

The ATN SARPs

Sub-Volume I

Introduction and System Level Requirements

Editors' Draft

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Errata and Disclaimer

Please note that this document was prepared from a number of separate files prepared by different editors. The initial page numbers in these files are not completely synchronised, and we have made no attempt to change this, in order to avoid problems with references from Working Papers. You may therefore find some overlap between pages numbers, when those pages came from different files.

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

FOREWORD

The material contained in this document was originally developed as the detailed part of the first set of Standards and Recommended Practices (SARPs) for the aeronautical telecommunication network (ATN) which has commonly been referred to as the CNS/ATM-1 Package. It was intended to make the material an appendix to the new Chapter 3 of Annex 10, Volume III, Part I, containing broad, general, stable and mostly regulatory-type provisions (the core part of new ATN SARPs).

In December 1997, the Air Navigation Commission (ANC), while conducting the final review of draft ATN SARPs, noted that actual implementation and operational experience was yet to be gained by the international civil aviation community. In this regard, the ANC agreed that the detailed part of ATN SARPs should be published as an ICAO manual, while retaining its SARPs-style language. The ANC will review the status of the document, in its entirety or in parts, after sufficient implementation and operational experience has been gained and the requirements for further standardization, in the interests of safety, regularity and efficiency of international civil aviation have been better ascertained.

This document consists of five Sub-Volumes:

- Sub-Volume I — Introduction and System Level Requirements
- Sub-Volume II — Air-Ground Applications
- Sub-Volume III — Ground-Ground Applications
- Sub-Volume IV — Upper Layer Communications Service (ULCS)
- Sub-Volume V — Internet Communications Service (ICS)

Provisions contained in Sub-Volumes II, III, IV and V have been developed in accordance with system requirements specified in Sub-Volume I.

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1.1 DEFINITIONS AND REFERENCES

1.1.1 DEFINITIONS

Note 1.— The aeronautical telecommunication network (ATN) comprises application entities and communication services which allow 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.

Note 2.— This document addresses the following ATN technical requirements:

- a) *General and system level requirements;*
- b) *ATN application entity requirements;*
 - 1) *System application entity requirements;*
 - i) *Context management (CM) application;*
 - 2) *Air-ground application entity requirements;*
 - i) *Controller pilot data link communication (CPDLC) application;*
 - ii) *Automatic dependent surveillance (ADS) application;*
 - iii) *Flight information service (FIS) applications;*
 - 3) *Ground-ground application entity requirements;*
 - i) *Air traffic services (ATS) inter-centre communication (ICC) applications;*
 - ii) *ATS message handling service (ATSMHS) application;*
- c) *ATN communication service requirements;*
 - 1) *Upper layer communications service;*
 - 2) *Internet communications service.*

Note 3.— An overview of this document is depicted in Figure 1-1.

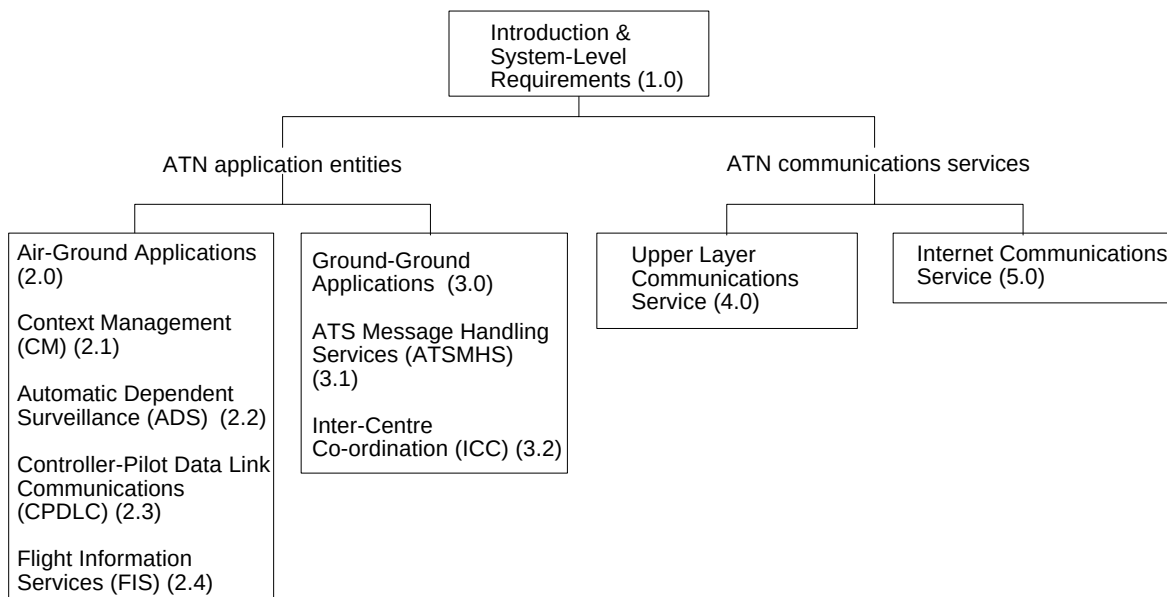


Figure 1.1. Overview of document

When the following terms are used in this document, they have the following meanings:

Abstract service interface. The abstract interface between the application entity (AE) and the application user.

Abstract syntax notation One (ASN.1). Abstract syntax notation One is defined in ISO/IEC 8824-1. The purpose of this notation is to enable data types to be defined, and values of those types specified, without determining their actual representation (encoding) for transfer by protocols.

Addressing plan. A plan that provides common address syntax and management of global addresses for the unambiguous identification of all end and intermediate systems in accordance with the rules prescribed in ISO/IEC 7498-3 and ISO/IEC TR 10730.

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..

ADS. The symbol used to designate automatic dependent surveillance.

ADS application. An ATN application that provides ADS data from the aircraft to the ATS unit(s) for surveillance purposes.

ADS Contract. An agreement between the ADS ground-user and the ADS air-user that the latter will provide reports to the former under the conditions specified in the contract.

Aeronautical administrative communication (AAC). Communication used by aeronautical operating agencies related to the business aspects of operating their flights and transport services. This communication is used for a variety of purposes, such as flight and ground transportation, bookings,

deployment of crew and aircraft or any other logistical purposes that maintains or enhances the efficiency of overall flight operation.

Aeronautical administrative messages. Messages regarding the operation or maintenance of facilities provided for the safety or regularity of aircraft operation. Messages concerning the functioning of the ATN and messages exchanged between government civil aviation authorities relating to aeronautical services.

Aeronautical fixed telecommunications network (AFTN). A world-wide system of aeronautical fixed circuits provided, as part of the aeronautical fixed service, for the exchange of messages and/or digital data between aeronautical fixed stations having the same or compatible communications characteristics.

Aeronautical industry service communication (AINSC). Communication related to aeronautical industry services including aeronautical operational control communication, aeronautical administrative communication, and aeronautical passenger communication. This communication involves one or more aeronautical industry service administrations. This term is used for purposes of address administration.

Aeronautical information service (AIS) messages. Messages concerning the aeronautical information service defined in ANNEX 15.

Aeronautical mobile-satellite service (AMSS). The AMSS comprises satellites, aeronautical earth stations (AESs), ground earth stations (GESs) and associated ground facilities such as a network coordination center. It uses the satellite subnetwork to provide aeronautical communication services between aircraft and ground users. Technical requirements for the AMSS are contained in Annex 10, Volume III, Part I, Chapter 4. The ATN supports the packet-mode data exchange provided by the AMSS.

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 communication (APC). Communication relating to the non-safety voice and data services to passengers and crew members for personal communication.

AFTN. The symbol used to designate aeronautical fixed telecommunication network

AFTN/AMHS gateway. An end system which provides bi-directional interworking between users of the ATS message service and users connected to the AFTN.

AFTN/ATN Type A gateway. An end system which provides a bi-directional interface between the ATN and the AFTN for the purpose of conveying AFTN messages over the ATN by implementation of the ATN pass-through service.

AFTN form address (AF-address). Either an AFTN addressee indicator as specified in Annex 10, Volume II, paragraphs 4.4.3.1.2 and 4.4.16.2.1.3 which is used to locate AMHS users, either direct or indirect, in the AFTN address space or a predetermined distribution addressee indicator (PDAI) as specified in Annex 10, Volume II, 4.4.14.

Note.— An AF-address (AFTN-form) is an ICAO AFTN 8-letter addressee indicator.

AIDC. The symbol used to designate ATS interfacility data communication.

AINSC. The symbol used to designate aeronautical industry service communication.

Air application service element (air-ASE). An abstract part of the aircraft system that performs the communication related functions of the application.

Airborne collision avoidance system (ACAS). An aircraft system based on secondary surveillance radar (SSR) transponder signals which operates independently of ground-based equipment to provide advice to the pilot on potential conflicting aircraft that are equipped with SSR transponders.

Aircraft address. A unique combination of twenty-four bits available for assignment to an aircraft for the purpose of air-ground communications, navigation and surveillance.

Aircraft flight identification. A group of letters, figures or a combination thereof which is either identical to, or the coded equivalent of, the aircraft call sign to be used in air-ground communication and which is used to identify the aircraft in ground-ground air traffic services communication.

Air-ground application. An application that has one peer application on an aircraft and its other peer application on the ground. An air-ground application may require the use of ground-ground subnetworks.

Air traffic control (ATC) clearance. Authorization for an aircraft to proceed under conditions specified by an air traffic control unit.

Note 1.— For convenience the term “air traffic control clearance” is frequently abbreviated to “clearance” when used in appropriate contexts.

Note 2.— The abbreviated term “clearance” may be prefixed by the words “taxi”, “take-off”, “departure”, “en-route”, “approach” or “landing” to indicate the particular portion of flight to which the air traffic control clearance relates.

Air traffic control (ATC) instruction. Directives issued by air traffic control for the purposes of requiring a pilot to take specific action.

Air traffic control (ATC) service. A service provided for the purposes of:

- a) preventing collisions:
 - 1) between aircraft, and
 - 2) on the manoeuvring area between aircraft and obstructions; and
- b) expediting and maintaining an orderly flow of traffic.

Air traffic services (ATS). A generic term meaning variously, flight information service, alerting service, air traffic advisory service, air traffic control service (area control service, approach control service or aerodrome control service).

Air user (air-user). The abstract part of the aircraft system that performs the non communication related functions of the application.

AMHS. The symbol used to designate ATS message handling system.

AMHS management domain. An AMHS management domain formed by an ATS organization for the management of that part of the AMHS which is under its responsibility.

AMHS message. An instance of the category of information object defined as message in ISO/IEC 10021-2 and conveyed in the AMHS. It is composed of an envelope and of a content.

AMHS probe. An instance of the category of information object defined as probe in ISO/IEC 10021-2 and conveyed in the AMHS. It is a class of message containing only an envelope which is conveyed by the message transfer agents (MTAs) from one user up to the MTA serving other users, used to determine the deliverability of messages.

AMHS report. An instance of the category of information object defined as report in ISO/IEC 10021-2 and conveyed in the AMHS. It is generated by a message transfer agent (MTA) in order to report on the outcome or progress of a message or probe in the set of interconnected MTAs pertaining to the AMHS.

Application. The ultimate use of an information system, as distinguished from the system itself.

Application entity (AE). Part of an application process that is concerned with communication within the OSI environment. The aspects of an application process that need to be taken into account for the purposes of OSI are represented by one or more AEs.

Application entity (AE) qualifier. That part of the AE title that unambiguously identifies the particular application entity.

Application entity (AE) service interface. The interface between the application users and the application service provider.

Application entity (AE) title. An unambiguous name for an application entity.

Application layer. The seventh layer of the OSI reference model that controls application user access to the communication system and provides services to perform a logical association to other applications.

Application layer structure (ALS). The application layer structure refers to the internal architecture of the OSI application layer as described in ISO/IEC 9545.

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 protocol data unit (APDU). An Application protocol data unit is an (N) PDU where N refers to the application layer. An APDU is the basic unit of information exchanged between the airborne application and the ground application.

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 AE and the application user.

Application service element (ASE). The element in the communication system which executes the application specific protocol. In other words, it processes the application specific service primitive sequencing actions,

message creation, timer management, error and exception handling. The application's ASE interfaces only with the application's CF.

Application service element (ASE) service interface. The abstract interface through which the ASE service is accessed.

Note.— In version 1 of the ADS application, the ADS-ASE service interface coincides with the ADS-AE abstract service interface.

Application service object (ASO). An active element within (or equivalent to the whole of) the application-entity embodying a set of capabilities defined for the application layer that corresponds to a specific ASO-type (without any extra capabilities being used). An ASO is a combination of application service elements (ASEs) and ASOs that perform a specific function. An ASO that provides the functions of the establishment and data transfer phases is considered a complete protocol.

Application user. That abstract part of the aircraft or ground system that performs the non-communication related functions of the application.

Association control service element (ACSE). The association control service element is the common mechanism in the application layer structure (ALS) for establishing and releasing application service object (ASO) associations.

ATIS. The symbol used to designate automatic terminal information service.

ATIS application. An ATN application that supports the ATIS.

ATN. The symbol used to designate the aeronautical telecommunication network.

ATN application. Refers to an application that is designed to operate over ATN communication services.

ATN communication services. Composed of the internet communications service and the upper layers communications service.

ATN environment. The environment that relates to functional and operational aspects of the ATN as a complete end-to-end communication system.

ATN profile requirement list (APRL). APRLs identify, in a tabular form, requirements together with the options and parameters for protocols used in the ATN. The supplier of an ATN protocol implementation claiming to conform to the ATN technical requirements must indicate conformance to those requirements by preparing a protocol implementation conformance statement (PICS) based on the set of APRLs.

ATS. The symbol used to designate air traffic services.

ATSC. The symbol used to designate air traffic services communication.

ATSC class. The ATSC class parameter enables the ATSC user to specify the quality of service expected for the offered data. The ATSC class value is specified in terms of ATN end-to-end transit delay at 95% probability.

ATS communication (ATSC). Communication 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 involves one or more air traffic service administrations. This term is used for purposes of address administration.

ATS interfacility data communication (AIDC). Automated data exchange between air traffic services units, particularly in regard to co-ordination and transfer of flights.

AIDC application. An ATN application dedicated to exchanges between ATS units (ATSUs) of air traffic control (ATC) information in support of flight notification, flight coordination, transfer of control, transfer of communication, transfer of surveillance data and transfer of general data.

ATS message. A unit of user-data, coded in binary form, which is conveyed from an originator of the data to one or more recipients of the data. It is possible to associate a unique message identifier and a priority with each ATS message.

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.

ATS message protocol stack Type A. The protocol implemented between two ATN end systems which support the ATN pass-through service.

ATS message server. An ATN end system which provides the relay function included in the ATS message service. It may also optionally provide the storage function included in the ATS message service.

ATS message handling system (AMHS). The set of computing and communication resources implemented by ATS organizations to provide the ATS message service.

ATS message user agent. An ATN end system which provides an interface to the ATS message service for an ATS message service user.

ATSMHS. The symbol used to designate ATS message handling services.

ATS organization. An ICAO State or organization which administers one or more ATS end and/or intermediate systems.

ATS unit (ATSU). A generic term meaning variously, air traffic control unit, flight information centre or air traffic services reporting office.

Authorized path. A communication path that the administrator(s) of the routing domain(s) has pre-defined as suitable for a given traffic type and category.

Automatic dependent surveillance (ADS). A surveillance 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.

Automatic terminal information service (ATIS). The provision of current, routine information to arriving and departing aircraft throughout the day or a specified portion of the day, via a data link or a continuous and repetitive voice broadcast.

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

CIDIN. The symbol used to designate common ICAO data interchange network.

CM. The symbol used to designate context management.

Connectionless network protocol (CLNP). The protocol responsible for forwarding packets through the ATN internet communications service.

Context management (CM) application. An ATN application that provides a logon service allowing initial aircraft introduction into the ATN and a directory of all other data link applications on the aircraft. It also includes functionality to forward addresses between ATS units.

Note.— Context management is a recognized OSI presentation layer term. The OSI use and the ATN use have nothing in common.

Controller pilot communication (CPC). In a controlled airspace, continuous listening watch on the appropriate radio frequency (either manual or automatic with signaling devices) and establishment of two-way communication with the appropriate air traffic control (ATC) unit.

Controller pilot data link communication (CPDLC). A means of communication between controller and pilot, using data link for ATC communications.

CPDLC application. An ATN application that provides a means of ATC data communication between controlling, receiving or downstream ATS units and the aircraft, using air-ground and ground-ground subnetworks, and which is consistent with the ICAO phraseology for the current ATC voice communication.

Control function (CF). That abstract part of the AE that performs the mapping between the ASE service primitives, the association control service element (ACSE) service primitives and other elements within the application entity.

Controlling ATSU (C-ATSU). The air traffic control unit exercising legal authority over the initiation, continuation, diversion or termination of flights and providing air traffic control service to controlled flights in the control area under its jurisdiction.

CPDLC. The symbol used to designate controller pilot data link communication.

Current data authority. The ground system that provides for the establishment and maintenance of a transport connection for the purposes of conducting a CPDLC dialogue pertaining to the services of the C-ATSU.

Data authority. A ground system that provides for the establishment and maintenance of a CPDLC transport connection with an aircraft. The transfer of communication from the current data authority to the next data authority is prepared prior to the actual data link switch by designating a next data authority in a specific CPDLC message.

Data communications equipment (DCE). An interface between data terminal equipment and the transmission mechanism.

Data link layer. The second layer of the OSI reference model that manages the operations of the physical layer and may utilize special error detection or retransmission techniques to achieve acceptable error rates.

Demand contract (DC). A contract between a requestor and a provider of information service, such as ADS or FIS, to provide a single report to the requestor (vs. Continual reports to one request).

Dialogue. A co-operative relationship between elements which enables communication and joint operation.

Dialogue service (DS). The lower service boundary of an ASE; the service allows two ASEs to communicate, such as a CM ground-ASE to communicate with a CM air-ASE.

Directory. A facility that supports on request the retrieval of address information or the resolution of application names.

Distinguishing path attribute (DPA). Used to discriminate among multiple routes to a destination, based on differences in the quality of service between the routes (for example, expense, transit delay or residual error probability.)

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.

Domain specific part (DSP). An addressing authority is responsible for its own addressing subdomain and network service access point (NSAP) addresses within that addressing domain are distinguished, where necessary, by the value of the DSP.

Downstream ATSU (D-ATSU). D-ATSU handles the coordination of the conditions of transfer for a flight from the controlling ATSU (C-ATSU) which may notify the D-ATSU of a flight's cleared profile prior to its effective transfer to the receiving ATSU (R-ATSU).

Downstream clearance (DSC). Specific clearance request by an aircraft to an ATSU which is not the controlling ATSU. The initiation of the DSC service can only be initiated by an aircraft.

Downstream data authority. The ground system that is permitted to conduct a downstream CPDLC downstream clearance (DSC) dialogue with an aircraft.

DSC. The symbol used to designate downstream clearance.

Emergency contract. A contract to provide ADS reports at regular intervals during an emergency situation.

End routing domain (ERD). A routing domain (RD) that only routes protocol data units (PDUs) from/to its own RD.

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

End-to-end. Pertaining or relating to an entire communication path, typically from (1) the interface between the information source and the communication system at the transmitting end to (2) the interface between the communication system and the information user or processor or application at the receiving end.

End user. An ultimate source and/or consumer of information.

Entity. An active element in any layer which can either be a software entity (such as a process) or a hardware entity (such as an intelligent I/O chip).

Estimated time of arrival (ETA). For IFR flights, the time at which it is estimated that the aircraft will arrive over that designated point, defined by reference to navigation aids, from which it is intended that an instrument approach procedure will be commenced, or if no navigation aid is associated with the aerodrome, the time at which the aircraft will arrive over the aerodrome. For VFR flights, the time at which it is estimated that the aircraft will arrive over the aerodrome.

Ethernet. Based on the local area network standard, ISO/IEC 8802-3, carrier sense multiple access with collision detection (CSMA/CD) access method, and physical layer specifications using broadcast technology which may connect as an ATN subnetwork.

Expense. The cost to perform some task. In the context of internetworking, expense is defined in terms of the incremental expense incurred for transfer of a single network service data unit (NSDU) of 512 octets in size.

Extended projected profile. A projected profile extended up to a number of way points.

Fast byte. The capability at any layer of the OSI reference model to negotiate out the capabilities of the base protocol.

Figure of merit (FOM). An indication of the level of accuracy of positional information given in an ADS report.

FIS. The symbol used to designate flight information service.

FIS application. An ATN application that provides to aircraft information and advice useful for safe and efficient conduct of flight.

FIS contract. An agreement between a FIS air-user and a FIS ground-user that the latter will provide FIS reports under the conditions specified in the FIS contract.

Flight information region (FIR). An airspace of defined dimensions within which flight information service and alerting service are provided.

Flight information service (FIS). A service provided for the purpose of giving advice and information useful for the safe and efficient conduct of flights.

Flight plan. Specified information provided to air traffic services units, relative to an intended flight or portion of a flight of an aircraft.

Note.— Specifications for flight plans are contained in Annex 2. A model Flight Plan Form is contained in Appendix 2 to PANS-RAC (Doc 4444).

Flow control. A function that controls the flow of data to perform buffer management within a layer or between adjacent layers.

Forward contract. A contract to provide a ground ADS system with ADS reports.

Forwarding information base (FIB). The information base that is maintained by each router and contains the set of forwarding paths reflecting the various policy and QoS rankings available to reach each known destination.

Function. A coherent set of activities which fulfils, by itself or together with other functionality, a concept. Examples of functions: conflict free planning; electronic representation of the flight.

Functional requirements. 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.

General communication. A category of communications which includes APC, public correspondence and other non-operational and non-administrative communication.

Ground application service element (ground-ASE). An abstract part of the ground system that performs the communication related functions of the application.

Ground user (ground-user). The abstract part of the ground system that performs the non-communication related functions of the application.

Ground earth station (GES). An earth station in the fixed satellite service, or, in some cases, in the aeronautical mobile-satellite service, located at a specified fixed point on land to provide a feeder link for the aeronautical mobile-satellite service.

Note.— This definition is used in the ITU's Radio Regulations under the term "aeronautical earth station." The definition herein as "GES" for use in the SARPs is to clearly distinguish it from an aircraft earth station (AES), which is a mobile station on an aircraft.

Ground forwarding function. The capability for a ground system to forward a CPDLC message to another ground system via a CPDLC message with an indication of success, failure or non-support from the receiving ground system. This function may be invoked by the current data authority in order to avoid retransmission of a request by an aircraft by forwarding the information to the next data authority. The downstream data authority may use this function in order to relay a message to the current data authority which then performs the actual transmission to the aircraft.

Ground-ground application. An application that has one both of its peer applications on the ground.

ICAO Facility Designator (ICAO AFTN Addressee Indicator). An eight-letter code group formulated in accordance with rules prescribed by ICAO and assigned to the ATS end system executing an application process.

ICC. The symbol used to designate inter-centre communication.

ICS. The symbol used to designate the internet communication services.

Initial domain part (IDP). The addressing authority responsible for an addressing subdomain that assigned the network service access point (NSAP) address and that specified the abstract syntax and structure of the remainder of the NSAP address.

Inter-centre communication (ICC). ICC is data communication between ATS units to support ATS, such as notification, coordination, transfer of control, flight planning, airspace management and air traffic flow management.

Intermediate system (IS). A system which performs relaying and routing function and comprises the lowest three layers of the OSI reference model.

International Alphabet No. 5 (IA5). International Alphabet Number 5 defined by ITU-T.

Note.— ATN uses the “6 bit ASCII” subset of IA5, as used in SSR Mode S specifications.

Internet communications service (ICS). The internet communications service 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 ISO OSI reference model.

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

Internetwork protocol (IP). A protocol that performs the basic end-to-end mechanism for the transfer of data packets between network entities. In the ATN internet communications service, the ISO/IEC 8473 internetwork protocol is used.

Interoperability. Describes the ability of the ATN to provide, as a minimum, a transparent data transfer service between end systems even though the ATN comprises various ground, air-to-ground and avionics subnetworks. The ability to interoperate between end systems can be extended to include commonality of upper layer protocols.

ISO. The symbol used to designate International Organization for Standardization.

ITU-T. The symbol used to designate International Telecommunication Union-Telecommunication Standardization Sector.

IETF. The symbol used to designate Internet Engineering Task Force.

Long transport service access point (TSAP). Composed of the router domain part (RDP) and the short TSAP.

Lower layers. The physical, data link, network and transport layers of the OSI reference model.

Managed object. Data processing and data communication resources that may be managed through the use of the OSI management protocol.

Management agent. Performs management operations on managed objects within its local environment as a consequence of management operations communicated from a manager. A management agent may also forward notifications emitted by managed objects to a manager.

Management domain (MD). 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.

Manager. The term given to a system that requests or otherwise receives information about managed objects.

Message. Basic unit of user information exchanged between an airborne application and its ground counterpart or between two ground applications. Messages are passed in one or more data blocks from one end user to another through different subnetworks.

Message element. A component of a message used to define the context of the information exchanged.

Message element identifier. The ASN.1 tag of the ATCUplinkMsgElementId or the ATCDownlinkMsgElementId.

Message handling system (MHS)-form address. An instance of the AMHS address form which is used to locate a direct or indirect AMHS user in the AMHS address space.

Message header. The control information used to maintain synchronization between the two end systems.

Mobile routing domains. Formed from ATSC and AINSC systems onboard an aircraft (or any other mobile platform), within the aircraft operator's administrative domain. A mobile RD is characterized as an end routing domain (ERD).

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. VHF/UHF radio, D band satellite or D band secondary surveillance radar) rather than contained media (e.g. wire or coaxial cable); thus they exhibit broadcast capabilities in the truest sense.

Mode select (Mode S). An enhanced mode of secondary surveillance radar (SSR) which permits the selective interrogation of Mode S transponders, the two-way exchange of digital data between Mode S interrogators and transponders and also the interrogation of Mode A or Mode C transponders.

Naming plan. A plan that provides common naming conventions and designations for the unambiguous identification of all end and intermediate systems in accordance with the rules prescribed in ISO/IEC 7498-3, ISO/IEC TR 10730 and ISO/IEC 9545.

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

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

Network entity title (NET). The global address of a network entity.

Network layer (NL). Provides a uniform service interface for the transfer of data among end systems and intermediate systems (ISs) utilizing the ISO protocol architecture.

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

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

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

Network service access point (NSAP) address prefix. Used to identify groups of systems that reside in a given routing domain or confederation. An NSAP prefix may have a length that is either smaller than or the same size as the base NSAP address.

Network topology map. Provides an overall view of the global network connectivity and is used in path computations by the operative routing algorithm.

Next data authority. The ground system that provides for the establishment and maintenance of a transport connection for the purposes of conducting a CPDLC dialogue pertaining to the services of the receiving ATS unit (R-ATSU).

NOTAM. A notice containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations.

Open systems interconnection (OSI) protocol architecture. A set of protocols used to implement the OSI reference model.

Open systems interconnection (OSI) reference model. A model providing a standard approach to network design introducing modularity by dividing the complex set of functions into seven more manageable, self-contained, functional layers. By convention these are usually depicted as a vertical stack.

Operational requirement. A statement of the operational attributes of a system needed for the effective and/or efficient provision of air traffic services to users.

OSI. The symbol used to designate open systems interconnection.

Packed encoding rules (PER). Encoding rules as defined in ISO/IEC 8825-2 which have been designed to minimize the number of bits transmitted.

Performance management. Enables the behavior of resources and the effectiveness of communication activities to be evaluated. Includes functions to gather statistical information, maintain and examine logs of system state histories, determine system performance under natural and artificial conditions and alter system modes of operation.

Performance requirements. Requirements that define a function's characteristics, such as reliability, availability, response time, processing delay, integrity, that are necessary to meet the operational requirements for a specific application of the function.

Periodic contract (PC). A contract to provide ADS reports at regular intervals.

Physical layer. The layer of the OSI reference model that controls access to the transmission medium which forms the basis for the communication system.

Presentation address (PA). The presentation address must, as a minimum, include a network service access point (NSAP) address and a transport service access point (TSAP) selector and may include a presentation service access point (PSAP) selector and session service access point (SSAP) selector based on the addressing structure adopted within the end system (ES) and whether the application requires the OSI session or presentation protocol.

Presentation data value (PDV). The unit of information specified in an abstract syntax, which is transferred by the OSI presentation-service (ISO/IEC 8822).

Presentation layer. The layer of the OSI reference model that controls the coding, format and appearance of the data transferred to and from the application layer.

Presentation service access point (PSAP) selector. The element of the presentation address that identifies the user of the presentation protocol entity.

Priority (P). The relative importance of a particular protocol data unit (PDU) relative to other PDUs in transit and used to allocate resources which become scarce during the transfer process.

Profile. Defines implementation conformance constraints on a set of reference specifications.

Projected profile. An indication of where and when the aircraft anticipates it will be at the following two way-points.

Protocol. A set of rules and formats (semantic and syntactic) which determines the communication behavior between peer entities in the performance of functions at that layer.

Protocol control information (PCI). Information included in a layer header which contains service primitives specific to that layer.

Protocol data unit (PDU). (1) A unit of data transferred between peer entities within a protocol layer consisting of protocol control information and higher layer user data (i.e. service data units). (2) A unit of data specified in an (N) protocol and consisting of (N) protocol control information and possibly (N) user data, where N indicates the layer.

Protocol implementation conformance statement (PICS). A protocol implementation conformance statement enables conformance testing of protocols. As recommended by ISO/IEC 9646-2, PICS proforma, tailored to ATN context, have been developed as ATN profile requirement list (APRLs) to provide an effective basis for conformance testing of implementations.

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.

RFC. The symbol to designate Request for Comments.

Receiving ATSU (R-ATSU). The next air traffic control unit which is the process of accepting the control authority and communication responsibility for a flight transferred by the controlling ATSU (C-ATSU).

Relaying. The process of transferring packets across subnetworks including any necessary packet conversion.

Requested QoS. The service characteristics desired by the service user.

Reserved value. Legal values for the respective fields (have not yet been assigned specific meanings by ICAO). These values should be processed normally in order to allow future assignment. Meanings may be assigned in the future and are not available for local use. The allocation of these values requires no change in the version identifier.

Residual error probability. Indicates the likelihood that a protocol data unit (PDU) will be lost, duplicated or corrupted. This probability is defined as the ratio of lost, duplicated or corrupted network service data units (NSDUs) to the total number of NSDUs transmitted by an ATN network service (NS) provider, normalized for an NSDU size of 512 octets.

Residual error rate (RER). The ratio of messages mis-delivered, non-delivered or delivered with an error undetected by the system, to the total number of messages delivered to the system during a measurement period (adapted from ISO/IEC 8072).

Note.— For the ATN, detected mis-delivered and non-delivered messages are not included in the ratio.

Route. The set of addresses that identifies the destinations reachable over the router and information about the route's path including the QoS and security available over the route.

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. A 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 which that entity can be reached.

Routing area (RA). A routing subdomain comprising one or more intermediate systems (ISs) and optionally one or more end systems (ESs).

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

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

Routing information base (RIB). A data base that is maintained by each router and comprises the information regarding the connectivity and topology of the end systems (ESs) and intermediate systems (ISs) within a particular routing domain and path information pertinent to paths interconnecting routing domains. It is maintained by way of the information received by a routing information exchange protocol. Each routing information exchange protocol has its own RIB specification.

Routing information exchange protocol. The protocol used to exchange subnetwork connectivity information between end systems and intermediate systems and between intermediate systems and intermediate systems.

Routing policy. A set of rules that control the selection of routes and the distribution of routing information by 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:

- a) general routing policy to ensure necessary connectivity at a reasonable routing information update rate, and
- b) user specified routing policy, i.e. individual policy rules which may be additionally implemented in BISs by administrations and organizations to meet their specific operational and policy needs.

Runway visual range (RVR). The range over which the pilot of an aircraft on the centre line of a runway can see the runway surface markings or the lights delineating the runway or identifying its centre line.

Secondary surveillance radar (SSR). A surveillance radar system which uses transmitters/receivers (interrogators) and transponders.

Security label. May indicate requirements for protection of a protocol data unit (PDU) and provide information used by network layer access control functions.

Service data unit (SDU). A unit of data transferred between adjacent layer entities, which is encapsulated within a protocol data unit (PDU) for transfer to a peer layer.

Service primitive. A function of an application service element (ASE) that is not broken down further into subfunctions and is presented as part of the abstract service interface (i.e. request, indication, response or confirmation).

Service provider. The ground and airborne application entities (AEs) for the application, all underlying data communication protocol entities and the physical media. As a consequence, it encompasses everything between the application-AE service interfaces of the end users of the application.

Session layer. The layer of the OSI reference model that establishes the rules of dialogue between two end user entities.

Session service access point (SSAP) selector. The element of the session address that identifies the user of the session protocol entity.

Short transport service access point (TSAP). Composed of the administrative region selector (ARS), (Optional), the location identifier (LOC), the system identifier (SYS), the network selector (SEL), and the transport selector (TSAP selector).

Stack (or protocol stack). A set of cooperating OSI protocols selected from different layers of the basic reference model. Hence, upper layer stack refers to session, presentation and application protocols, while lower layer stack refers to physical, data link, network and transport protocols.

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

Subnetwork access protocol (SNAP). The actual protocol used to receive services for a particular sub-network. For example, the subnetwork access protocol to many public data networks is X.25.

Subnetwork dependent convergence function (SND CF). The set of rules and procedures needed to convert the data transfer needs of the subnetwork independent convergence protocol to the actual services provided by a subnetwork.

Subnetwork (SN) domain. The set of end systems and intermediate systems connected to the same physical network.

Subnetwork independent convergence function (SNICF). The common protocol for all host computers and routers that is used for the transfer of data. The SNICF is the connectionless network protocol defined by ISO/IEC 8473.

Subnetwork point of attachment (SNPA). The point at which a real end system, interworking unit or real subnetwork is attached to a real subnetwork and is a conceptual point within an end or intermediate system at which the subnetwork service is offered.

Subnetwork point of attachment (SNPA) address. Provides information used in the context of a particular real subnetwork to identify a SNPA. An SNPA address is a subnetwork address such as X.25 data terminal equipment (DTE) addresses, ethernet MAC addresses, etc.

Subset. An implementation of an application air or ground service conforming to the application SARPs which supports a defined, technically acceptable but not complete application functionality.

Subsetting rules. Formal instructions relating to the requirement for combinations of elements within an application SARPs, constituting limited application functionality.

System application. An application supports the operation of the air-ground applications, ground-ground applications, or communication services. A system application can take the form of either an air-ground application or a ground-ground application.

System level requirement. The system level requirement is a high-level technical requirement that has been derived from operational requirements, technological constraints and regulatory constraints (administrative and institutional). The system-level requirements are the basis for the functional requirements and lower level requirements.

Systems management (SM). ATN systems management gives deterministic and controllable behaviour in support of the required communications service levels by providing facilities to control, co-ordinate and monitor the resources which allow communications to take place in the ATN environment. These facilities include fault management, accounting management, configuration management, performance management and security management.

Traffic category. A subdivision of the operational communication traffic type used to distinguish between ATS communication and aeronautical operational control (AOC).

Traffic type. A means used to distinguish different types of message traffic for the purposes of establishing communication paths to support operational and legal requirements. There are four traffic types:

- a) the operational communication traffic type is subdivided into two categories representing safety and regularity of flight communication:
 - 1) ATS communication
 - 2) Aeronautical operational control
- b) administrative communication representing non-safety and regularity of flight communication sent by aircraft operating agencies and ATS administrations
- c) general communication, representing APC, public correspondence and other non-operational and non administrative communication, and
- d) systems management communication representing systems management information that is critical for support of network operations.

Note.— The differentiation of traffic types is required because different data traffic may have different access to subnetworks. The traffic type is conveyed in the ATN security label of ISO/IEC 8473 and ISO/IEC 10747. It is used to qualify connectionless mode network protocol (CLNP) data packets and (inter-domain) routes according to the class of traffic that they carry. Based on this qualification, access of subnetworks is controlled by the ATN internet communications service.

Transit delay. In packet data systems, the elapsed time between a request to transmit an assembled data packet and an indication at the receiving end that the corresponding packet has been received and is ready to be used or forwarded.

Transit routing domain (TRD). A domain whose policies permit its boundary intermediate systems (BISs) to provide relaying for protocol data units (PDUs) whose source is located in either the local routing domain or in a different routing domain.

Transport layer. The fourth layer of the OSI reference model which ensures that the data are reliably delivered to the correct destination regardless of which network layer protocol and underlying subnetworks are being used.

Transport protocol class 4 (TP-4). Transport protocol class 4 is defined in ISO/IEC 8073 and profiled for ATN context to provide the connection mode transport service as described in ISO/IEC 8072.

Transport service access point (TSAP). The logical access point to the transport layer.

Transport service access point (TSAP) address. The complete communication address which unambiguously defines a transport service user. The TSAP address comprises the NSAP address and a TSAP selector.

Transport service data unit (TSDU). The data presented to the transport layer for transmission over the ATN internet communications service.

Update contract (UC). A contract to provide a piece of FIS information and any update of this information.

Upper layer (UL) communications service. A term pertaining to the session, presentation and application layers of the OSI reference model.

User. That abstract part of the aircraft or ground system that performs the non-communication related functions of the application. The direct user of the ATN is an application within an end system supporting ATS or aeronautical industry services. The air traffic controller, other ground staff or the pilot are users of the ATN. The user may also be seen more on the abstract level as an organization, e.g. airline or service provider

User requirements. Requirements that are allocated to the user to ensure the interoperability of the communication services and application entities.

UTC. The symbol used to designate coordinated universal time.

Very high frequency (VHF) digital link (VDL). Packet data communication to aircraft and ground users comprised of airborne VHF data radios (VDRs), VHF ground stations and connectivity to routers on the aircraft and the ground.

X.25 packet switched data network (PSDN). A communication network that provides a network access service in compliance with CCITT recommendation X.25.

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1.2 GENERAL

1.2.1 The aeronautical telecommunication network (ATN) shall provide data communication services and application entities in support of:

- a) the delivery of air traffic services (ATS) to aircraft;
- b) the exchange of ATS information between ATS units; and
- c) other applications such as aeronautical operational control (AOC) and aeronautical administrative communication (AAC).

Note 1.— The conceptual model of the ATN is as shown in Figure 1.2.

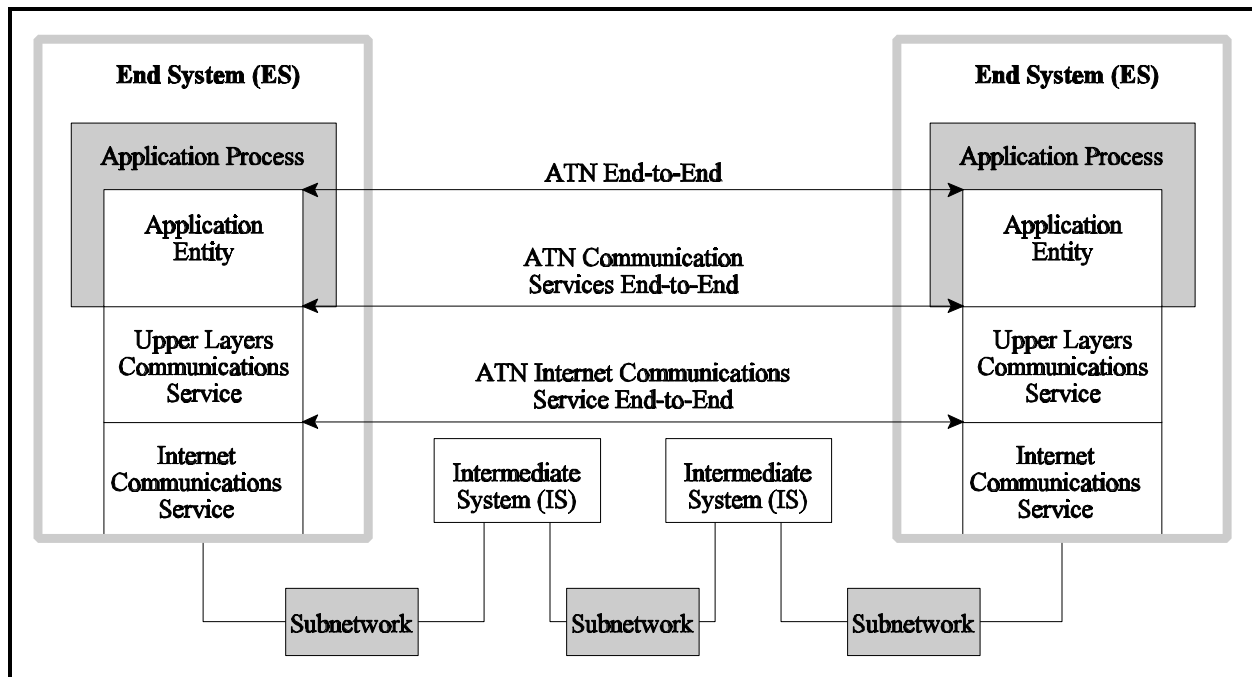
Note 2.— Provisions have been made to accommodate the exchange of information between aircraft operator ground based systems and ATS units, such as weather, flight plans, notices to airmen and dynamic real time air traffic flow management.

Note 3.— Provisions have also been made to accommodate aeronautical passenger communication (APC).

1.2.2 When the aeronautical telecommunication network is used in support of air traffic services, it shall conform with the provisions of this document.

1.2.3 Requirements for use of the ATN shall be made on the basis of regional air navigation agreements.

1.2.4 **Recommendation.**— *Civil aviation authorities should co-ordinate, with national authorities and aeronautical industry, those implementation aspects of the ATN which will permit its world-wide safety, interoperability and efficient use, as appropriate.*



Note 1.— Shading indicates elements outside the scope of these SARPs. User requirements define the interface between the application entity and the user and ensure the functionality and interoperability of the ATN.

Note 2.— The figure represents a simplified model of the ATN and does not depict all of its capabilities (e.g. the store and forward capability which is provided for ATS message handling service).

Note 3.— Various end-to-end points have been defined within the ATN to specify certain end-to-end performance requirements. It may be necessary, however, to define different end-to-end points to facilitate the qualification of implementations to those performance requirements. In such cases, the end-to-end points should be clearly defined and correlated with the end-to-end points shown in the figure.

Figure 1.2. Conceptual model of the ATN

1.3 SYSTEM LEVEL REQUIREMENTS

Note.— The system level requirements are high-level technical requirements that have been derived from operational requirements, technological constraints and regulatory constraints (administrative and institutional). These system-level requirements are the basis for the functional requirements and lower level requirements.

1.3.1 The ATN shall use International Organization for Standardization (ISO) communication standards for open systems interconnection (OSI).

1.3.2 The ATN shall provide a means to facilitate migration to future versions of application entities and/or the communication services.

Note.— It is an objective that the evolution towards future versions facilitates the backward compatibility with previous versions.

1.3.3 The ATN shall enable the transition of existing AFTN users and systems into the ATN architecture.

1.3.4 The ATN shall make provisions whereby only the controlling ATS unit may provide ATC instructions to aircraft operating in its airspace.

Note.— This is achieved through the current and next data authority aspects of the CPDLC application entity.

1.3.5 The ATN shall accommodate routing based on a pre-defined routing policy.

1.3.6 The ATN shall provide means to define data communication that can be carried only over authorized paths for the traffic type and category specified by the user.

1.3.7 The ATN shall offer ATSC classes in accordance with the criteria in Table 1-1.

Table 1-1. Transit delays for ATSC Classes

Maximum One way ATN End-to-End Transit Delay at 95% probability (seconds)	ATSC Class
Reserved	A
4.5	B
7.2	C
13.5	D
18	E
27	F
50	G
100	H
No value specified	no preference
<i>Note 1.— The value for the ATN end-to-end transit delay represents approximately 90% of the value for the total end-to-end transit delay between the ultimate users of the system.</i> <i>Note 2.— The 95% probability is based on the availability of a route conforming to the requested ATSC class.</i>	

Note 1.— When ATSC class is specified by an application process, packets will be forwarded in the ATN internet communications service on a best effort basis. Best effort basis means that when a route is available of the requested ATSC class the packet is forwarded on that route. When no such route is available, the packet will be forwarded on the first known route of ATSC class higher than that requested, or if there is no such route, first known route of lower ATSC class than that requested.

Note 2.— The ATN communication services will not inform application entities if the requested ATSC class was not achieved. It is the responsibility of the application entity to determine the actual transit delay achieved by local means such as time stamping.

1.3.8 The ATN shall operate in accordance with the communication priorities defined in Table 1-2 and Table 1-3.

Table 1-2. Mapping of ATN Communication Priorities

Message Categories	ATN Application	Corresponding Protocol Priority	
		Transport Layer Priority	Network Layer Priority
Network/Systems Management		0	14
Distress Communications		1	13
Urgent Communications		2	12
High Priority Flight Safety Messages	CPDLC, ADS	3	11
Normal Priority Flight Safety Messages	AIDC	4	10
Meteorological Communications		5	9
Flight Regularity Communications	CM, ATSMHS	6	8
Aeronautical Information Service Messages	ATIS	7	7
Network/Systems Administration		8	6
Aeronautical Administrative Messages		9	5
<unassigned>		10	4
Urgent Priority Administrative and U.N. Charter Communications		11	3
High Priority Administrative and State/Government Communications		12	2
Normal Priority Administrative		13	1
Low Priority Administrative		14	0
<i>Note 1.— Priorities above the bold line are for communications related to safety and regularity of flight.</i> <i>Note 2.— The network layer priorities shown in the table apply only to connectionless network priority and do not apply to subnetwork priority.</i>			

Table 1-3. Mapping of ATN Network Priority to Mobile Subnetwork Priority

Message Categories	ATN Network Layer Priority	Corresponding Mobile Subnetwork Priority		
		AMSS	VDL (Mode 1 and Mode 2)	SSR Mode S
Network/Systems Management	14	14	see note 2	high
Distress Communications	13	14	see note 2	high
Urgent Communications	12	14	see note 2	high
High Priority Flight Safety Messages	11	11	see note 2	high
Normal Priority Flight Safety Messages	10	11	see note 2	high
Meteorological Communications	9	8	see note 2	low
Flight Regularity Communications	8	7	see note 2	low
Aeronautical Information Service Messages	7	6	see note 2	low
Network/Systems Administration	6	5	see note 2	low
Aeronautical Administrative Messages	5	5	see note 2	not allowed
<unassigned>	4	not applicable	see note 2	not allowed
Urgent Priority Administrative and U.N. Charter Communications	3	3	see note 2	not allowed
High Priority Administrative and State/Government Communications	2	2	see note 2	not allowed
Normal Priority Administrative	1	1	see note 2	not allowed
Low Priority Administrative	0	0	see note 2	not allowed
<i>Note 1.— Priorities above the bold line are for communications related to safety and regularity of flight.</i> <i>Note 2.— VDL Mode 1 and Mode 2 have no specific subnetwork priority mechanisms.</i> <i>Note 3.— The AMSS SARPs specify mapping of message categories to subnetwork priority without explicitly referencing ATN network layer priority.</i> <i>Note 4.— The term “not allowed” means that only communications related to safety and regularity of flight are authorized to pass over this subnetwork as defined in the subnetwork SARPs.</i>				

1.3.9 The ATN shall enable exchange of application information when one or more authorized paths exist.

1.3.10 The ATN shall notify the appropriate application processes when no authorized path exists.

1.3.11 The ATN shall provide means to unambiguously address all ATN end and intermediate systems.

1.3.12 The ATN shall enable the recipient of a message to identify the originator of that message.

1.3.13 The ATN addressing and naming plans shall allow States and organizations to assign addresses and names within their own administrative domains.

- 1.3.14 The ATN shall support data communication to fixed and mobile systems.
- 1.3.15 The ATN shall accommodate ATN mobile subnetworks as defined in this Annex.
- 1.3.16 The ATN shall make provisions for the efficient use of limited bandwidth subnetworks.
- 1.3.17 The ATN shall enable an aircraft intermediate system to be connected to a ground intermediate system via concurrent mobile subnetworks.
- 1.3.18 The ATN shall enable an aircraft intermediate system to be connected to multiple ground intermediate systems.
- 1.3.19 The ATN shall enable the exchange of address information between application entities.
- 1.3.20 The ATN shall support the context management (CM) application when any of the other air-ground applications are supported.
- 1.3.21 The ATN shall be capable of establishing, maintaining, releasing and aborting peer to peer application associations for the context management (CM) application.
- 1.3.22 The ATN shall be capable of establishing, maintaining, releasing and aborting peer to peer application associations for the automatic dependent surveillance (ADS) application.
- 1.3.23 The ATN shall be capable of establishing, maintaining, releasing and aborting peer to peer application associations for the controller pilot data link communication (CPDLC) application.
- 1.3.24 The ATN shall be capable of establishing, maintaining, releasing and aborting peer to peer application associations for the automatic terminal information service (ATIS) application.
- 1.3.25 The ATN shall be capable of establishing, maintaining, releasing and aborting application associations for the ATS message handling services (ATSMHS) application.
- 1.3.26 The ATN shall be capable of establishing, maintaining, releasing and aborting peer to peer application associations for the ATS interfacility data communication (AIDC) application.
- 1.3.27 Where the absolute time of day is used within the ATN, it shall be based on coordinated universal time (UTC).
- 1.3.28 The end system shall make provisions to ensure that the probability of not detecting a 255-octet message being mis-delivered, non-delivered or corrupted by the internet communications service is less than or equal to 10^{-8} per message.

Note.— It is assumed that ATN subnetworks will ensure data integrity consistent with this system level requirement.
