to identify the same real open system.

In the ATN communication system, system titles assigned to ATN air end systems are the "24-bit ICAO aircraft identifier" and system titles assigned to ATN ground end systems are the "ICAO facility designation“[2].

The ICAO facility designation includes:

- as a mandatory field, a location indicator coded on 4 characters (the first or two first characters identify the country), as defined in ICAO Doc. 7910 [ICA12]]. Some examples are provided in the following table:

"LFBO"	TOULOUSE/BLAGNAC, France
"LIJJ"	ROMA (CAA), Italy
"EISN"	SHANNON (ACC/UACC/FIR/UIR), Ireland
"EHAM"	AMSTERDAM /SCHIPHOL, Netherlands
"EDDM"	MUNCHEN, Germany
"LEPA"	PALMA DE MALLORCA, Spain

- as an optional field, an organisation indicator coded on 3 or 4 characters, the 3 first characters identifying the aeronautical authorities or services, as defined in ICAO Doc 8585 [ICA13]]. Some examples are provided in the following table:

"YAY"	Government Civil Aviation Authority
"YBY"	Meteorological Operational Telecommunications Network Europe (MOTNE)
"YCY"	Rescue Co-ordination Centre
"YDY"	Authority supervising the aerodrome
"ZBZ"	Repetitive Flight Plan Office
"ZDZ"	Air Traffic Flow Control Unit
"ZIZ"	Flight Information Centre
"ZTZ"	Control Tower

3.2.3 Application Processes

Application processes are identified by **Application Process Titles** (APT) that are unambiguous throughout the ATN environment. An ATN APT is a single name the internal structure of which being specified by ICAO in the ULCS SARPs [ICA10]].

The ATN ULCS SARPs [ICA10] mandate the ASN.1 Object Identifier (OID) format for naming application processes. An Object Identifier is a sequence of integer values which may be represented as a tree of values. The Object Identifier Tree defined for application naming purpose in the ATN is illustrated in Figure 3-2.

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2 The terms « Ground facility designation » and « Ground facility designator » are both used in the ICAO SARPs.

ISO/IEC 8824-1 [ISO2] specifies the top of the hierarchical OID name space. At the first level, provision is made for ISO, International Telecommunication Union - Telecommunication Standardisation Sector (ITU-T) and joint ISO/ITU-T sub-name spaces.

The ISO name space is further subdivided into:

a) standard (0),

b) registration-authority (1),

c) member-body (2), and

d) identified-organisation (3).

ICAO has requested and obtained the allocation of an International Code Designation (ICD). The ICD obtained, name and number "icao (27)", uniquely identifies ICAO and allows ICAO to establish its own object identifier space within the International Organisation arc using the prefix { iso (1) identified-organisation (3) icao (27)}. Similarly, IATA has obtained an ICD of "iata (19)" in order to manage application names for AOC/AAC applications.

Immediately under the ICAO arc, the value "atn-end-system-air (1)" or "atn-end-system-ground (2)" identifies the type of the end-system.

The next element, <end-system-id>, is the system-title identifying unambiguously the end system within the aeronautical community. <end-system-id> is the ICAO 24-bit address for aircraft end systems, or the ICAO facility designation for ground end systems. (n) is an integer derived from the <end-system-id> (the way the integer value is computed from the 24-bit address or the 8 character string is detailed in the ULCS SARPs).

Immediately beneath the <end-system-id> arc is an arc whose value is determined by the category of the ATN application. For the present, only the following names and values are defined for the application category:

a) operational (0).

Additional values are reserved for other types of application (general(1), system(2) and administrative(3)).

Thus, the ATN Application Process Title is of one of the following form:

{ iso (1) identified-organisation (3) icao (27) atn-end-system-air (1) <end-system-id> (n) operational (0) }

or:

{ iso (1) identified-organisation (3) icao (27) atn-end-system-ground (2) <end-system-id> (n) operational (0) }

Examples of OID values for AP Titles and their encodings are given in the following table.

Entity	Object Identifier	PER Encoding (Hex)
AP-title for airborne ATC applications	{ iso (1) identified-organisation (3) icao (27) atn-end-system-air (1) 000000011011011001100110 (112,230) operational (0) }	2B 1B 01 86 EC 66 00
AP-title for ground ATC applications in Paris LFPO	{ iso (1) identified-organisation (3) icao (27) atn-end-system-ground (2) LFPOLHX operational (0) }	2B 1B 02 8C 86 90 8F 84 8C 88 18 00

3.2.4 Application Entities

Application entities are identified by **Application Entity Title** (AET) that are unambiguous throughout the ATN environment. An AET is composed of an APT and an Application Entity Qualifier (AEQ). The division into two components permits the user of an AET to obtain information specific to the application process or to the application entity. The AEQ is unambiguous within the scope of the application process.

The ATN ULCS SARPs [ICA10] mandates the ASN.1 Object Identifier (OID) format for naming application entities. This format is illustrated in Figure 3-2.

The AE Qualifier component of the AE Title is an INTEGER type. ICAO has assigned values for the initial set of ATN applications as follows:

a) Automatic Dependent Surveillance application: "ads (0)",

b) Context Management application: "cma (1)",

c) Controller Pilot Data Link Communication application: "cpc (2)",

d) Automatic Terminal Information Services (ATIS) application: "ati (3)",

e) Type A Gateway application: "gwa (4)",

f) Systems Management application: "sma (5)",

g) ATS Inter-Facility Data Communications (AIDC) application : "idc (6)",

h) ATS Message application: "ams (7)",

i) AFTN-AMHS Gateway application: "gwb (8)",

j) ATS Message User Agent: "aua (9)", and

k) ADS Report Forwarding application: "arf (10)".

Thus, the ATN Application Entity Title is of one of the following form:

{ iso (1) identified-organisation (3) icao (27) atn-end-system-air (1) <end-system-id> (n) operational (0) <ae-qualifier> (m) } or: { iso (1) identified-organisation (3) icao (27) atn-end-system-ground (2) <end-system-id> (n) operational (0) <ae-qualifier> (m) }

Examples of OID values for AE Titles and their encodings are given in the following table.

Entity	Object Identifier	PER Encoding (Hex)
AE-title for ADS-air	{ iso (1) identified-organisation (3) icao (27) atn-end-system-air (1) 000000011011011001100110 (112,230) operational (0) ads (0) }	2B 1B 01 86 EC 66 00 00

AE-title for CM-ground	{ iso (1) identified-organisation (3) icao (27) atn-end-system-ground (2) LFPODLHX operational (0) cm (1)}	2B 1B 02 8C 86 90 8F 84 8C 88 18 00 01

Note. As a consequence of this naming scheme, all the ESs installed in a ground facility or in an aircraft have the same system-title. It is therefore not possible to identify separately two end systems at the application level. In fact, this is not needed since it is foreseen that only one instance of application will be operational at any time on a single machine. Therefore, it will not be necessary to identify the application X on the machine Y of the ground facility Z but only the application X running in the ground facility Z.

However, there is one exception. One System Management Agent will be installed on all machines (ES and IS). The SM Managers should be able to communicate with each of the agents of the same ground facility. Therefore each SM Agent in the ground facility shall be assigned a unique name. A Defect Problem form has been raised against the SARPs to address this particular issue.

3.2.5 Application Address

Each application entity is associated with one PSAP and hence the AET is associated with the corresponding application address or **PSAP Address**. The PSAP address consists in the following tuple: ATN NSAP address, TSAP selector, SSAP selector and PSAP selector.

For the initial version of ATN, there is no upper layer addressing. All upper layer selectors are necessarily absent. As there are no presentation or session selectors, the PSAP address is identical to the TSAP address. All addressing of the AE-type is complete with the **TSAP address**. The TSAP Address is an NSAP address and a TSAP selector.

The format of the **NSAP address** and the associated registration procedures are described in chapter 2 of this document.

The **TSAP selector** is administrated on a local basis. The ATN SARPs do not assign values to TSAP selector. Only the format of the selector is defined: an ATN TSAP selector shall be either one or two octets in length and shall contain an unsigned binary number in the range 0 to 65535. The TSAP selector value is unambiguous within the scope of the end system.

3.2.6 Application Context Name

In addition to the AE title, the ATN naming scheme allows to identify unambiguously Application Context Names. The Application Context Name is used to indicate the version and the policy aspects relative to the AE with which it is associated.

Application Context Names have the following structure:

{iso(1) identified-organisation(3) icao(27) atn-ac(3) version-<n>(n)} where n is an integer in the range 0.255.

3.2.7 Registration Procedures

It is of utmost importance that names be unambiguous within the environment in which they are used. To effect this, registration mechanisms are used, whereby authority is given to some organisation to hold a register of names for objects of some given type. It is of the responsibility of such authority to ensure non-ambiguity, i.e. that different objects have different names.

The operation of naming within ATN requires the establishment of registration procedures:

a) for the assignment of titles which are unambiguous throughout the ATN for the following objects:

(1) System title,

(2) Application process title, and

(3) Application entity title,

b) for the assignment of other applications objects not related to naming and addressing such as the application context name or the abstract syntaxes, and

c) for the assignment of some ATN NSAP addresses components

The registration authority for the ATN objects listed above is ICAO.

The definition of rules for the allocation of values to non-ATSC application objects is considered to be out of the scope of this document (this falls within the competence of IATA and the European airlines).

3.2.8 The AMHS Application

The AMHS application must be studied apart from the ATN air-ground applications and the AIDC application. Indeed, the protocol stack used to support the communication of the AMHS application is different[3] and leads to the definition of a specific naming and addressing scheme.

3.2.8.1 The AMHS Naming Scheme

The ATS Message Handling System is made of a set of ATS Message Transfer Agent (MTA), ATS Message User Agents (UA), Message store (MS) and Access Unit (AU):

- interconnected MTAs form the MHS backbone in which messages are routed from the initiating MTA to the recipient MTA. An AE is defined to support the communication capability of the MTA. This AE contains the ACSE (Association Control), RTSE (Reliable Transfer) and MTSE (Message Transfer).

- User Agents are the interface between the AMHS user and the set of MTAs. An AE is defined to support the communication capability of the UA.

- Message Stores provide a storage capability allowing the UA to retrieve messages stored in the MS at its convenience. MSs communicate locally with the UA and the MTA.

- Access Units define an interface with non-MHS technologies. The AFTN/AMHS gateway is the only UA defined currently in the SARPs. AUs communicate locally with the MTA.

The AMHS naming addresses two different aspects:

- naming of AMHS users, which is made by means of O/R names (i.e. Originator/Recipient names), and

- naming of the application processes and application entities in the ATN end systems participating in the AMHS, i.e. the application entities of the MTAs and UAs involved in the transfer of the message from the originator to the recipient.

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[3] The AMHS application makes use of the communication services provided by an OSI Upper Layer full stack implementing the full functionality of both the OSI Session and the OSI Presentation.

3.2.8.1.1 Naming of AMHS Users

The form selected for the ATN O/R Name is the one denominated MF-address (MHS-form address). Any AMHS SARPs compliant system is requested to support this form of O/R Name.

An addressing scheme is required to specify the selected structure of the MF-address. The selection of the AMHS addressing scheme is usually a matter of policy local to each AMHS management domain. This addressing scheme may be either local to one domain or common to several domains.

A common AMHS addressing scheme is defined in the ICAO AMHS SARPs [ICA14], in which a specific structure of the MF-address (the so-called "XF-address") allows a direct mapping between the AFTN addresses and the AMHS O/R names. AMHS domains managing an interface with the AFTN world have to support this form of MF-address.

The XF-Address comprises exclusively the following attributes:

a) C (country-name) = either of the following

   1) two-characters alphabetical country indicator as specified in ISO 3166,

   2) three-digit data-country-code as specified in CCITT recommendation X.121, or

   3) the two-letter alphabetical value reserved for international registration.

b) A (administrative-management-domain-name) = ADMD name or single space,

c) P (private-management-domain-name) = PRMD name (present only if the AMHS Management Domain operates as a PRMD),

d) O (organisation-unit) = "AFTN", and

e) OU1 (organisational-unit-name) = 8-letter ICAO AFTN address.

The top part of the MF-address (i.e. fields C, A and P) should be subject to international agreements since it is used as routing criteria by the MTAs involved in the transfer of the AMHS message. The bottom part of the MF-address is domain-dependent since it is used within the target private domain to identify the target MTA.

3.2.8.1.2 Naming of Application Processes and Entities

Each application entity participating in the AMHS is identified with an Application Entity Title. The values of the OID's arcs are defined consistently with the naming provisions specified in the ULCS SARPs and described in chapter 3.2, in particular a value for the AE qualifiers has been assigned for the different ATSMHS applications.

3.2.8.2 The AMHS Addressing Scheme

The PSAP address of the MTA systems is a full OSI address, i.e. it includes an NSAP address, a Transport selector, a Session selector and a Presentation selector. These PSAP addresses are assigned to the MTA Application Entities and used to establish presentation connections between MTAs.

The address of the recipient' UA depends on the type of protocol implemented between the UA and the ATS Message Server of the delivering MTA. The type and the assigned value are therefore a local matter and no instructions or guidelines are needed for their construction.

3.3 Proposed European ATN Application Naming and Addressing Plan

3.3.1 Application Naming Plan

The European ATN application naming plan must conform to the ATN naming hierarchy specified in the ATN SARPs.

As shown in Figure 3-2, the only variable fields of the APTs and AETs are the <end-system-id> and the AE qualifier. The <end-system-id> values are fully specified for the ground systems in ICAO documentation 7910 and 8585 and for the aircraft systems by the ICAO 24-bit aircraft address.

As far as the AEQ is concerned, only an initial set of values has been standardised by ICAO. With the introduction of new applications, new values will have to be defined. The ATN applications supporting the data link services identified in ACCESS WP 202 for the European ATN will have to be assigned an already standardised value.

The ATN application naming scheme defines actually a closed application name structure, in that the system designers/administrators have no choice in the way the applications they build/manage are named. The application names are logically deduced from the geographical location of the system hosting the application and from the type of the application, the values of these two parameters being pre-defined.

As a consequence, this document does not provide any guidelines on how values can be assigned to the application objects of the European ATN but only provides information about their structure.

3.3.2 Application Addressing Plan

As mentioned before, the ATN internetwork addressing plan is completely defined through the assignment of the NSAP addresses. Chapter 2.3 of this document has proposed some assignment principles for the variable fields of the NSAP address in the scope of the European ATN.

The last field to be allocated to obtain a complete PSAP address for ATN air-ground applications and the AIDC application is the TSAP selector. The allocation of this field is left open to the system administrators since the scope of the selector is limited to the end-system itself. Moreover, there is no requirement for an ATN system to know a priori the TSAP selectors assigned to a given remote system, since the entire PSAP addresses are dynamically made available through the Context Management application.

Therefore there is no need, even in the European ATN context, to force the use of certain values for the TSAP selectors.

The only exception to this rule might be encountered for the initial address used by the Context Management application. In order to avoid the maintenance of a CM address data base in the aircraft, the proposal to define a "logical CM application address" identifying the CM Application Entity in a given ground facility is being discussed at ICAO level. If this proposal is accepted, a TSAP selector for the CM application entity will have to be unilaterally selected, e.g. the zero value encoded in a single octet.

It is recommended that a default value be assigned in any ATN end-system identified in the European ATN Naming and Addressing Plan to the CM Application Entity as its TSAP selector[4].

[4] This topic is being discussed by ATNP Working Groups. A « logical » NSAP address for CM would allow the calling end system to build logically the adress of the peer CM without having to maintain an addressing data base on-board. Investigations are being carried out to find out how the fields of the NSAP address could be assigned logical values.

Note. The default value could be for instance "0x00".

3.3.3 The AMHS Application

The allocation of the NSAP addresses obeys the rules defined in chapter 2 of this document. The allocation of the Transport, Session and Presentation selectors is considered as a local matter for the organisations responsible of AMHS systems.

The AMHS addressing schemes in place in Europe will have to be based on the structure of the MF-address specified in the ATN SARPs. The schemes selected will depend on factors such as the organisation of European AMHS in administrative and private domains and the internal organisation of these private domains. Very few requirements are defined on the AMHS schemes and an almost total freedom of specification is left to the AMHS administrators.

However, communication may be eased by the adoption of common schemes, whereby the address of an intended recipient can be deduced by an originator, based on commonly agreed logical rules. It is why the ICAO sub-group editor of the AMHS SARPs has been tasked to produce guidelines for the definition of addressing scheme by AMHS Management Domain administrators. Also European projects (e.g. SPACE) have been launched to propose a Common AMHS addressing scheme suitable for Europe. Therefore it seems premature to propose an AMHS addressing scheme in the scope of this ACCESS WP before the results of the studies mentioned above are known.

Appendix A - Acronyms

AAC	Aeronautical Administrative Communications
ACC	Area Control Centre
AFTN	Aeronautical Fixed Telecommunication Network
AINSC	Aeronautical Industry Service Communications
AOC	Aeronautical Operational Communications
APC	Aeronautical Passenger Communications
ATC	Air Traffic Control
ATM	Air Traffic Management
ATN	Aeronautical Telecommunication Network
ATS	Air Traffic Services
ATSC	Air Traffic Services Communications
ATSO	Air Traffic Services Organisation
AU	Access Unit
BIS	Boundary Intermediate System
CAA	Civil Aviation Authority
CLNP	Connection-Less Network Protocol
ECAC	European Civil Aviation Conference
ES	End System
IACSP	International Aeronautical Communications Service Provider
ICAO	International Civil Aviation Organisation
IDRP	Inter Domain Routing Protocol
IS	Intermediate System
METAR	Meteorological Actual Report
MS	Message Store
MTA	Message Transfer Agent
NSAP	Network Service Access Point
OSI	Open System Interconnection
RD	Routing Domain
RD	Routing Domain Identifier
RDC	Routing Domain Confederation
RDCI	Routing Domain Confederation Identifier
SARPs	Standard And Recommended Practices
SIGMET	Significant Meteorological Information
SM	System Management
TAF	Terminal Area Forecast
UA	User Agent