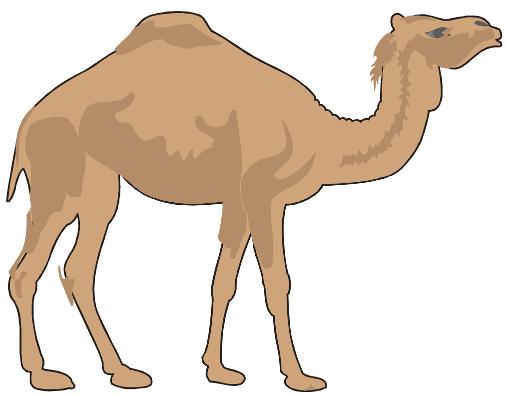
Aeronautical Telecommunication Network (ATN)

Comprehensive ATN Manual (CAMAL)

Part I
Introduction and Overview



Editor's Draft (January 1999)

The preparation of this document has been on a "best efforts" basis and no warrantee is offered as to its correctness..

This PDF version has been prepared for the ATNP Working Groups by FANS Information Services Ltd - http://www.fans-is.com
Please check our Web Site regularly for information on updates to the SARPs and Guidance Material

9th January 1999

PART I

TABLE OF CONTENTS

1. *Introduction*

1.1 Background

1.1.1 In the early 1980s, the international civil aviation community started to express concern about the limitations of existing facilities and procedures and their inability to cope with increasing air traffic in future years. Consequently, a special committee, called the Special Committee on Future Air Navigation Systems (FANS), was established by the ICAO Council in 1983 to study, identify and assess new concepts and new technology in the field of air navigation, including satellite technology, and to make recommendations thereon for the development of air navigation for international civil aviation over a period of twenty-five years.

1.1.2 A major result of the work of the FANS Committee was the global communications, navigation, and surveillance/air traffic management (CNS/ATM) systems concept which identified the use of data communications and of satellite-based systems as being the two major areas of improvement to the then existing systems.

1.1.3 The global CNS/ATM systems concept was consequently endorsed by the Tenth Air Navigation Conference in 1991. The systems concept was further developed and refined by the Phase II of the FANS Committee which concluded its work in 1993. Furthermore, noting the fact that some implementation activities had begun, the name "global CNS/ATM systems concept" was changed to "CNS/ATM systems". The aeronautical telecommunication network (ATN) is an integral part of the CNS/ATM systems.

1.1.4 In February 1993, the Air Navigation Commission (ANC) established the Aeronautical Telecommunication Network Panel (ATNP) to develop Standards and Recommended Practices (SARPs), (commonly called the CNS/ATM-1 Package) guidance material and other relevant documents for the ATN. The first set of ATN SARPs was finalized at the second meeting of the ATN Panel in November 1996.

1.1.5 In 1997 the ANC requested the ATN Panel to consolidate all ATN guidance material into a single comprehensive document. This document is the result of that consolidation and is known as the Comprehensive ATN Manual.

1.2 Purpose

This document is intended to assist ATN-related planning and implementation activities undertaken at all organizational levels covering States, regional planning and implementation groups, aircraft operating agencies, international aeronautical communication service providers (IACSP), systems implementors and other interested parties.

1.3 Scope

1.3.1 The ATN comprises application entities and communication services which allow ground, air-to-ground and avionics data subnetworks to interoperate. This is done by adopting common interface services and protocols based on International Standards. The ATN has been designed to provide data communications services to Air Traffic Service provider organizations and Aircraft Operating agencies for the following types of communications traffic:

a) air traffic services communication (ATSC);

b) aeronautical operational control (AOC);

c) aeronautical administrative communication (AAC); and

d) aeronautical passenger communication (APC).

1.3.2 The guidance material in this document covers the following:

a) essential planning guidelines for ATN users and providers;

b) detailed guidance on the implementation of ATN SARPs contained in Annex 10; and

c) guidelines on ongoing activities that are necessary for the use and/or provision of ATN services.

1.4 Overall document organization

1.4.1 The document is divided into four Parts:

PART I	Introduction and Overview
PART II	System Level Considerations
PART III	Applications Guidance Material
PART IV	ATN Communications Services

1.5 Organization of PART I — Introduction and Overview

1.5.1 Chapter 1 is the introduction.

1.5.2 Chapter 2 describes the operational benefits that can be derived from the use of ATN. It should be noted that benefits will be achieved through the use of ATN applications, and not by the underlying network. In addition, it is pointed out that a cost/benefit analysis must be based on the whole solution, i.e. the benefits which are achieved through the enhancement of ATM services provided by the ATN while taking into account costs associated with implementing and operating both the underlying network and the applications.

1.5.3 Chapter 3 describes the ATN concept, basic design and the associated terminology.

1.5.4 Chapter 4 identifies specific planning and administrative tasks required for the ATN implementation process and its associated ongoing activities. Guidance is provided to all management tasks which should be performed to establish an ATN installation and to connect it to the network(s). This chapter also highlights the general implementation process and gives an overview of the issues which should be considered in each stage of that process.

1.5.5 Chapter 5 contains lists of some commonly-used abbreviations and definitions.

— — — — — — — —

2. *Operational Benefits*

2.1 This chapter presents the operational objectives that were considered during the development of the ATN. It also defines the features of the ATN that support those objectives. The material helps the planner assess the ATN in the specific operational context (within a given region or State) and determines the expected benefits.

2.2 As air traffic increases, it becomes apparent that the existing air traffic management (ATM) systems should be enhanced. In particular:

a) increased use of distributed ATM automation requires an increased level of computer-to-computer data interchange. This includes data communication between aircraft-based and ground-based computers serving mobile and fixed users;

b) increased levels of distributed ATM automation require a more integrated communications infrastructure than that which is in existence today, both in aircraft-based and ground-based environments; and

c) real success in ATM automation can only be achieved when aircraft-based computer systems are designed and implemented as data processing and networking peers to their respective ground-based computers, rather than continuing in their current role as independent processors, functioning in parallel, but with little data sharing with ground-based hosts.

2.3 ATN provides the data communication required to support this distributed ATM automation.

2.4 Compared to conventional voice communication systems, the ATN and its ATM applications offer the following benefits:

a) better clarity of communications resulting in reduced transmission and/or interpretation errors;

b) more efficient use of communication channels resulting in less air-ground radio channels and less dedicated lines on the ground;

c) possibility of connecting any two-end users (airborne or ground-based) in a global data communication network environment;

d) reduced workload for pilots, controllers and other personnel involved in ATM due to the availability of a variety of pre-formatted and stored messages; and

e) reduced requirements for multitude of communication systems by accommodating ATSC, AOC, AAC and APC.

2.5 The first set of Standards and Recommended Practices (SARPs) for the ATN, which is commonly referred to as the CNS/ATM-1 Package, offers real operational benefits to users and providers of air traffic services through the following applications:

a) air-ground applications

1) context management (CM);

2) automatic dependent surveillance (ADS);

3) controller-pilot data link communications (CPDLC);

4) flight information service (FIS); and

b) ground-ground applications

1) ATS message handling service (ATSMHS); and

2) ATS inter-facility data communications (AIDC).

2.5.1 Provisions have been made for AFTN/ATN gateways so that existing investments in AFTN can continue to be used during the transition period. Further guidance material on such gateways is provided in Part II of this document.

2.6 Aircraft Operations

2.6.1 The aircraft operators have been using data communication services (both air-ground and ground-ground) for many years, for aeronautical operational control (AOC) and aeronautical administrative communication (AAC). The airline ground communication services support ticket sales, flight planning, crew assignment, weather, and so on. They use a combination of standards and protocols and often use service of international aeronautical communication service providers (IACSPs). The airlines, through the International Air Transport Association (IATA), have developed and published a set of airline-preferred OSI profiles called the Aeronautical OSI Profile (AOP), which is available to be used over the ATN. The ATN offers more efficient bit-oriented protocol, reduces dependence on proprietary protocols, provides for more integrated applications and services, and standardizes applications. The ATN will also provide a standard network for communication between airlines and ATS units.

2.7 ATN Features contributing to Cost/Benefit Analysis

2.7.1 States and organizations, when planning for the implementation of ATN based ATS, may wish to undertake a cost/benefit analysis. The following features should be considered to determine the potential benefits afforded by the introduction of the ATN:

a) the ATN provides a single solution to satisfy a wide range of data communication needs. It therefore eliminates the need for multiple dedicated communication systems, each of which can only provide limited functionality;

b) the ATN provides robust communication services achieving higher availability and integrity, which would be necessary for improved operational capabilities (e.g. reduced aircraft separation);

c) the ATN architecture allows for the easy introduction of new applications;

d) the use of ATN-compliant data links would reduce congestion on the voice communication channels (studies conducted by one ICAO State have indicated significant reduction in communication induced delays for flight operations in high density en route and terminal airspace);

e) many operational benefits like reduced fuel consumption and flight time through the use of the ATN could be obtained;

f) the ATN provides a means to improve flight crew access to flight information;

g) the ATN provides a means to improve productivity of air traffic controllers and flight crews. It also reduces human errors by supporting automation tools; and

h) the ATN provides for the timely exchange of ATS information between ground facilities, potentially improving safety and productivity.

2.8 Transition issues

2.8.1 Provisions have been made so that existing AFTN and CIDIN could be used together with new ATN facilities and certain ground-ground applications. Also, air-ground data links and subnetworks developed, or being developed by ICAO, use common network access protocols allowing easy integration into a global ATN.

2.8.2 There are, however, some existing data communication systems used by aircraft operating agencies which have not been standardized by ICAO. One example of such existing systems is the aircraft communications addressing and reporting system (ACARS) which is extensively used for AAC and AOC. Some ATS providers are using ACARS for limited ATS applications like pre-departure clearance, ATIS and so on. These applications are character-based and are developed and refined by the industry.

2.8.3 An effort has been made by the industry to use new and more efficient bit-oriented ATM applications (e.g. ADS and CPDLC) over existing character-oriented ACARS air-ground data links and its associated ground networks. The results have been the development of FANS-1 avionics package (by BOEING) and similarly FANS-A (by AIRBUS).

2.8.4 The use of FANS-1/A in the interim period when the ATN was still under development has served as a valuable step towards the early introduction of ATM applications and gaining operational benefits as well as experience. However, ATN and its associated ATM applicaitons is the ultimate end state defined and standardized by ICAO.

2.8.5 The ATN provides advantages over FANS-1/A. Bandwidth is used more effectively. The routing protocols provide more efficient establishment and use of paths between the aircraft and air traffic centre. The integrity of data transmission is also improved. The ATN includes applications which are purpose-built for the ATN, are fully compatible and consistent with one another (e.g. address creation, version negotiation, etc.) and take full advantage of the ATN's communication services. These advantages will allow greater reliance on the use of datalink, particularly in areas of high traffic density.

2.8.6 Recognizing the need to accommodate FANS-1/A aircraft in ATN environments during the transition (to all ATN) period, some guidance material has been provided in Part II of this document to facilitate implementation activities.

— — — — — — — —

3. *ATN Concept*

3.1 ATN Functionality

3.1.1 From a data communication users point of view, the ATN offers a reliable, robust and high-integrity communication service between two computer systems (End Systems), either at a fixed location such as an ATS unit, or mobile such as an avionics end system, while taking into account requirements (e.g. transition paths, end-to-end delay etc.) expressed by supported applications.

3.1.2 The ATN is distinguished from other data communication systems because it:

a) is specifically and exclusively intended to provide data communication services for the aeronautical community, including ATS providers/users and the aeronautical industry;

b) provides communication services between ground and airborne systems as well as between multiple ground systems, whereby various mechanisms within the communication system (e.g. route selection) are transparent to the user;

c) provides a communication service which has been designed to meet the security and safety requirements of the application services;

d) accommodates various classes of service and message priorities required by various ATN applications; and

e) uses and integrates various aeronautical, commercial and public data networks into a global aeronautical communication infrastructure.

3.2 ATN Components

3.2.1 The ATN supports communication between:

a) airline systems and ATS systems;

b) airline and aircraft systems;

c) ATS and aircraft systems;

d) (ground) ATS systems; and

e) airline systems.

3.2.2 Figure 3-1 shows the basic structure of the ATN. There are a number of key points illustrated by this diagram:

a) the main infrastructure components of the ATN are the subnetworks, the ATN routers (intermediate systems or IS) and the end systems (ES);

b) a subnetwork is part of the communication network, but is not part of the ATN. It is defined as an independent communication network based on a particular communication technology (e.g. X.25 Packet-Switched Network) which is used as the physical means of transferring information between ATN systems. A variety of ground-ground as well as air-ground subnetworks provide the possibility of multiple data paths between end systems;

c) the ATN routers are responsible for connecting various types of subnetworks together. They route data packets across these subnetworks based on the requested class of service and on the current availability of the network infrastructure (e.g. suitable routes to the destination system); and

d) ATN end systems host the application services as well as the upper layer protocol stack in order to communicate with peer end systems.

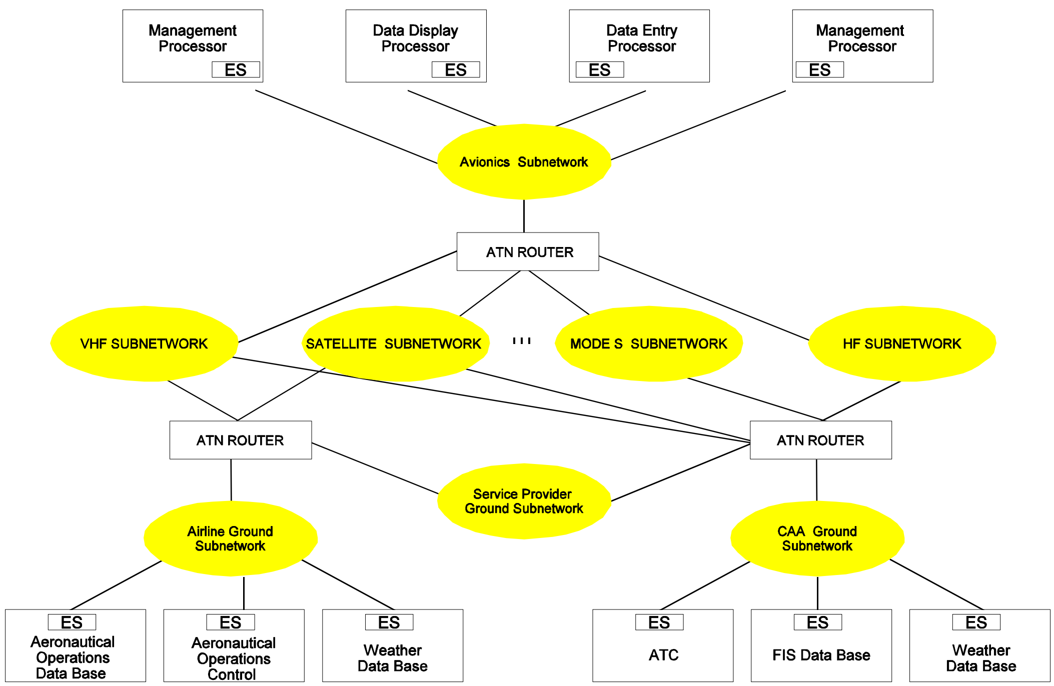


Figure 3-1. ATN data communication environment

Note.— ES designates an ATN End System

3.2.3 Figure 3-2 shows the constituent elements of both the ATN end system and intermediate system according to the OSI 7-layer reference model. Similarly, Figure 3-3 illustrates the end-to-end relationship over these layers.

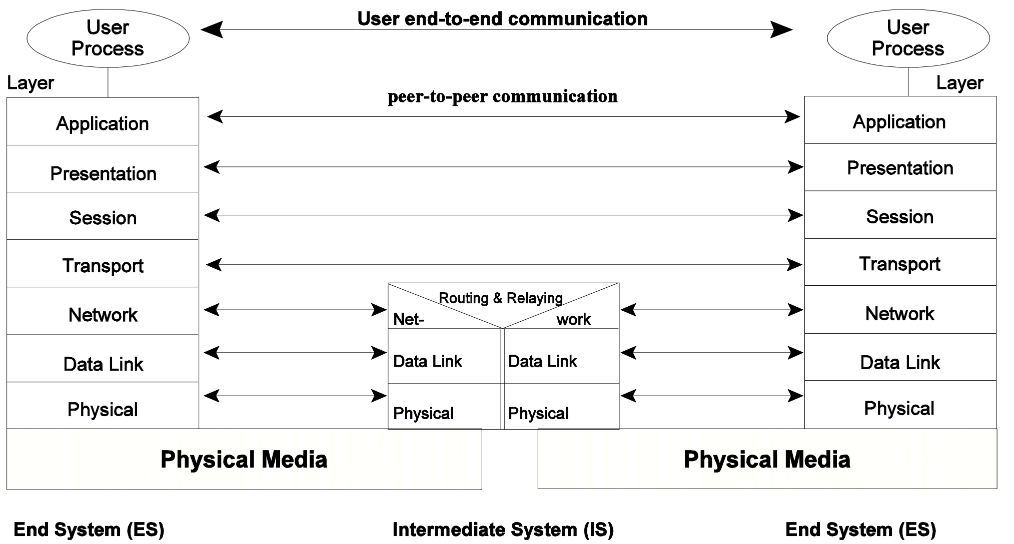


Figure 3-2. OSI reference model

3.3 End Systems

3.3.1 ATN end systems are capable of communicating with other ATN end systems to provide end-to-end communication services to ATN applications. For this purpose, the ATN end systems include a full 7-layer protocol stack to host the appropriate communication services in support of one or more ATN applications. ATN end systems are also the interface to automation and/or the human machine interface.

3.3.2 ATN routers

3.3.2.1 As an aircraft moves, the path through the network which must be taken to reach that aircraft will change. The ATN supports a dynamic routing process which allows the route information possessed by each router to be updated, both as a result of the movement of the aircraft and as a result of other changes in the network topology due to failures, maintenance activities and so on.

3.3.2.2 The routers are intermediate systems comprising the lower 3 layers of the OSI reference model and include, according to their type, the appropriate set of routing protocols. The routers are responsible for forwarding each packet containing the user data via the appropriate paths towards its destination, taking into account the particular service requirements encapsulated in the header of the packet. The choice of the appropriate subnetwork to be used, when forwarding data packets through the ATN, is based on connectivity, security and quality of service considerations and can be influenced by the application services. Furthermore ATN routers exchange routing information, i.e. information about available routes, their characteristics, and the end systems reachable via these routes, with other adjacent routers.

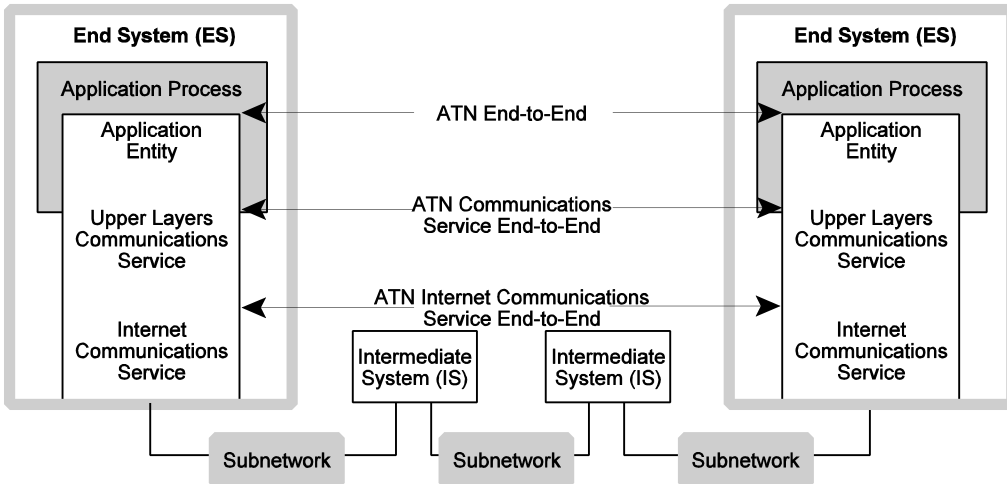


Figure 3-3. ATN data communication environment

3.3.2.3 The ATN distinguishes different types of routers by the number/types of protocols supported:

a) static or dynamic intra-domain routers (Intermediate System -IS); and

b) inter-domain routers (Boundary Intermediate System -BIS).

3.3.2.4 Routers of group a) above are for use only within an ATN routing domain and are local matters, i.e. not subject to international standardization, whereas those of group b) are required to provide ATN-compliant, standardized communication service to adjacent routing domains and other routers of the same type (i.e. BISs) within their own routing domain. If a group b) router encompasses in addition the functionality of an intra-domain router (i.e. group a) router), then this portion of its functionality is a local matter. Inter-domain routers have the capability to apply routing policies when disseminating routes to other BISs in neighbouring domains.

3.3.2.5 The key differences between an ATN inter-domain router and a standard OSI router are:

a) possibility of applying a specific set of routing policies in support of mobile communication (e.g. efficient air-ground routing);

b) support provided for ATN security functions;

c) use of compression for air-ground routers to increase the efficiency when using bandwidth-limited air-ground data links; and

d) support of route initiation and termination procedures to cater for the dynamic process of aircraft entering or leaving the coverage of the respective ground routing domain.

3.3.3 **Subnetworks**

3.3.3.1 Subnetworks may be distinguished as either ground-ground (fixed), air-ground (mobile) or airborne subnetworks. They can be separated into local area networks (LANs) and wide area networks (WANs). Typically LANs are used to interconnect ESs and ISs (e.g. within an ATC centre or within an aircraft) whereby WANs are classically used for more long-distance connections between ISs. The ATN router adapts the data packets to the specifics of the subnetwork for transfer between adjacent ATN systems. This concept of subnetwork dependent convergence of packets and protocol functions is essential to the versatility of the ATN.

3.3.3.2 Existing fixed and mobile data networks may be used as subnetworks within the ATN, thereby having the potential to significantly reduce the initial set-up cost of the ATN infrastructure, provided they meet certain minimum criteria like byte and code independence. In any case, the use of a certain subnetwork on one path does not impose a restriction to use a different subnetwork on another path.

3.3.3.3 ***Air-Ground (Mobile) Subnetworks***

3.3.3.3.1 A number of aeronautical mobile subnetworks (aeronautical mobile-satellite service (AMSS), very high frequency (VHF) digital link, SSR Mode S data link, and high frequency (HF) data link) have been or are being standardized by ICAO and are currently either under development or in use for air-ground communication.

3.3.3.3.2 These ATN-compatible air-ground subnetworks constitute an essential building block of the overall ATN. It will be the integration of these mobile subnetworks into the ATN that will enable major benefits for air traffic management. Depending on the particular implementation chosen for a certain region, some of these subnetworks may be accessed indirectly via a service provider. A further system to mention here is the Gatelink, a communication system which can be used when aircraft are parked at the gate (this system is not being standardized by ICAO).

3.3.3.4 ***Ground-Ground Subnetworks***

3.3.3.4.1 A number of networks for communication within ATS centres and between host computers of ATS centres are available. Such possible candidates for ATN subnetworks are LANs (e.g. Ethernet, Token Ring, fibre distributed data interface (FDDI)) and WANs (e.g. X.25, Frame Relay, asynchronous transfer mode (ATM) or integrated services digital network (ISDN)). In addition, common ICAO data interchange network (CIDIN), based on a modified X.25 communication service, may be used as an ATN subnetwork.

3.3.3.5 ***Avionics Subnetworks***

3.3.3.5.1 Similar to ground systems, a variety of communication networks are available for use within an aircraft. Possible candidates for ATN subnetworks are airborne LANs based on ARINC Specifications 429 (Williamsburg) and 629, Ethernet and FDDI.

3.4 ATN Physical and Administrative Structure

3.4.1 In order to simplify the implementation of large OSI networks, ISO has defined a routing framework which allows large scale networks to be designed and built in a modular fashion. This routing framework is applied to the ATN in order to provide the required structured approach to routing. The OSI routing framework, as applied to the ATN, recognizes that end systems, routers and networks are owned and operated by different organizations and therefore introduces two functional entities: the administrative domain and the routing domain. In general, there is no interdependence between these two, that is a routing domain (or routing domain confederation) may be different from an administrative domain but must be wholly contained within an administrative domain.

3.4.2 Routing Domain and Routing Domain Confederation

3.4.2.1 Each ATN provider operates one or more routing domains. Each routing domain will consist of one or more inter-domain (either air-ground or ground-ground) routers and one or more end systems. In addition, interconnection to other routing domains is typically required. Routing domains are thus elements of the physical structure of ATN (see Figure 3-4).

3.4.2.2 Adjacent administrations may combine their routing domains into a single routing domain (routing domain confederation), sharing a common policy, which can be treated by the "outside" world as a single entity for routing purposes. A routing domain confederation has its own unique routing domain identifier.

3.4.2.3 A routing domain can be characterized as follows:

a) inside the domain, connectivity and Quality of Service (QoS) information related to all internal systems (those systems which are located in the local routing domain), are exchanged between the intra-domain routers of the same level without restrictions;

b) inside the domain, the selected routes (the most preferred, routes to external systems which are located outside of the local domain) are advertized by a BIS router to all other BISs within this domain; and

c) the routes to internal systems (those systems which are located in the local routing domain) advertised to BISs outside the local domain are determined and controlled by the Routing Policy applied by the advertising BIS.

3.4.2.4 These principles ensure that the exchange of routing information within a routing domain occurs with a significant degree of trust between the systems. Conversely, inter-domain communication cannot assume a comparable level of trust and appropriate policies must be negotiated for use between two adjacent domains.

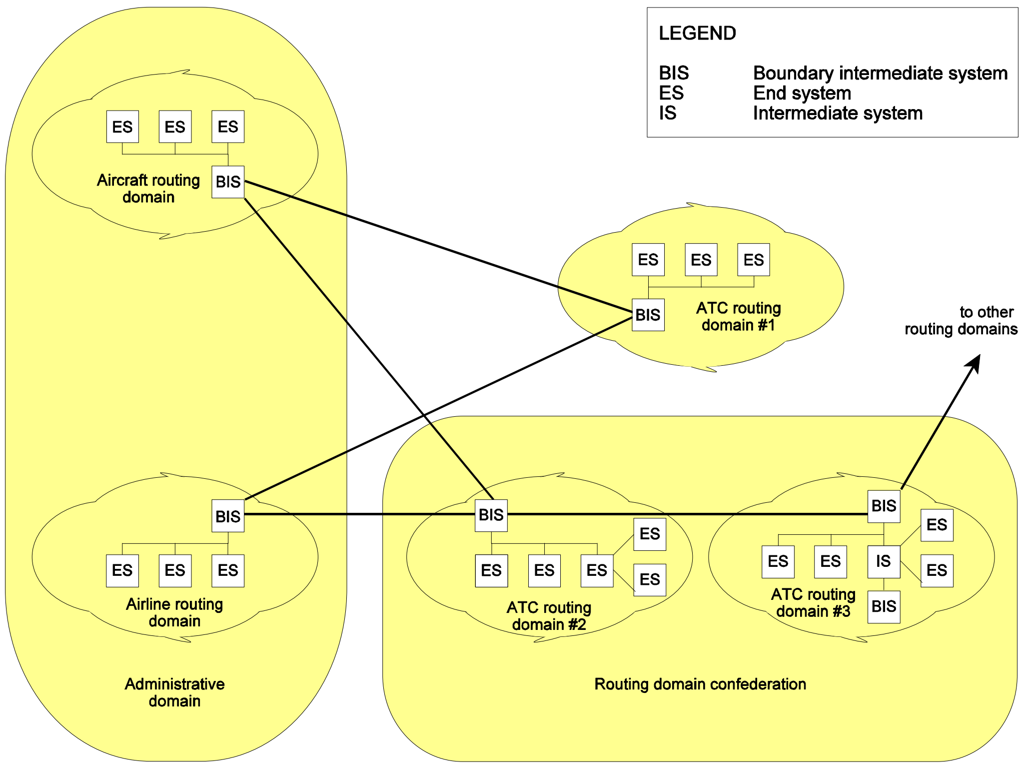


Figure 3-4. Example for an ATN domain structure

3.4.3 Administrative Domains

3.4.3.1 An administrative domain, which consists of multiple routing domains, is that part of the ATN which is administered by a single administrative organization or authority. The purpose of the administrative domain is to clearly indicate the domain of an organization's responsibility and to differentiate communication within an organization from communication between organizations. This administrative authority can be a civil administration authority (CAA), an ATS provider, an aircraft operating agency, or an international aeronautical communication service provider (IACSP).

3.4.4 Naming and Addressing

3.4.4.1 This section provides a short overview of the ATN naming and addressing concept and introduces the different types of names and addresses used within the ATN. A more detailed presentation of relevant ATN naming and addressing issues can be found in Part II of this document.

3.4.4.2 The ATN naming and addressing scheme is based on the OSI Basic Reference Model (ISO 7498-3 Naming and Addressing Addendum). It supports the principles of unique and unambiguous identification of ATN objects and global ATN address standardization which are essential for an international mixed-user communication system.

3.4.5 ATN Names and Addresses

3.4.5.1 Names are used to identify information objects (e.g. a system, a protocol, an application, etc.) while addresses are used to locate information objects. Names are generally expressed in a mnemonic format whereas addresses are generally expressed in a coded or numeric format in order to be directly used by hardware equipment (e.g. interface controllers) or automated algorithms (e.g. routing algorithms).

3.4.5.2 ATN addresses are used by the ATN communication protocols to identify the sender of a message, to locate the recipient of a message, and to determine the end points and intermediate points of paths through the network. These addresses have to be assigned to ATN information objects according to a globally unambiguous scheme.

3.4.5.3 The ATN information objects which require the assignment of unambiguous addresses are shown in Table 3-1:

Table 3-1. ATN Objects Requiring Unambiguous Addresses

ATN Object	Generic Address
Subnetwork Access Point	Subnetwork Point of Attachment (SNPA) Address
Network Layer Entities	Network Entity Title (NET)[1]
Network Service Users	Network Service Access Point (NSAP) Address
Transport Service Users	Transport Service Access Point (TSAP) Address
Session Service Users	Session Service Access Point (SSAP) Address
ATN Applications	Presentation Service Access Point (PSAP) Address

[1] According to ISO 7498-3, network layer entities are both named and located by their NET

3.4.5.4 Table 3-2 lists those ATN information objects which require the assignment of unambiguous names:

Table 3-2. ATN Elements Requiring Unambiguous Names

ATN Object	Generic Name
Network Layer Entities	Network Entity Title (NET)
Routing Domains	Routing Domain Identifier (RDI)
routing domain Confederations	Routing Domain Identifier (RDI)
Administrative Domains	Administrative Domain Identifier (ADI)
Application Processes	Application Process Title (AP-Title)
Application Entities	Application Entity Title (AE-Title)
Application Context	Application Context Name
Presentation Context	Presentation Context Identifier
ATSMHS User	ATSAMHS Originator/Recipient Name (O/R Name)
Security Type Objects	Security Registration Identifier
Managed Objects	Managed Object Name

3.4.5.5 In general, a single ATN router or end system hosts multiple ATN objects which need to be named or assigned addresses. Thus, several addresses and names have to be assigned, registered, administered and finally configured into the system hardware or software when putting an ATN system into operation.

3.4.6 ATN Addressing Plan

3.4.6.1 An addressing plan has been established for the ATN which meets the needs of a variety of aeronautical data communication user groups, including ATS providers, airspace users and international aeronautical communications service providers (IACSPs). Furthermore, it supports essential goals of ATN internal operation, such as efficient information reduction when exchanging address information (as part of the routing information) and unambiguous and complete address reconstruction from received address fragments when establishing initial contact between aircraft and ground-based applications (as part of the Context Management Application).

3.4.6.2 The ATN addressing plan has been organized in a way that the addresses of information objects contained within an ATN system are similar, i.e. they share, for example, common address prefixes, or include identical address portions. The addresses of most information objects within an ATN system can be derived from its network address (network entity title, see Table 3-1).

3.4.6.3 The ATN addressing and naming concept is organized in a hierarchical tree-structure, i.e. the whole addressing/naming space is composed of a set of hierarchically organized address/name domains. Each address/name domain contains a set of address/name formats and values which are administered by a single addressing/naming authority. Each addressing/naming authority is responsible for its own address/name domain, and may further partition it into several subordinate address/name domains in a recursive fashion, and delegate authority for these subdomains. This principle allows the assignment of unique addresses/names in a de-centralized fashion without the need to co-ordinate between address domains.

— — — — — — — —

4. *ATN Planning and Implementation Process*

4.1 General

4.1.1 The ATN implementation process is expected to be regional in nature. Even within a given region, it is likely that individual States will transition to the ATN at different times and possibly in different ways while maintaining interoperability and continuity of ATM services.

4.1.2 The implementation process for an aircraft operating agency will depend on current fleet equipage and region(s) in which they operate. However, most aircraft operators do not segregate their fleet for region specific operation.

4.1.3 Whilst the considerations for ATS providers and users are different, clearly the plans of one will directly and indirectly affect the other.

4.1.4 Noting the above, instead of specifying exactly what a State or organization should do to implement the ATN, a list is given for all activities that are necessary for successful planning, implementation, certification/commissioning and operation of the ATN in a structured and cost-effective manner.

4.2 Major tasks

4.2.1 Generally, the over-all process of ATN planning and implementation includes the completion of the following major tasks in sequence:

a) ATM operational concept;

b) network operating concept;

c) transition planning;

d) implementation planning;

e) operational evaluations; and

f) certification and commissioning.

4.2.2 Each of these tasks is briefly discussed below.

4.2.3 ATM operational concept

4.2.3.1 *Objectives*

4.2.3.1.1 As discussed before, the ATN is an enabling technology, i.e. it does not directly deliver benefits to users. Rather, it enables the introduction of new air traffic services which provide operational capabilities that benefit both the airspace managers and users.

4.2.3.1.2 As a result, the definition of an ATM Operational Concept for the airspace within a region or State in which the ATN is planned is crucial to determine all potential benefits. Functional requirements for the ATN, associated with specific operational objectives, can then be deduced from the operational concept.

4.2.3.2 ***Scope***

4.2.3.2.1 The operational concept embodies the understanding of how an organization conducts its daily business. In this instance, an air traffic service provider would document how it provides those air traffic services. It would document what those services are, what resources are required to provide them (in both material and human terms) and what procedures need to be in place.

4.2.3.2.2 Typically, its operational concept document is both a record of the existing environment and a plan for future evolution. As such, the operational concept is closely linked to the transition plan discussed below. The operational concept documents what an organization intends to do and the transition plan documents how this will be achieved.

4.2.3.2.3 The documentation of the change process will be shared between those two documents. Regardless of where it resides, however, the process for implementing changes to the operational environment must be planned and documented.

4.2.3.2.4 In preparing the operational concept, an organization will need to consider both the nature and timing of changes to its operating environment; issues which should naturally be addressed in any cost/benefit analysis.

4.2.3.2.5 In the case of the ATN, the operational concept should document how the services enabled by the ATN will be employed to achieve the benefits claimed in the cost/benefit analysis. There is also a need for extensive co-ordination between all stakeholders in order to achieve a stable environment.

4.2.4 **Network Operating Concept**

4.2.4.1 ***General***

4.2.4.2 Having established in the ATM operational concept which indicates what facilities will be required to support the delivery of ATM services, the next step is to refine the requirements for those facilities and to identify the way in which they will be provided and managed.

4.2.4.2.1 This is the role of the network operating concept which is a record of what the system will look like and how it will be managed. In order to develop the network operating concept, the following issues must be addressed:

a) network architecture;

b) network sizing;

c) security management;

d) system management;

e) system performance;

f) integration into the global ATN; and

g) allocation of administrative responsibility

4.2.4.2.2 The idea of the network operating concept is similar to that of the ATM operational concept in that it embodies the organization's understanding of the nature, design, capabilities of the network and the way it will be managed.

4.2.4.3 ***Network architecture***

4.2.4.3.1 The objective of this task is to design the overall architecture of the network, i.e. to decide on the type and location of elements and/or components like end systems, routers, subnetworks, gateways and so on. Such a network will be capable of achieving the functional, topological and performance requirements identified through analysis of the ATM operational concept.

4.2.4.3.2 The architectural design should address the end-to-end communication path and address the following design issues (as appropriate to the type of organization):

a) ground architecture including the fixed part of the air-ground components and associated management architecture; and

b) airborne architecture including mobile part of the air-ground component and associated management architecture.

4.2.4.3.3 With regard to the ground ATN, the main implementation issues to be addressed are:

a) definition of the administrative domains: includes identifying the list of administrative domains required to establish end to end connectivity;

b) design of the architecture for the administrative domain. This should include:

   1) identification of end systems, fixed and mobile subnetworks, ATN routers (IS or BIS) to be deployed in that domain; and

   2) connectivity between the various components identified

c) identification of the type of traffic and the quality of service required. This will result in the definition of a routing policy to be used within the routing domain; and

d) identification and analysis of possible agreements between adjacent administrative domains. This may result in the combination of individual routing domains into routing domain confederations.

4.2.4.4 ***Security management***

4.2.4.4.1 Development of a network security plan is required to ensure the integrity of the network. This should address both the control of physical access to the system and the application of security management facilities according to ICAO provisions. An organization should assign an administrative authority to establish and maintain the respective security management authorities of its management domains.

4.2.4.5 ***System management***

4.2.4.5.1 ATN managed resources should be grouped into management domains in order to assign responsibility for control of the resources. An organization should assign an administrative authority to establish and maintain the respective system management authorities of each of its management domains, and to manage the transfer of control of resources from one system management domain to another.

4.2.4.6 ***System Performance***

4.2.4.7 In order to assess the potential of the network for providing the services envisaged in the ATM operational concept, it is necessary to analyse its performance characteristics such as reliability, maintainability, integrity and availability. When these parameters meet required values, the network will provide an acceptable quality of service (QOS) for the intended applications.

4.2.4.7.1 The ATN supports prioritization of messages to maintain a required minimum QoS for specific message traffic even during periods of network congestion. Assigning priorities to message types allows the ATN internet to shift the effect of congestion to messages of lower priority, and to service (route) messages in order of priority during normal and congested conditions.

4.2.4.8 ***Integration into the global ATN***

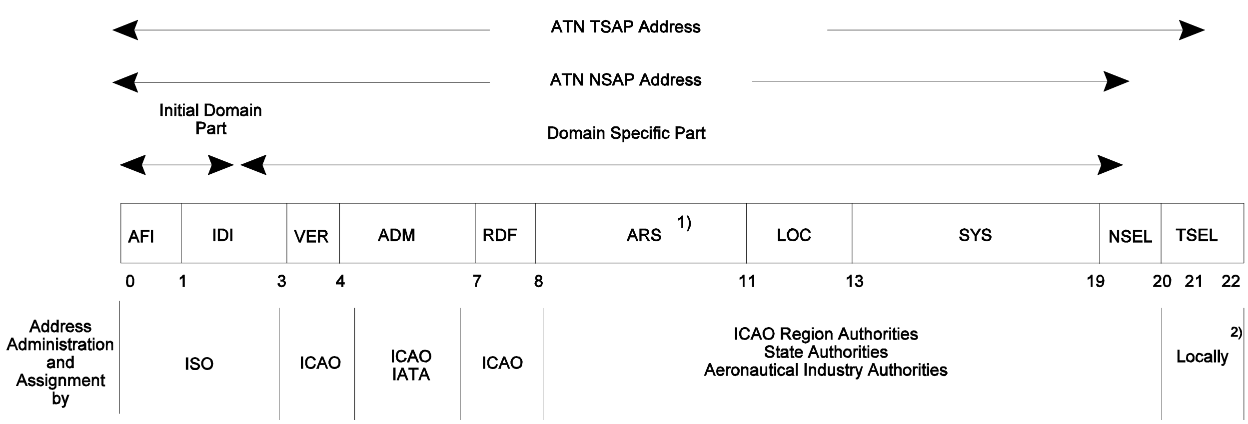
4.2.4.8.1 Issues relating to the interconnection of an isolated ATN implementation with the global operational ATN must be addressed. These will include, *inter alia*, issues such as conformance and interoperability testing and routing efficiency. Impact of the design of the new system to be connected, on the performance of the overall system will need to be examined.

4.2.4.9 ***Name and Address Administration***

4.2.4.9.1 **Address Allocation Principles**

4.2.4.9.1.1 The general philosophy that is underlying the assignment of ATN network addresses is that the administration of the higher order address parts (i.e. the address domains which are close to the root of the hierarchical address structure) is performed by entities with a global scope (e.g. international organizations such as ISO, ICAO and IATA). The further down in the hierarchical address structure one moves (i.e. the closer to the tail of the address), the more the responsibility for address assignment and administration is delegated to entities with a more restricted scope (i.e. regional, national or local authorities).

4.2.4.9.1.2 Figure 4-1 illustrates this distributed responsibility for address allocation using the example of an ATN transport service access point (TSAP) address. This type of address is composed of 10 consecutive address fields comprising a total length of 21 or 22 bytes (depending on the length of the TSEL field which may be either one or two octets). According to the ATN addressing plan, address values within the first two fields (AFI and IDI) are assigned by ISO, within the next three fields (VER, ADM and RDF) by ICAO and IATA, or ICAO exclusively, and within the fields six to nine (ARS, LOC, SYS, NSEL) by ICAO Region authorities, State authorities and aeronautical organizations. Administration and address value assignment for the last field (TSEL) of an ATN TSAP address is done locally.



Note 1.— In mobile network addressing domains the value of the ARS field is the 24-bit ICAO Aircraft Identifier and is consequently assigned and administered by ICAO.

Note 2.— Allocation, assignment and administration activities may be transferred in parts or completely to the national State authority or aeronautical industry authority.

Figure 4-1. Responsible Addressing Authorities Illustrated for the Example of an ATN

4.2.4.9.1.3 It should be noted that, due to this hierarchical structure, several registration authorities exist for an ATN address. Each registration authority is responsible for the allocation and registration of values (address fields) within its address space. The address registration function for the higher order fields of ATN addresses has already been partially performed in parallel to the development of the ATN SARPs. As a result of this, the values of the address prefix up to and including the RDF field (bytes 1 through 8 in Figure 4-1) of the ATN addresses for ATSC systems are registered with ISO and ICAO (as contained in Sub-Volume V of the *Manual of Technical Provisions for the Aeronautical Telecommunication Network (ATN)* (Doc 9709).

4.2.4.9.2 **Name Allocation Principles**

4.2.4.9.2.1 Similar to the address allocation, a hierarchical naming structure under the ultimate authority of ISO has been defined for ATN names. Within this naming hierarchy, Sub-Volume IV of the above-mentioned document assigns names to defined ATN objects under the ICAO name space which is a sub-space of the ISO name space. In this context the ATN provisions constitute an international register for a set of ATN names, such as CNS/ATM-1 Application Process Titles and Application Entity Qualifiers. All ATN objects requiring globally unambiguous names in the context of CNS/ATM-1 are registered through the above-mentioned document and, therefore, further registration of such names by States will not be required.

4.2.4.9.3 **Responsibilities of Administrations**

4.2.4.9.3.1 As illustrated in Figure 4-1, a number of ATN address fields are expected to be registered and administered at a State level or by an aeronautical industry authorities. Furthermore, provisions are made for the delegation of the administrative responsibility for address assignment in certain cases by ICAO to State authorities or aeronautical organizations.

4.2.4.9.3.2 States are, therefore, expected to assume full responsibility and administrative duties related to their own and/or delegated address space(s). In doing so, States should establish the necessary administrative structure to carry out the necessary administration activities for ATN addresses, i.e. to put in place an address (and naming) registration authority.

4.2.4.9.3.3 The role of an address registration authority is to:

a) assign and make available unambiguous addresses;

b) record definitions of the objects to which addresses are assigned; and

c) disseminate assigned and registered addresses to interested parties within its sphere of responsibility.

4.2.4.9.3.4 A State or organization may choose to delegate its authority for its own address space to another State or organization. States may even opt to delegate this authority back to ICAO. In the case of delegation of addressing authority the respective State(s) or organization(s) have to assume full administrative duties related to the delegated responsibilities. Appropriate arrangements have to be established on mutually agreed basis which cater for this transfer of authority.

4.2.4.9.3.5 Beside acting as addressing authority for a given portion of ATN addresses, the role of ICAO in the area of naming and addressing is one of international co-ordination, advice and consultation. Thus, ICAO may be expected to provide advice to States and organizations to ensure that address administration is carried out in a manner that supports the orderly and efficient operation of the global ATN.

4.2.4.9.3.6 Assigned and registered addresses have to be promulgated so that end users can locate each other. This may range from simple bilateral exchanges of address registers on an "as-needed" basis up to regular publication of official directories. The method chosen will depend on individual security and reachability requirements. It should be noted that this promulgation of address information, which is a pure administrative matter and will most likely result in appropriate static configuration of ATN systems, should not be confused with the dynamic distribution of address information by routing protocols during ATN operation. More detailed information and guidelines on address assignment in support of routing information exchange reduction can be found in Part II of this document.

4.2.4.10 ***Transition and interface considerations***

4.2.4.10.1 When a State or organization transitions to an ATN environment, consideration must be given to interfacing with systems of other States and organizations. For the purpose of this discussion, an entity transitioning to the ATN will be called an " ATN organization". Each interface from such an organization will be either to another ATN organization or to an AFTN/CIDIN organization. Furthermore, the ground-to-air interface(s) will be either to an ATN aircraft or to a FANS-1/A aircraft. Although an ATN organization may have non-ATN elements during transition, interface(s) between these elements will be considered equivalent to interface(s) between two separate organizations. Different possible interfaces between ATN and non-ATN entities are illustrated in Figure 4-2. Within this figure, the following example entities are used:

a) ATN Implementation A: an ATS provider using full ATN-compliant air-ground application services and ground-ground application services via the ATN, or (for the ground-ground case) via Gateways to AFTN or CIDIN;

b) ATN Implementation B: an ATS provider using only ground-ground ATN application services, both via ATN and via Gateways to AFTN or CIDIN;

c) ATN Implementation C: an ATS provider using:

1) air-ground ATN services and accommodation of FANS-1/A aircraft;

2) the possibility of ATN ground-ground forwarding of air-ground ATN services; and

3) ground-ground applications services via conventional means.

d) non-ATN Implementation D: an ATS provider not in transition to ATN using conventional ground-ground application services;

e) ATN aircraft: an aircraft carrying airborne ATN communication equipment and corresponding ATN applications;

f) FANS-1/A aircraft: an aircraft carrying airborne FANS-1/A communication equipment and corresponding applications; and

g) IACSP: an international aeronautical communication service provider operating both ATN and conventional air-ground networks.

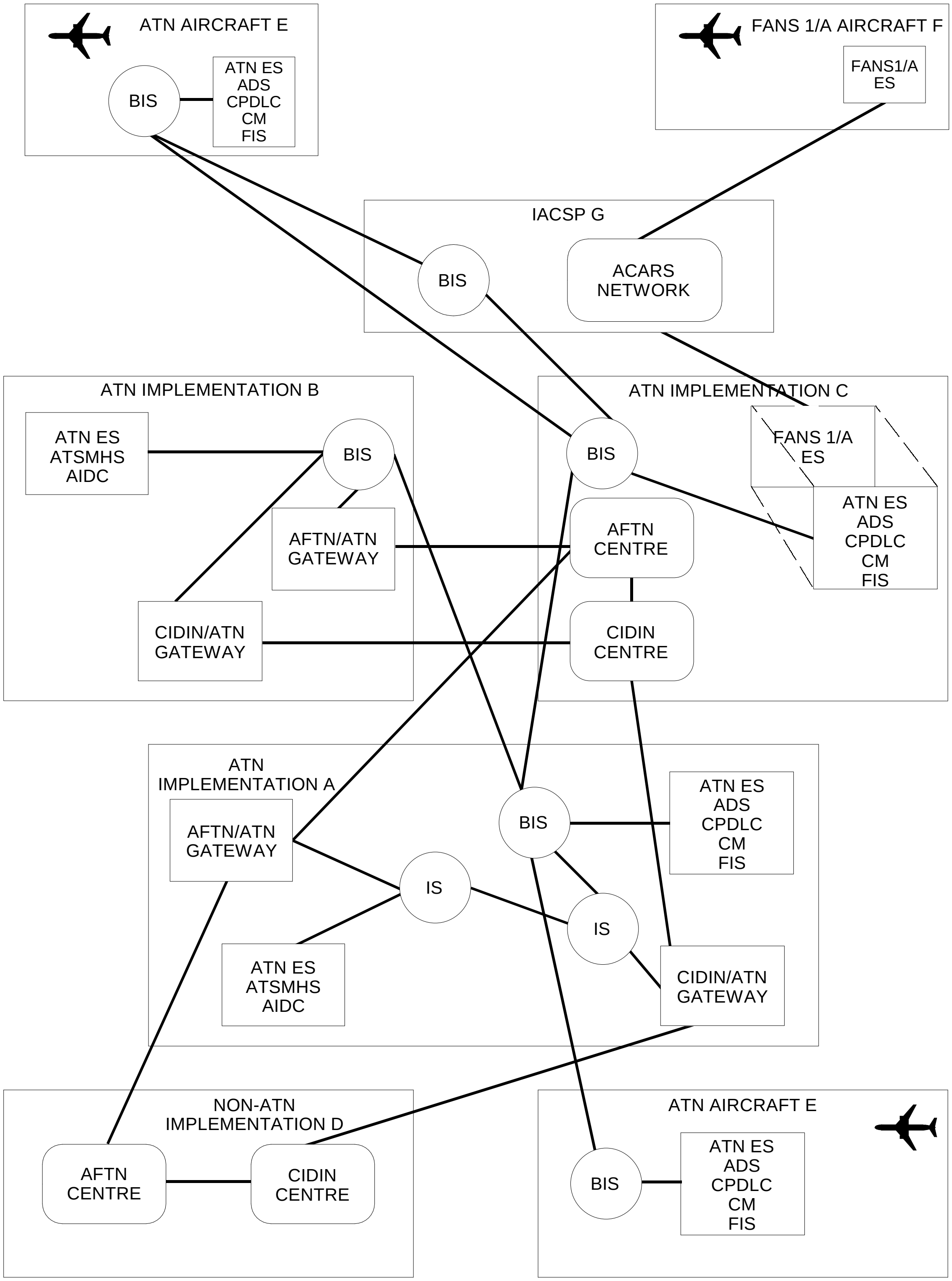


Figure 4-2. Examples of ATN connectivity during transition

4.2.4.10.2 **Interface to another ATN organization**

4.2.4.10.2.1 Interface to another ATN organization will be done by arranging for a wide-area network (WAN) connection between the BISs of the two organizations. Two ATN organizations may pass data through one or more intervening ATN organizations, depending on routing policies.

4.2.4.10.3 **Interface with an AFTN/CIDIN organization**

4.2.4.10.3.1 Interface with an AFTN organization will be performed using an AFTN protocol. An AFTN/ATN gateway must be provided to translate ATN protocols, messages, and addresses to equivalent AFTN entities, and vice versa.

4.2.4.10.3.2 Interface with a CIDIN organization will be performed using a CIDIN data interchange protocol. A CIDIN/ATN gateway must be provided to translate ATN protocols, messages, and addresses to equivalent CIDIN entities and vice versa.

4.2.4.10.4 **Interface with an ATN aircraft**

4.2.4.10.4.1 An ATN organization which needs to exchange data with ATN aircraft should implement applications which are the ground-based peers of the aircraft applications. In addition, the ground ATN environment must be connected to the aircraft ATN environment via one or more mobile subnetworks. There are two possible ways to use a mobile subnetwork. The first is a direct connection from a BIS of the ATN organization (air-ground router) to the aircraft router. The second way is to use the air-ground router and mobile subnetwork of another ATN organization, such as an IACSP.

4.2.4.10.5 **Interface with FANS-1/A aircraft**

4.2.4.10.5.1 Communication with a FANS-1/A aircraft will be accomplished by an "accommodation software" in an ATN air-ground organization (see Part II, Chapter 11 for details). For integrity reasons, it is assumed that the accommodation software will co-exist with the ground ATN end-system. If the ability to change between FANS-1/A and ATN, while in flight, is available from the airborne system architecture, then a specific accommodation solution on the ground will not be necessary. All FANS-1/A accommodation-related work will be done on the ground. Both ATN and FANS-1/A downlink messages will be processed without restriction, and uplink messages will arrive correctly at their intended destination (i.e. FANS-1/A to FANS-1/A aircraft and ATN to ATN aircraft). However, the FANS-1/A only aircraft are not expected to be able to obtain the same operational services which will be offered to ATN aircraft.

4.2.5 **Certification and commissioning issues**

4.2.5.1 The implementation of the ATN will require commissioning and/or certification of ground and airborne systems that will provide ATN-based air traffic services. The commissioning and/or certification processes use systems engineering methods and safety analyses. These analyses use top-down, structured, and rigorous techniques that assess a total function in the context of its operational environment. The results of such analyses are used to establish safety objectives and interoperability requirements for the total function. The safety objectives will be used to derive safety requirements. These safety and interoperability requirements will then be allocated to various parts of the system. Disciplines are applied to develop processes to ensure that specific implementations satisfy the safety objectives and interoperability requirements with acceptable levels of confidence. When considering a global system, a total function within that system transcends the boundary at which any one State/organization can apply systems engineering and safety analysis. Therefore, establishing the safety objectives and interoperability requirements for the total function based on top-down structured, and rigorous techniques needs to be derived through a co-operative effort by all the parties involved.

4.2.5.2 Additionally, as changes are made to ATN systems or their operational environment, safeguards need to be put in place to ensure continued operational safety. This will require co-ordination among all States and organizations concerned to assess the impact of the changes as well as the extent of re-commissioning and re-certification.

4.3 ATN Regional Implementation

4.3.1 There are six (6) formal ICAO regional planning groups world-wide covering the nine (9) ICAO regions (Africa, Asia, Caribbean, Europe, Middle East, North America, North Atlantic, Pacific and South America):

a) African Planning & Implementation Regional Group (APIRG);

b) Asia Pacific Air Navigation Planning & Implementation Regional Group (APANPIRG);

c) Caribbean South American Planning & Implementation Regional Group (GREPECAS);

d) European Air Navigation Planning Group (EANPG);

e) Middle East Air Navigation Planning & Implementation Regional Group (MIDANPIRG); and

f) North Atlantic System Planning Group (NATSPG)

4.3.2 In addition, Canada, Mexico and the United States, conduct their regional plannings under the North America Free Trade Agreement (NAFTA).

4.3.3 Noting the regional/global nature of the ATN, its planning, implementation and operation requires a high degree of co-ordination between ATS providers and users as well as the providers of communication systems and networks. Within a region in which ATN is being implemented, commitment by all concerned parties to an agreed co-ordinated plan as well as to a strict and rigorous change control is essential. Such commitments would minimize unnecessary modifications, maximize benefits and facilitate the implementation of a truly global ATN.

4.3.4 The aeronautical civil aviation community has always expressed a desire for a co-operative systems engineering approach to deploy a world-wide communications network. Taking into account technical, institutional, and economic considerations, a world-wide co-operative approach should:

a) be applied integral to the development of an operating concept;

b) contribute to the validation of the operating concept and the performance requirements specified for CNS/ATM functions;

c) provide a more robust solution to hazard mitigation and greater reliance on total system architecture, thereby providing for a more cost effective solution and making the system easier to maintain/evolve during operational service;

d) provide for defining safety objectives as part of a region-specific or general operating concept, which addresses abnormal operations, thereby making the operating concept more robust;

e) provide a consistent approach to applying technology to solving different and unique problems in different regions;

f) provide for harmonization of regional differences;

g) when there are common applications among the regions, the results of the hazard analysis should yield consistent performance requirements specified for CNS functionalities for all regional implementations; and

h) maintain responsibility and ownership of safety and interoperability with the regional implementation and planning groups.

— — — — — — — —

5. ***Glossary and Definitions***

5.1 **List of Abbreviations:**

AAC	Aeronautical Administrative Communications
ACARS	Aircraft Communication Addressing and Reporting System
ACF	ACARS Convergence Function
ACSE	Application Control Service Element
AD	Administrative Domain
ADI	Administrative Domain Identifier
ADM	Administrative Identifier
ADS	Automatic Dependent Surveillance
AE	Application Entity
AES	Aircraft Earth Station
AFI	Authority and Format Identifier
AFS	Aeronautical Fixed Service
AFTN	Aeronautical Fixed Telecommunication Network
AI	Aircraft Identifier
AIDC	ATS Interfacility Data Communication
AINSC	Aeronautical Industry Services Communication
AIS	Aeronautical Information Services
AMHS	ATS Message Handling System
AMS	Aeronautical Mobile Service
AMSS	Aeronautical Mobile Satellite Service
ANM	ATFM Notification Messages
AOC	Aeronautical Operational Control
AOP	ATN OSI Profile
AP	Application Process
APC	Aeronautical Passenger Communications
APRL	ATN Protocol Requirements List
ARS	Administrative Region Selector
ASN.1	Abstract Syntax Notation One
ASO	Application Service Object
ATC	Air Traffic Control
ATCC	Air Traffic Control Centre
ATFM	Air Traffic Flow Management
ATIS	Automatic Terminal Information Service
ATM	Air Traffic Management
ATN	Aeronautical Telecommunication Network
ATNP	Aeronautical Telecommunication Network Panel

ATS	Air Traffic Services
ATSMHS	ATS Message Handling Services
ATSU	Air Traffic Service Unit
BCD	Binary Coded Decimal
BIS	Boundary Intermediate System
CAA	Civil Aviation Authority
CCITT	International Telegraph and Telephone Consultative Committee
CIDIN	Common ICAO Data Interchange Network
CL	Connectionless
CLNP	Connectionless-mode Network Protocol
CM	Context Management
CMA	Context Management Application
CNS	Communications, Navigation and Surveillance
CO	Connection Oriented
COP	Character Oriented Protocol
CPDLC	Controller-Pilot Data Link Communications
DCE	Data Communications Equipment
DIT	Directory Information Tree
DLAC	Data Link Application Coding
DNIC	Data Network Identification Code
DR	Disconnect Request
DSP	Domain Specific Part
DTE	Data Terminal Equipment
ES	End System
FANS	Future Air Navigation System
FDDI	Fibre Distributed Data Interface
FIB	Forwarding Information Base
FIR	Flight Information Region
FIS	Flight Information Services
FMS	Flight Management System
FP	Flight Plan
GA	General Aviation
GES	Ground Earth Station
HDLC	High-Level Data Link Control
HF	High Frequency
HMI	Human Machine Interface
IA5	International Alphabet No. 5
IACSP	International Aeronautical Communication Service Provider
IATA	International Air Transport Association

ICAO	International Civil Aviation Organization
ICC	Inter-Centre Coordination
ICD	International Code Designator
ID	Identification
IDI	Initial Domain Identifier
IDP	Initial Domain Part
IDRP	Inter-Domain Routing Protocol
IEC	International Electrotechnical Commission
IFR	Instrument Flight Rules
IS	Intermediate System
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
ISOPA	ISO Protocol Architecture
ITU-T	International Telecommunication Union — Telecommunication Standardization Sector
LAN	Local Area Network
LOC	Location Identifier
MHS	Message Handling Services
Mode S	Mode Select
MORTs	Managed Objects Requirement Templates
MTA	Message Transfer Agent
MTP	Manual Teletypewriter Procedures
MTS	Message Transfer System
NET	Network Entity Title
NOTAM	Notice to Airmen
NPDU	Network Protocol Data Unit
NSAP	Network Service Access Point
NTN	Network Terminal Number
N-SEL	Network Selector
OID	Object Identifier
OPMET	Operational Meteorological Traffic
O/R	Originator/Recipient
OSI	Open System Interconnection
PANS-RAC	Procedures for Air Navigation Services - Rules of the Air and Air Traffic Services
PCI	Protocol Control Information
PDU	Protocol Data Unit
PER	Packed Encoding Rules
PIB	Policy Information Base
PIREP	Pilot Reports

PSAP	Presentation Service Access Point
PSDN	Packet Switched Data Network
PSEL	Presentation Selector
PTT	Post, Telephone, and Telegraph
PVC	Permanent Virtual Circuit
QOS	Quality of Service
RD	Routing Domain
RDC	Routing Domain Confederation
RDF	Routing Domain Format
RDI	Routing Domain Identifier
RDN	Relative Distinguished Name
RIB	Routing Information Base
SAR	Search and Rescue
SARPs	Standards and Recommended Practices
SEL	Selector
SICASP	SSR Improvements and Collision Avoidance Systems Panel
SIGMET	Significant Meteorological Information
SN	Subnetwork
SNPA	Subnetwork Point of Attachment
S-SEL	Session Selector
SSAP	Session Service Access Protocol
SSR	Secondary Surveillance Radar
SYS	System Identifier
TCP/IP	Transmission Control Protocol/Internet Protocol
TSAP	Transport Service Access Point
TSEL	Transport Selector
UA	User Agent
UHF	Ultra High Frequency
VDL	Very High Frequency Digital Link
VER	Version Identifier
VHF	Very High Frequency
WAN	Wide Area Network

5.2 Definitions

Address Domain. An Address Domain is a set of address formats and values administered by a single address authority. Under the ISO plan, any address authority may define subdomains within its own domain, and delegate authority within those subdomains.

Addressing Authority. An Addressing Authority defines formats and/or values of NSAP addresses within its jurisdiction.

Administrative Domain. A collection of end systems, intermediate systems, and subnetworks operated by a single organization or administrative authority. An administrative domain may be internally divided into one or more routing domains.

Aeronautical Administrative Communications (AAC). Communications used by aeronautical operating agencies related to the business aspects of operating their flights and transport services. These communications are used for a variety of purposes, such as flight and ground transportation bookings, deployment of crew and aircraft, or any other logistic purposes that maintains or enhances the efficiency of overall flight operation.

Aeronautical Mobile Satellite Service (AMSS). AMSS provides packet-mode data and circuit-mode data and voice service to aircraft and ground users provided by a satellite subnetwork which comprises satellites, Aircraft Earth Stations (AESs), Ground Earth Stations (GESs), and associated ground facilities such as a network co-ordination center.

Aeronautical Operational Control (AOC). Communication required for the exercise of authority over the initiation, continuation, diversion or termination of flight for safety, regularity and efficiency reasons.

Aeronautical Passenger Communications (APC). Communications relating to the non-safety voice and data services to passengers and crew members for personal communications.

Aeronautical Telecommunication Network (ATN). The Aeronautical Telecommunication Network is an internetwork architecture which allows ground, air-to-ground, and avionics data subnetworks to interoperate by adopting common interface services and protocols based on the International Organization for Standardization (ISO) Open Systems Interconnection (OSI) reference model.

Air Traffic Control (ATC). ATC is a service operated by an appropriate authority to promote the safe, orderly, and expeditious flow of air traffic.

Air Traffic Management (ATM). ATM consists of a ground and air part, both needed to ensure the safe and efficient movement of aircraft during all phases of operation.

Air Traffic Services Communications (ATSC). Communications related to air traffic services including air traffic control, aeronautical and meteorological information, position reporting, and services related to safety and regularity of flight. This communication must involve one or more air traffic service administrations. This term is used for purposes of address administration.

Application. Software providing services to its users, in the guise of a consistent set of functionality; example given, the ATC related functions implemented in the server(s) and/or controller work position host computers.(from EATCHIP Glossary of Terms/COPS/CWP Report)

Application Entity (AE). Part of an application process that is concerned with communications within the OSI environment. The aspects of an application process that need to be taken into account for the

Application process (AP). A set of resources, including processing resources, within a real open system which may be used to perform a particular information processing activity.

Application service. The abstract interface between the (N)-service and the (N)-service user, where N refers to the Application layer; thus it is the boundary between the ATN-App-AE and the Application-user.

ATM/ATS Applications. These are applications supporting ATM or other ATS functions and do not necessarily correspond to ATN applications. The term is usually used to distinguish between ATM functions and other non-ATM functions using the same communication service.

ATN Applications. Refers to applications that support ATM or aeronautical industry functions and that are designed to operate across an OSI communications system. ATN applications are always distributed applications, i.e. peer processes are hosted by different end systems which are interconnected.

ATN Environment. The term ATN environment relates to functional and operational aspects around the ATN as a complete end-to-end communication system.

ATN Internet (ATNI). An implementation of the ISO OSI network layer services and protocols for support of interprocess data communication between aeronautical host computers. It is defined to be the collection of the connected internetwork routers and subnetworks that conform to ATN internetwork requirements.

ATN Network Operating Concept. An ATN Network Operating Concept will address the administrative, operational, institutional, and policy issues and additional (non-SARPs) technical aspects to enable the efficient and correct operation of the ATN.

ATN Router. The communication element that manages the relaying and routing of data while in transit from an originating ATN host computer to a destination ATN host computer. In ISO terms, an ATN router comprises an OSI intermediate system and an end system supporting a systems management agent.

ATN Routing Domain Confederation(RDC). The ATN RDC is the set of interconnected routing domains that together form the ATN internetwork.

ATN Services. The ATN services are provided to ATN users that require ground-ground or air-ground data communication. The ATN internet service is provided at the transport layer (service access point). The ATN accommodates different grades of services which can be expressed by Quality of Service parameters.

ATN Systems Management. The ATN Systems Management provides mechanisms for monitoring, control and co-ordination of resources necessary to provide ATN services. ATN Systems Management is based on OSI System Management principles and may be distributed, centralized, or local.

ATS message handling services (ATSMHS). Procedures used to exchange ATS messages over the ATN such that the conveyance of an ATS message is in general not correlated with the conveyance of another ATS message by the service provider. There are two ATS message handling services. They are the ATS message service and the ATN pass-through service.

Automatic Dependent Surveillance (ADS). A technique in which aircraft automatically provide, via a data link, data derived from on-board navigation and position-fixing systems, including aircraft identification, four-dimensional position, and additional data as appropriate. ADS is a data link application.

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

Context Management (CM). Refers to an ATN application. This application implements an ATN logon service allowing initial aircraft introduction into the ATN. The logon service also allows indication of all other data link applications on the aircraft. CM also includes functionality to forward addresses between ATC centres. Thus, CM is a logon and simple directory service. Note: "Context Management" is a recognised OSI presentation layer term. The OSI use and the ATN use have nothing in common.

Domain. A set of end systems and intermediate systems that operate according to the same routing procedures and that is wholly contained within a single Administrative domain.

End System (ES). A system that contains the seven OSI layers and contains one or more end user application processes.

Functional Requirements. Operational requirements that determine what function a system should perform. They can usually be expressed by a verb applying to a type of data, e.g. display aircraft position.

Gateway. A system used to interconnect dissimilar networks. A gateway may contain all seven layers of the OSI reference model.

Integrated Services Digital Network (ISDN). A public telecommunications network that supports the transmission of digitised voice and data traffic on the same transmission links.

Intermediate System (IS). A system comprising the lower three layers of the OSI reference model and performing relaying and routing functions.

Internetwork. A set of interconnected, logically independent heterogeneous subnetworks. The constituent subnetworks are usually administrated separately and may employ different transmission media.

Management Domain. Resources that for systems management purposes are represented by managed objects. A management domain possesses at least the following quantities: a name that uniquely identifies that management domain, identification of a collection of managed objects that are members of the domain, and identification of any inter-domain relationships between this domain and other domains.

Mobile Subnetwork. A subnetwork connecting a mobile system with another system not resident in the same mobile platform. These subnetworks tend to use free-radiating media (e.g. radio) rather than "contained" media (e.g. wire); thus they exhibit broadcast capabilities in the truest sense.

Network Management. The set of functions related to the management of various OSI resources and their status across the Network Layer of the OSI architecture.

Operating Concept. The technical functionality of a system and its inherent capabilities regarded from the system operator's point of view. This includes the interaction between user and system, the services provided by the system as well as the internal operation of the system.

Operational Concept. Describes, from the user's point of view, the operational requirements, constraints, and prerequisites within which a technical system is supposed to work as well as the inherent capabilities of the system. It describes the interaction between the user and the system as well as the services the user may expect from the system. Broad outline of an operational structure able to meet a given set of high level user requirements. It comprises a consistent airspace organisation, general operational procedures, and associated operational requirements for system support.

Performance Requirements. Requirements with respect to the performance of a system (e.g. reliability, availability, response time, processing delay, etc.) and are derived from Operational Requirements. In general, they describe the minimum performance figures that a system must provide in order to fulfil the operationally required functions.

Quality of Service (QoS). Information relating to data transfer characteristics (for example, requested throughput and priority) used by a router to perform relaying and routing operations across the subnetworks which make up a network.

Router. The communication element that manages the relaying and routing of data while in transit from an originating end system to a destination end system. An ATN router comprises an OSI intermediate system and end system supporting a systems management agent.

Routing. A function within a layer that uses the address to which an entity is attached in order to define a path by wich that entity can be reached.

Routing Domain. A set of end systems and intermediate systems that operate the same routing protocols and procedures and that are wholly contained within a single administrative domain. A routing domain may be divided into multiple routing subdomains.

Routing Policy. A set of rules that control the selection of routes and the distribution of routing information by ATN Boundary Intermediate Systems (BISs). These rules are based on policy criteria rather than on performance metrics such as hop count, capacity, transit delay, cost, etc. which are usually applied for routing. There are two groups of routing policy in the ATN: (1) general routing policy specified in the ATN Internet SARPs in order to ensure necessary connectivity in the ATN at a reasonable routing information update rate and (2) user specified routing policy, i.e. individual policy rules which may be additionally implemented in ATN BISs by administrations and organizations to meet their specific operational and policy needs. The set of rules in a BIS that determines the advertisement and use of routes is known as a Routing Policy. Each organizational user of the ATN must determine and apply their own Routing Policy.

Safety Case. An analysis presenting an overall justification for the declaration that a particular systems satisfies its safety requirements.

Security Management. To support the application of security policies by means of functions which include the creation, deletion and control of security services and mechanisms, the distribution of security-relevant information, and the reporting of security-related events.

Subnetwork. An actual implementation of a data network that employs a homogeneous protocol and addressing plan, and is under control of a single authority.

Systems Management. The set of functions related to the management of various OSI resources and their status across all layers of the OSI architecture.

User Requirements. A discription of what users expect to obtain from the system (not how the system should do it). They are usually expressed on a high level and do not include technical details. The direct user of the ATN is an application within an end system supporting Air Traffic Management or Aeronautical Industry functions. The Air Traffic Controller, other ground staff, or the Pilot are the human beings using directly, or indirectly, the ATN. The user may also be seen more on the abstract level as an organization, e.g. airline or air navigation service provider.

Validation. In the ICAO context, a process that ensures that systems meet user requirements to an agreed level of confidence and can be produced from written SARPs and Guidance material. One has to distinguish between performance based and functional validation. Single subsystems of the ATN, like routers, may be validated on a functional basis; validation of the ATN's suitability with respect to network performance etc. requires definition of performance requirements.

5.3 ATNP Lexicon

5.3.1 The following list of terms, known as "ATNP lexicon", provides explanations for terms which sometimes created confusion due to the different understanding of their meaning. Although some of the terms have not been defined elsewhere, the ATNP lexicon recognizes the existence of a glossary and a list of acronyms and abbreviations which are contained in a number of reference documents. The purpose of this list is not to re-iterate these terms and definitions, but rather to concentrate on the explanation of ambiguous respectively differently used terms and additional expressions. This list was used as a working aid to ensure common understanding within the working groups developing the ATN SARPs and Guidance Material, and is therefore reproduced here.

5.3.1.1 *Addressing (logical)*

5.3.1.1.1 Logical addressing means that the address defined in the addresing plan and used to locate the addressed object is a virtual address which is a substitute of the actual (physical) address of an object. Address mapping functions have to fulfill this substitution, carefully maintaining unambiguity of identification of objects.

5.3.1.2 ***Addressing (physical)***

5.3.1.2.1 Physical addressing means that the address defined in the addressing plan and used to locate the addressed object is the physical, i.e. hardwired, hard-coded, or configured address of the object. An example of a physical address is the ICAO 24-bit Aircraft Address used for the SSR Mode S Transponder.

5.3.1.3 ***ATN Manual Edition 2:***

5.3.1.3.1 The second edition of the ATN Manual approved at the SICASP/5 Meeting (not to be published by ICAO). The ATN Manual Edition 2 is derived from the material developed by the SICASP in the form of the ATN Manual (Version 2) and recommended for publication at the fifth meeting of this panel.

5.3.1.4 ***ATN Communication Services:***

5.3.1.4.1 The ATN communication services are provided to ATN users that require ground-ground or air-ground data communication. The ATN accomodates different grades of services which can be expressed by Quality of Service parametersand by communication priorities.

5.3.1.5 ***ATN System Applications:***

5.3.1.5.1 System Applications support the operation of the ATN communication services and are either not directly or not at all used by ATN users but rather by the service providers, operators or other ATN applications. Typical examples of ATN system applications are the ATN directory service, ATN context management or ATN systems management.

5.3.1.6 ***Congestion***

5.3.1.6.1 In the ATN Internet sense, congestion describes the state where the network is overloaded. Typical effects of congestion are extended transit delays, drastically reduced throughput, and the loss of data packets

5.3.1.7 ***Congestion Avoidance***

5.3.1.7.1 Techniques that regulate the data flow into the network in order to prevent the network from getting overloaded. These encompass both open-loop techniques which ensure that a traffic contract specified by the source is respected, and closed-loop techniques which monitor signals generated by the network and adapt the traffic generated by the sources accordingly.

5.3.1.8 ***Congestion Management***

5.3.1.8.1 This term refers to a set of rules and techniques which prevent congestion, e.g. by monitoring actual network load. Co-operative interaction of all end systems is required in order to prevent individual end-systems taking up the throughput saved by well-behaving systems.

5.3.1.9 ***Congestion Recovery/Congestion Control***

5.3.1.9.1 This term refers to a mechanism which reacts to congestion after it has occurred in order to remove the overload condition. Congestion Recovery can be initiated only after congestion has been experienced, and is not able to safely prevent congestion in the network.

5.3.1.10 ***Directory Service***

5.3.1.10.1 The ATN Directory Service provides the ATN user with the addressing information which is associated with the application process title or application entity title used as input to the directory. The addressing information provided by the directory service includes the network address as well as further technical addresses on the layers above, as required or applicable. Furthermore, the ATN Directory Service resolves generic application process titles or application entity titles, i.e. names which may be incomplete or contain "don't care" elements, into the corresponding (list of) non-generic application process titles or application entity titles.

5.3.1.11 ***Engineering Trials***

5.3.1.11.1 In contrast to operational trials, engineering trials may be based on pre-operational, prototype or experimental equipment. Aim is to demonstrate the technical feasibility and correctness of applied techniques, concepts and specifications.

5.3.1.12 ***Institutional Issues***

5.3.1.12.1 Issues related to ownership, control and responsibility for correct implementation and operation of systems which involve more than one state or organization.

5.3.1.13 ***Operational Trials***

5.3.1.13.1 Operational trials are based on operational environment. This includes operational systems and operational equipments, e.g. routinely scheduled flights in an operational ATS environment. Aim is to demonstrate the operational acceptance and correctness of applied mechanisms, applications and concepts.

— — — — — — — —