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# Introduction (BOEING)

## Purpose

## Scope

## Relationships to other Standards Activities and Documents

## Document Organization

This document is generally organized in six sections as follows:

* Section 1 – Introduction

This section ….

* Section 2 – ATN/IPS Overall Architecture

This section ….

* Section 3 – ATN/IPS Airborne Architecture

This section ….

* Section 4 – Security

This section ….

* Section 5 – ATN/IPS Airborne Implementation Options

This section ….

* Section 6 – Airborne Application Data Considerations

This section ….

* Attachment 1 – List of Acronyms

This attachment provides a list of acronyms used in the report.

* Attachment 2 – Glossary

This attachment explains the precise meaning of terms used in this report to avoid ambiguity and confusions.

* Appendix A – ATN/IPS Ground Architecture Considerations

This appendix ….

* Appendix B – Airbus Profiles

This appendix ….

* Appendix C – Boeing Profiles

This appendix ….

# ATN/IPS OVERALL ARCHITECTURE (TH)

## System overview

### Introduction

The IPS system described within this document is designed to provide the airborne element of an end-to-end data communications service between applications on an aircraft and applications on the ground. It is delivered over a selection of communications bearers with differing characteristics, such as bandwidth, delay and security provision, but in such a way that the bearer or bearers in use at any particular time remain invisible to the applications and the users of the system.

The ATN/IPS system uses the Internet Protocol Suite as a network protocol. This allows aviation data communications to benefit from the ubiquity of IP and years of real network experience that underpins its use in demanding and critical communications environments. Reflecting the evolution of IP that is happening in the commercial Internet, ATN/IPS has adopted the IPv6 standard.

Whilst this section discusses the overall IPS architecture, this document defines only the airborne element of the IPS system.

### Logical End-to-End Architecture

The ATN/IPS system comprises an airborne element and a ground based element to deliver its functionality. Figure 1 provides an illustration of the two elements of the system within the context of existing communications infrastructure.



Figure 1 IPS System Context Diagram

### The Airborne System

The airborne system connects to the existing data capable radios, namely the VHF and L-Band Satellite devices currently certified for safety communication. It is recognized that the IPS system will have to be capable of accommodating legacy equipment and its connectivity, as well as newer equipment. It will also have to accommodate existing functionality such as the ACARS routing function and the architecture shall take account of this. The airborne IPS system will also connect to future planned radios such as AeroMACS and LDACS as these become available.

If the radios have a native IPv6 interface for safety critical data, this may be used to pass traffic. However, the VHF radios do not support IP natively and so adaptation is required. This will be discussed in detail in later sections.

The existing ACARS routing capability does not form part of the IPS system although its wider connectivity to aircraft systems and its need to access the data communications radios will necessitate its consideration within this document. Both the airborne IPS System and the ACARS router connect to the External Communications Manager which provides the control necessary to ensure a functioning coexistence of the two operations.

The airborne IPS System is designed to provide connectivity for existing and future ATS applications. The IPS system is specified to connect to the AC domain on the aircraft and to serve applications hosted within this domain. There is no provision within the architecture to connect to the AIS Domain and any shared use of communications bearers shall be handled by arbitration functions embedded with the radios. ATS applications currently delivered over ACARS infrastructure, are intended to be migrated to ATN/IPS.

An ATN/IPS system will not support ATN/OSI. To this end, the ATN/IPS system shall provide a Dialog Service (DS) to the applications with an identical interface to that provided by the ATN/OSI. Thus existing ATN applications shall be able to use the new protocol suite without change. It is however recognized that some aircraft will operate an ATN/OSI capability for some time after the introduction of ATN/IPS and that an accommodation will be required. It is a requirement that such an accommodation be implemented within the ground segment of the ATN system. There is no intention for any aircraft to support both ATN/OSI and ATN IPS.

### The Ground System

Although not the focus this document, the IPS ground system complements the airborne system and so provides a vital part of the overall capability of the ATN/IPS. As can be seen from figure 1 earlier, the ground system employs an IPS gateway function which connects to all supported radios via their ground stations. The ground stations are required to identify and handle the radio data traffic such that the ATN/IPS data is separated from any other data. In this way, existing data protocols may continue to operate without hindrance from the new IPS service. IPS traffic is then directed over the IPS ground network to hosts running ATN applications.

It is recognized that the transition to ATN/IPS from ATN/OSI will take some time and there will be a period of transition during which some regions continue to operate an OSI based infrastructure whilst others adopt IPS. Furthermore, some (possibly older) aircraft will be fitted with OSI based equipment while newer aircraft may adopt IPS. The ground system will be required to take account of this diversity and accommodate all possible aircraft configurations.

The ground system will thus be capable of receiving ACARS, ATN/OSI and ATN/IPS protocols and directing the application data contained therein to the most appropriate end system. This may involve protocol translation to allow application data generated within one regime to be handled by the other regime on the ground. This functionality will be handled by the IPS Gateway function.

### Applications

Whilst current communications services support ATN applications, the introduction of the ATN/IPS system acts as an enabler for the enhancement of aviation data-link services. As shown below, current services include ATN-B1 and B2 carried over the OSI protocol suite and FANS 1/A and ARINC623 applications carried over the ACARS data links.



Figure 2 Applications and Networks and Networks (modified from ARINC 658 Fig 1-2)

Note that the above figure has been modified to reflect the agreed scope of the IPS system and does not now include a connection to the AIS domain. AOC applications’ data hosted on the AC domain will be handled by ATN/IPS; AOC applications in the AIS domain will be handled by separate AISD IP routing.

The ATN/IPS service (shown in blue) will continue to support FANS-1/A and ARINC623 applications, but over the IPS protocols. It will also support the introduction of full ATN Baseline 2 and Baseline 3 operations.

#### ARINC 623

ARINC Specification 623 covers character based ATS messages transmitted over ACARS. These messages are not directly compatible with the IPS system and would require an adaptation layer to be defined.

#### FANS

FANS-1/A and FANS-1/A+ comprise CPDLC messaging and ADS-C position reporting and operate over the ACARS network. As a bit oriented protocol, FANS uses ARING 622 mechanisms to adapt to the character oriented protocols of ACARS. As in the case of ARINC-623, FANS will require an adaptation later to operate over ATN/IPS

#### Baseline 1 (B1)

Baseline 1 is a subset of the ICAO ATN application set defined under ICAO 9705 and ICAO 9880. It includes Context Management, ADS-C, CPDLC and FIS although currently only CPDLC and CM are implemented in production systems. It is specified to operate over OSI protocols and its use is mandated within European airspace over VDL mode 2 carriers above Flight Level 285.

The ICAO 9880 specification includes a Dialog Service between the application and the OSI stack. To facilitate the transfer to an IPS bearer, ICAO 9896 specifies a new Dialog Service that mimics the service interface defined for by ICAO 9880.

#### Baseline 2 (B2)

The transition from B1 to B2 represents a significant expansion of ATN capability and includes 4D Trajectory based operations and airport services. The transition to full B2 functionality will be made using a stepped approach starting with B2A which will be implemented over ATN/OSI within Europe. As with B1, these services will be accommodated on ATN/OSI using the Dialog Service specified in ICAO9896.

#### Baseline 3

The future of ATN beyond B2 is currently undefined and may continue to use the Dialog Service indicated above or may define a new service.

#### AOC Applications

Applications such as flight planning, weather information, etc. are currently carried over the ACARS network. The ATN/IPS system is designed to accommodate AOC safety applications currently run on ACD resources and is not intended to accommodate those applications hosted on AISD platforms. Whilst current AOC applications can be handled using an adaptation layer, future applications should be designed to operate over the IPS network natively.

#### Aeronautical Information Management (AIM)

AIM applications are currently being developed. Most of these services are expected to utilize AISD connectivity and thus fall outside the scope of the ATN/IPS considered here. However the ATN/IPS will be capable of handling such applications if written to communicate natively over IPS.

*Editor’s Note: It should be confirmed which, if any, AIM applications are likely to be hosted on the AC Domain*

## Airborne IPS System Functions

The Airborne IPS System comprises a number of functions that have a significant effect outside of the system itself. These functions are functionally described in Section §3.

### Mobility

As shown above, the airborne IPS system connects to one or more radio based bearers which will change depending on the current flight phase. Such transitions bay occur at the edge of Flight Information Regions or as the aircraft transitions from one type of airspace to another or when the aircraft takes off or lands. Even within a block of airspace, the available communications channels may change resulting in a change of technology or provider.

It is a desirable feature of the operation of the system that such events are handled with minimum disruption to data flow and that the aircraft remains accessible at all times at an identifiable address.

Mobility is the function that enables this to occur.

### Security

The introduction of the Internet Protocol (IP) into safety critical systems has significant security implications. The Ubiquity of the Internet Protocol and the interconnected nature of IP networks, means that malicious activity directed towards IP hosts is extensive. Furthermore, it cannot be assumed that a network disconnected from the wider internet is immune from such risks. Thus, careful consideration is therefore required when determining how best to secure avionics equipment, software and networks connected to IP networks. The security architecture of the end-to-end ATN/IPS system is designed primarily to protect two key security attributes: the integrity of the communications and the availability of the communications service.

The IPS Security function manages the security features of the airborne IPS System. This includes key management for the security associations that protect the integrity of the data both between the aircraft and the ground IPS infrastructure and between aircraft and ground applications.

### Integrity

The security architecture is designed to ensure that information received from a legitimate source may be absolutely determined by the receiver to be both from that source, and unmodified and information not from a legitimate source is rejected. The applications connected to the ATN/IPS system must be able to trust the integrity of the data.

Integrity may be achieved in a number of different ways and one or more mechanisms will be used within the ATN/IPS system depending on the protocols and the bearers used. These could potentially be done at any of the following levels:

* At the bearer level
* At the network level
* At the application level

#### At the bearer level

Some bearers provide link layer security which includes cryptographic integrity protection. Satellite services for instance use IPSec tunnels to secure data streams. In this case the security exists between the airborne terminal and the ground terminal and the data is encapsulated.

Other bearers like VHF do not include privacy or integrity of data as part of their specification. For those bearers, data integrity must be provided within the layers above the link.

#### At the network level

Protection and authentication of data may be implemented at the Network layer of the data flow and this may be necessary where bearers do not provide security protection. In this case, the end systems could implement IPsec with ESP or Authentication Header. However, the overhead of such a scheme is believed incompatible with VHF data services and TLS over such links is proposed to authenticate traffic as part of the architecture.

*Editor’s note: It needs to be determined what network level security mechanisms are needed where bearers already provide IPsec or similar.*

#### At the Application Level

ICAO 9698 proposes a Secure Dialog service for ATN applications. This service is compatible with the Dialog Service defined in ICAO 9880 making the transition from ATN/OSI to ATN/IPS straightforward.

### Prioritization

The applications eligible for ATN/IPS have to be prioritized. Based on ICAO Doc 9896 Part III, the applications shall have the following priority:

* High: ADS-C, CPDLC,
* Normal: AIS, CM,
* Default: AOC.

This classification ensures that the ATC applications have the priority over AOC applications in order to comply with the performance requirements for ATS services.

## ATN/IPS protocol architecture

The ATN/IPS protocol is intended to replace the existing ATN/OSI protocol suite which is currently implemented within European Airspace using the VDL mode 2 radio infrastructure. VDL mode 2 carries ATN/OSI packets within AVLC frames. The AVLC protocol is also used to transport ACARS messages as AoA, and the AVLC frame header may be used to determine the data protocol contained within. The transition to ATN/IPS will require AVLC support for IPS packets when VDL mode 2 is used.

It is also expected that ATN/IPS will be operated over satellite links as well as newer terrestrial links such as LDACS and AeroMACS. These links are typically native IP links offering an IP interface to on-board and ground systems. However, the use of these links natively may be complicated if they use IP version 4.

The ATN/IPS system is designed to have minimal impact on the existing ATN applications allowing them to continue in use with little or no modification. To this end, the Airborne ATN/IPS system presents a near identical interface to the ATN applications through the use of the IPS Dialogue Service which is modeled on the OSI Dialogue Service defined in ICAO 9880 pt III. The Dialogue service maps the application level primitives to the TCP/UDP protocol primitives and allows the applications to establish and maintain connectivity to the ground based applications with familiar commands. In Figure 3 below, the Dialog Service is incorporated within the OSI/IPS convergence function.



Figure 3 ATN/IPS Protocol Architecture (from ICAO9896)

Below the IPS Dialog Service is the transport layer. This comprises UDP (connectionless) and TCP (connection oriented). Both protocols use well-known ports to achieve connectivity and provide checksum protection of the header and data content of packets. These protocols in turn rely on the network protocol – IP version 6. Whilst much of the internet is still using version 4 of the Internet Protocol, it has a number of shortcomings that are addressed in IP version 6. Of particular interest to ATN/IPS is the native support for security through IPSec.

Network layer protocols have no demarcation of start and finish and thus require to be framed in a link layer protocol for transmission. There are many link layer protocols for local and wide area networks and the ATN/IPS packets may be expected to operate over links with different link layer protocols. Current ATN/OSI implementations run over VDL mode 2 which uses AVLC as a link layer protocol. This protocol is based on the HDLC protocol widely used in serial communication but with some modification to suit the VHF aviation data links.

## Assumptions and constraints

### Overview

### Transition Phase

The ATN/IPS system is designed to replace the incumbent systems represented by ATN/OSI and ACARS. However it is recognized that there will be a significant time during which ATN provision on existing aircraft will be met by ATN/OSI whilst newer aircraft may use ATN/IPS, with the likelihood that both shall be operating simultaneously within the same airspace. It is an assumption that aircraft will support one or the other, but not both. Furthermore, it is likely that ACARS will continue in use for some time after the introduction of ATN/IPS.

During this transition phase it will be necessary to accommodate aircraft using either ATN system within each airspace and the accommodation with thus have to be made by the ground systems. For this reason it is anticipated that the ground service providers shall support all of ATN/IPS, ATN/OSI and ACARS on all appropriate bearer technologies during the transition phase.

### Assumptions by Function

#### Other Airborne Routers

Current generation aircraft are equipped with a routing capability for ACARS and optionally ATN/OSI. This capability is typically located within a CMU, ATSU or similar. It is assumed that The ATN/IPS capability will replace the ATN/OSI capability on aircraft either within the CMU platform or as a separate entity. It is assumed that an aircraft will not support all three stacks.

#### Airborne Applications

It is assumed that the airborne applications that currently make use of the Dialog Service (DS) defined in ICAO 9880 pt III will make use of the IPS DS defined in ICAO 9896 pt III instead. This new dialog service presents an identical set of primitives to minimize the need for application changes

Current applications are:

* CPDLC
* ADS (Automatic Dependent Surveillance)
* FIS

#### Radio Bearers

The ATN/IPS service is intended to operate over a variety of current and future bearers, some of which already host the ATN/OSI service.

The current deployment of ATN/OSI within Europe which operates over VDL mode 2 is expected to continue for some time after the introduction of ATN/IPS. It is assumed that the European airspace will transition to ATN/IPS when the LDACS communications system comes into service.

#### Ground system

Given the requirement placed on the ground system to accommodate aircraft using either ATN protocol suite, it is assumed that the ground system shall support both ATN protocol suites simultaneously. The ground system shall be equipped with the routing capability to receive data using the OSI and IPS protocols as well as ACARS and to direct it to the appropriate end systems.

# ATN/IPS AIRBORNE ARCHITECTURE (HONEYWELL)

# SECURITY (RC)

## TBD

# ATN/IPS AIRBORNE IMPLEMENTAION OPTIONS (RC)

## Overview and Assumptions

## ARINC 429

## ARINC 664

## Ethernet

## Etc.

## Redundancy Considerations

Not sure if this should be included, but multiple ports may be needed depending on functional requirements that are trying to be met

# AIRBORNE APPLICATION DATA CONSIDERATIONS (BOEING)

Potentially separate document? Describe assumptions instead of specifics?

## B1/B2

## FANS1/A

## ACARS

## Non-DSI Encapsulation

## Etc.

1. List of Acronyms *🡨 FROM 658*

4DT Four Dimensional Trajectory

4DTRAD Four Dimensional Trajectory Datalink

A-G or A/G Air-to-Ground

A-ISAC Aviation Information Sharing and Analysis Center

AC Advisory Circular

ACARS Aircraft Communications Addressing and Reporting System

ACD Aircraft Control Domain

ACL ATC Clearance

ACM Aircraft Communications Message

ACMS Aircraft Condition Monitoring System

ACR Avionics Communications Router

ACSP Air/Ground Communications Service Provider

ADS-C Automatic Dependent Surveillance-Contract

ADS-C EPP ADS-C Extended Projected Profile

AEEC Airlines Electronic Engineering Committee

AeroMACS Aeronautical Mobile Airport Communications System

AFN ATS Facilities Notification

AIM Aeronautical Information Management

AIREP Aircraft Report

AIS/MET Aeronautical Information Services/Meteorological

AISD Aircraft Information Services Domain

ALGA Active Low Gain Antenna

AMC ATC Microphone Check

AMET Airborne Meteorological

ANSP Air Navigation Service Provider

AOA ACARS Over AVLC

AOC Airline Operational Control

ARAC Aviation Rulemaking Advisory Committee

ARU AeroMACS Radio Unit

ASBU Aviation System Block Upgrade

ASN Access Service Network

ASN-GW Access Service Network Gateway

ATA Air Transport Association

ATC Air Traffic Control

ATM Air Traffic Management

ATN Aeronautical Telecommunication Network

ATS Air Traffic Services

ATSP Air Traffic Service Provider

ATSU Air Traffic Services Unit

AUTOMET Automatic Meteorological (report)

AVLC Aviation VHF Link Control

BLOS Beyond Line Of Sight

BS Base Station

CA Certificate Authority

CAA Civil Aviation Authority

CARATS Collaborative Actions for Renovation of Air Traffic Systems (Japan)

CDU Control Display Unit

CDM Collaborative Decision Making

CLNP Connectionless Network Protocol

CM Context Management

CMF Communications Management Function

CMU Communications Management Unit

CNS/ATM Communications Navigation Surveillance/Air Traffic Management

CoS Class of Service

COTP Connection Oriented Transport Protocol

COTS Commercial Off The Shelf

CP Communications Panel (ICAO)

CP Certificate Profile (PKI)

CPDLC Controller Pilot Data Link Communications

CPU Central Processing Unit

CRL Certificate Revocation List

CSN Connectivity Network Service

CSP Communication Service Provider

CSR Certificate Signing Request

D8PSK Differential 8-Phase Shift Keying

D-ATIS Digital Automatic Terminal Information Service

D-OTIS Datalink Operational Terminal Information Service

D-TAXI Digital TAXI

DAL Design Assurance Level

DCL Departure Clearance

DCNS Data Communications Network Service

DDoS Distributed Denial of Service

DLIC Data Link Initiation Capability

DLS-IR Data Link Services Implementing Rule

DME Distance Measuring Equipment

DoD Department of Defense

DoS Denial of Service

D-RNP Dynamic Required Navigation Performance

DS Dialog Service

DSI Dialog Service Interface

DSP Data Link Service Provider

EASA European Aviation Safety Agency

ECAC European Civil Aviation Conference

EFB Electronic Flight Bag

EIPI Extended Initial Protocol Identifier

EIRP Equivalent Isotropically Radiated Power

ESA European Space Agency

EU European Union

FAA Federal Aviation Administration

FANS Future Air Navigation System

FCI Future Communications Infrastructure

FDD Frequency Division Duplex

FEP Front End Processor

FF/ICE Flight and Flow Information for a Collaborative Environment

FIR Flight Information Region

FIS Flight Information Service

FMF Flight Management Function

FMS Flight Management System

FY Fiscal Year

G-G or G/G Ground-to-Ground

GANP Global Air Navigation Plan

GATM Global Air Traffic Management

GES Ground Earth Station

GHz Gigahertz

GNSS Global Navigation Satellite System

HDLC High-level Data Link Control

HF High Frequency

HFDL High Frequency Data Link

HGA High Gain Antenna

ICAO International Civil Aviation Organization

ICS Internet Communication Service

IER Information Exchange and Reporting

IETF Internet Engineering Task Force

IM Information Management

IMA Integrated Modular Avionics

IMS Information Management Services

IOC Initial Operational Capability

IP Internet Protocol

IPI Initial Protocol Identifier

IPS Internet Protocol Suite

IPsec Internet Protocol Security

IPv4 / IPv6 Internet Protocol Version 4 or Version 6

IS Information Services

ISO International Standards Organization

ISWG Infrastructure Specific Working Group

ITP In-Trail Procedure

ITU International Telecommunication Union

LDACS L Band Digital Aviation Communication System

LEO Low Earth Orbit

LGA Low Gain Antenna

LOS Line of Sight

MAS Message Assurance

MASPS Minimum Aviation System Performance Standards

MCDU Multi-purpose Control and Display Unit

MET Meteorological

MHz Megahertz

MIAM Media Independent Aircraft Messaging

MOPS Minimum Operational Performance Standards

MP-TCP Multi-Path Transmission Control Protocol

MRO Maintenance Repair and Overhaul

NAS National Airspace System

NextGen Next Generation Air Transportation System

NM Nautical Miles

NOTAM Notice to Airmen

OCL Oceanic Clearance

OEM Original Equipment Manufacturer

OFDM Orthogonal Frequency Division Multiplexing

OSWG Operational Specific Working Group

OTIS Operations Terminal Information System

PFIS Passenger Flight Information Systems

PGW Protocol Gateway

PIESD Passenger Information Services Domain

PKI Public Key Infrastructure

PLP Packet Layer Protocol

PMC Program Management Committee

POA Plain Old ACARS

PPPoE Point to Point Protocol over Ethernet

PR Position Reporting

PS Policy Statement

PT Project Team

QAR Quick Access Recorder

QoS Quality of Service

RCP Required Communication Performance

RCTP Required Communication Technical Performance

RF Radio Frequency

RFC Request For Comment

RNP Required Navigation Performance

RSP Required Surveillance Performance

RSTP Required Surveillance Technical Performance

SAL Security Assurance Level

SARPS Standards and Recommended Practices

Satcom Satellite Communications

SBB Swift Broadband

SBD Short Burst Data

SCTP Stream Control Transmission Protocol

SDO Standards Development Organization

SDR Software Defined Radio

sDS Secure Dialog Service

SDU Satellite Data Unit

SESAR Single European Sky Air Traffic Management (ATM) Research

SIGMET Significant Meteorological Information

SNAcP Subnetwork Access Protocol

SPR Safety and Performance Requirement

SWaP Size Weight and Power

SWIM System Wide Information Management

TAC Technical Advisory Committee

TACAN Tactical Air Navigation

TBD To Be Determined

TBO Trajectory Based Operations

TCP Transmission Control Protocol

TDLS Terminal Data Link System

ToR Terms of Reference

TSO Technical Standard Order

UDP User Datagram Protocol

UI Unnumbered Information

ULCS Upper Layer Communication Services

US United States

USB Universal Serial Bus

V&V Verification and Validation

VDL VHF Data Link

VDLM2 VHF Data Link Mode 2

VHF Very High Frequency

VOLMET Vol (flight) Meteo (weather)

VPN Virtual Private Network

WG Working Group

WiMAX Worldwide Interoperability for Microwave Access

WoW Weight on Wheels

XID eXchange Identification

1. GLOSSARY 🡨 FROM 658

AAC – Aeronautical Administrative Communications

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 maintain or enhance the efficiency of over-all flight operation.

ACARS – Aircraft Communications Addressing and Reporting System

A digital datalink network providing connectivity between aircraft and ground end systems (command and control, air traffic control).

ACD – Aircraft Control Domain

It consists of systems and networks whose primary functions are to support the safe operation of the aircraft. This domain connects to high-priority Air Traffic Services (ATS) and some Airline Operational Control (AOC) communications.

ADS-C – Automatic Dependent Surveillance-Contract

ADS-C is the same as ADS-A. Automatic Dependent Surveillance-Addressedis a datalink application that provides for contracted services between ground systems and aircraft. Contracts are established such that the aircraft will automatically provide information obtained from its own on-board sensors, and pass this information to the ground system under specific circumstances dictated by the ground system (except in emergencies).

Airborne ATN/IPS System

An airborne component that supports main ATN/IPS functions.

AISD – Aircraft Information Services Domain

This domain provides general purpose routing, computing, data storage and communications services for non-essential applications. The AISD domain can be subdivided into two sub-domains;

* Administrative sub-domain, which provides operational and airline administrative information to both the flight deck and cabin,
* Passenger support sub-domain, which provides information to support the Passengers

AOA – ACARS Over Aviation VHF Link Control

AOA is an attempt at gaining some early benefits of digital technology without the full risk of ATN. It is a step between full ACARS and full ATN. The most significant near-term benefit is the reduction of VHF congestion problems by transitioning traffic to the VDLM2 air/ground network. AOA allows airborne and airline host applications to remain unchanged (character format). The airborne AOA process packages the data so that it can be routed over the digital VDLM2 network. At some point on the ground, the data is restored to its original format for processing by legacy airline host applications. VDLM2 operates at 31.5 kbps versus ACARS at 2.4 kbps.

AOC – Airline Operational Control (Aeronautical Operational Control)

Operational messages used between aircraft and airline dispatch centers or, by extension, the DoD to support flight operations. This includes, but is not limited to, flight planning, flight following, and the distribution of information to flights and affected personnel.

APC – Aeronautical Passenger Communications

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

Application

Functions that provide the services needed by the users. Applications are grouped into Application sets that are associated to specific network protocols. In the ACD domain the Applications sets are providing air traffic and operational control services.

ATN – Aeronautical Telecommunications Network

An internetwork architecture that allows ground/ground, air/ground, and avionic data subnetworks to interoperate by using common interface services and protocols based on the ISO OSI Reference Model.

ATN/IPS Node

An ATN/IPS node is a device that implements IPv6. There are two types of ATN/IPS nodes; 1) the ATN/IPS system that forwards Internet Protocol (IP) packets not explicitly addressed to itself and 2) ATN/IPS host, which does not have the capability to route traffic flows.

ATN/IPS

Internetwork consisting of ATN/IPS nodes and networks operating in a multinational environment in support of Air Traffic Services (ATS) as well as aeronautical industry service communication such as Aeronautical Operational Control (AOC) and Aeronautical Administrative Communications (AAC).

ATS – Air Traffic Services

A generic term meaning variously, flight information service, alerting service, air traffic advisory service, air traffic control service. The latter is a service provided for the purpose of preventing collisions, expediting and maintaining an orderly flow of traffic.

ATSU – Air Traffic Services Unit

A unit established for the purpose of receiving reports concerning air traffic services and flight plans submitted before departure. It is a generic term meaning air traffic control unit, flight information center, or air traffic service reporting office.

CM – Communication Manager

This function manages the connectivity of the aircraft with the ground system. It is decomposed into two sub-functions:

* ATN/IPS Communication Manager, which manages in the ATN/IPS system the selection of the radio bearer for a dedicated traffic flow and the associated mode of communication.
* External Communication Manager, which performs router selection and associated vertical handover decisions. This entity may be extended to include the management of multi-domain link selections.

CMU – Communication Management Unit

The CMU performs two important functions: it manages access to the various datalink sub-networks and services available to the aircraft and hosts various applications related to datalink. It also interfaces to the flight management system (FMS) and to the crew displays.

CNS/ATM – Communication, Navigation, Surveillance/Air Traffic Management

CNS/ATM is a system based on digital technologies, satellite systems, and enhanced automation to achieve a seamless global Air Traffic Management. Modern CNS systems will eliminate or reduce a variety of constraints imposed on ATM operations today.

CPDLC – Controller-Pilot Data Link Communications

The CPDLC application provides for the exchange of flight planning, clearance, and informational data between a flight crew and air traffic control. This application supplements voice communications and, in some areas, data may supersede voice.

DS – Dialog Service

The Dialog Service serves as an interface between the ATN applications and the ATN/OSI or ATN/IPS upper layer protocols via the control function.

FANS-1/A – Future Aircraft Navigation System 1/A

A set of operational capabilities centered around direct datalink communications between the flight crew and air traffic control. Operators benefit from FANS-1/A in oceanic and remote airspace around the world.

FMF – Flight Management Function

A collection of processes or applications that facilitates area navigation (RNAV) and related functions to be executed during all phases of flight. The FMF is resident in an avionics computer and automates navigational functions reducing flight crew workload particularly during instrument meteorological conditions. The Flight Management System encompasses the FMF.

FMS – Flight Management System

A computer system that uses a large database to allow routes to be preprogrammed and fed into the system by a means of a data loader. The system is constantly updated with respect to position by reference to designated sensors. The sophisticated program and its associated database insure that the most appropriate aids are automatically selected during the information update cycle. The flight management system is interfaced/coupled to cockpit displays to provide the flight crew situational awareness and/or an autopilot.

Ground ATN/IPS Router

A ground device that is used to support ATN/IPS packet forwarding in both air/ground and ground/ground environments.

Infrastructure

This is a general term corresponding to the communication systems that support the application sets. It consists of the Network and Sub-networks functions.

LINK 2000+ – The EUROCONTROL LINK 2000+ Program

The European validation program that demonstrated controller-pilot data-link-communication (CPDLC) services into a set for implementation in the European Airspace using the ATN and VDLM2 (Aeronautical Telecommunication Network and VHF Digital Link).

MASPS – Minimum Aviation System Performance Standards

High-level documents produced by RTCA that establish minimum system performance characteristics.

MOPS – Minimum Operational Performance Standards

Standards produced by RTCA that describe typical equipment applications and operational goals and establish the basis for required performance. Definitions and assumptions essential to proper understanding are included as well as installed equipment tests and operational performance characteristics for equipment installations. MOPS are often used by the FAA as a basis for certification.

Multilink

Concept that defines the use of concurrent, existing and future communication links between air and ground (e.g., AeroMACS, LDACS and Satcom), depending on the defined criteria (performance needs).

NAS – National Airspace System

One of the most complex aviation systems in the world that enables safe and expeditious air travel in the United States and over large portions of the world’s oceans.

Network

The Network function is decomposed into two main sub-functions; a router that routes data packets from a source to a destination and the communication manager, which is responsible for the network and link selections.

Network Layer

The Network Layer is based on Internet Protocol (IP) ensuring global routing over interconnected packet-switched communication networks.

Physical and Link Layers

They are associated with the Sub-networks and handle the physical interface with the transmission medium (i.e., radio links).

PIESD – Passenger Information and Entertainment Services Domain

It is characterized by the need to provide passenger entertainment and network services. Beyond traditional IFE systems, it may also include passenger device connectivity systems, Passenger Flight Information Systems (PFIS), broadband television or connectivity systems.

SARPS – Standards and Recommended Practices

Produced by ICAO, they become the international standards for member states. As the name implies, they are only “recommended” practices. It is up to each member states to decide how/if to implement them.

Satcom – Satellite Communications

Communication service providing data, voice, and fax transmission via satellite. Allows aircraft to communicate in BLOS areas.

SESAR – Single European Sky ATM Research

European air traffic control infrastructure modernization program. SESAR aims at developing the new generation ATM system capable of ensuring the safety and fluidity of air transport worldwide over the next 30 years.

Sub-network

The sub-networks correspond to all radio systems that are used to communicate between the aircraft and the ground.

Transport Layer

The transport layer protocols are used to provide reliable or unreliable communication services over the ATN/IPS system. Those include TCP for reliable transport services and UDP that is used to provide best effort service.

VDL – VHF Data Link

Also known as VHF Digital Link, VDL is the LOS sub-network supporting data communications that are sent over VHF frequencies. The traditional VHF voice radio can be used in conjunction with a data modem to send data messages over VHF frequencies.

VDLM2 – VHF Data Link Mode 2

A datalink-only service designed to digitize VHF and improve the speed of the VHF link. VDLM2 is intended for use within the US and Europe as an interim datalink solution for enroute ATC functions. VDLM2 provides a 31.5 kbps channel rate.

Vertical Handover

[AI - Arnaud TH]

1. ATN/IPS GROUND ARCHITECTURE CONSIDERATIONS (RC IMS)
   1. Potential Ground Architectures
      1. Full End-to-End
      2. Multiple “Segment Correlations”
   2. Gateway Architectures
      1. Dual-Stack (OSI / IPS)
      2. Dual-Stack (ACARS / IPS)
      3. Triple-Stack (ACARS / OSI / IPS)
   3. Gateway Functional Requirements (BOEING)

1. AIRBUS PROFILES (AIRBUS)
   1. Federated
   2. Modular
2. BOEING PROFILES (BOEING)
   1. Federated
   2. Modular