Guidance Material

Background
The CNS/ATM Advisory Group (AG) has a mandate to address Future Air Navigation Systems (FANS) implementation and to provide clarification and guidance in a consistent manner in all of the regional and global forums as well as in fleet planning.

Introduction
Operators must be knowledgeable about the FANS technological requirements as well as being equipped, trained and certified for the airspace in which they are required to fly.

The CNS/ATM AG provides guidance on CNS/ATM topics to intercontinental operators so they can make informed decisions on aircraft avionics and their crew training.

The purchasers of aircraft and avionics will be dictating the type of equipment and training they require. The OEMs are listening and are working with the potential buyers to develop FANS equipment to meet current and future demands.

CNS/ATM
The CNS/ATM system is based on available global communications, navigation, and surveillance systems.

Air Traffic Management (ATM) is a result of these integrated systems working together to provide Air Traffic Control, Airspace Management, and Air Traffic Flow Management.

Controller Pilot Data Link Communications (CPDLC) and the ADS data link applications were originally envisaged for use across a digital data communications network for the entire aeronautical community as defined within the International Civil Aviation Organization (ICAO) as the Aeronautical Telecommunications Network (ATN).

However the ATN is still not universally available.

FANS-1/A
In the interim Boeing and Airbus Industrie built the FANS applications to run on the existing Aeronautical Radio, Incorporated (ARINC) Aircraft Communications Addressing and Reporting System (ACARS).

These avionics packages became known as FANS-1/A (1 for Boeing and A for Airbus). The FANS-1/A system achieved the packaging of binary messages as character-based messages in accordance with the ARINC AEEC 622/ACARS specification.

FANS-1/A technology is implemented in oceanic airspace around the world and is being used in some domestic airspace in Australia, Maastricht's Upper Airspace Centre (MUAC) and in the domestic airspace of a number of other States.

The Maastricht Upper Area Control Centre (UAC), which is responsible for air traffic control in the upper airspace of Benelux and in the north-west part of Germany, provides CPDLC services using a gateway that allows communication with both FANS-1/A aircraft and those fitted with ATN data link avionics.
ATM APPLICATIONS

1. Communications

2. Navigation

3. Surveillance

COMMUNICATIONS

Controller Pilot Data Link Communications (CPDLC) is a data link communications application that allows for the direct exchange of text-based pre formatted messages between a controller and a pilot. CPDLC greatly improves communication capabilities in oceanic areas, especially in situations where controllers and pilots have previously had to rely on a third party HF communications relay.

CPDLC adds a number of benefits to the system. It allows the flight crew to print messages, allows the auto loading of specific uplink messages into the Flight Management System (FMS) and allows the crew to downlink a complex route clearance request which the controller can re-send when approved without having to type a long string of coordinates. Specific uplink messages arm the FMS to automatically downlink a report when an event such as crossing a waypoint occurs and specific downlink messages and the response to some uplink messages will automatically update the Flight Data Record in some ground systems.

This type of communications reduces errors and assists with workload management. Although the connections are established at a system level, the CPDLC application is a hands-on crew tool. The CPDLC connection has built in integrity with a number of security mechanisms.

CPDLC is available for suitably equipped and certified aircraft and certified aircrews.

CPDLC is fast, reliable and secure. It can be used in combination with ADS-B, TCAS/ACAS, “Free Flight” protocols/standards and the appropriate automated aircraft/ground controlling systems to provide a better Air Navigation System.

CPDLC is not currently compulsory.

However, CPDLC will become compulsory in specific jurisdictions at some point in the near future to facilitate and enable reduced separation standards.

CPDLC will become compulsory in Europe in 2011 to assist in reducing frequency congestion.

Other

Data link services are being provided in the South Pacific, some of the Indian Ocean, some Asian and Far East Russian FIRS and across the North Pacific between the West coast of the USA and Japan. FANS work stations are being installed in many ground facilities around the world.

Satellite voice communications (SATCOM) may some day enable Direct Controller Pilot Communications (DCPC) by voice in oceanic and remote airspace.
NAVIGATION

RNAV

_Area Navigation_ (RNAV) enables aircraft to fly on any desired flight path within the coverage of ground or space based navigation aids, within the limits of the capability of the self-contained systems, or a combination of both capabilities. RNAV aircraft have better access and flexibility for point-to-point operations.

Domestic and oceanic airspace has been redesigned to use RNAV performance specifications.

RNP

_Required Navigation Performance_ (RNP) is _RNAV with the addition of an onboard performance monitoring and alerting capability_. A defining characteristic of RNP operations is the ability of the aircraft navigation system to monitor the navigation performance it achieves and inform the crew if the requirement is not met during an operation. This onboard monitoring and alerting capability enhances the pilot’s situation awareness and can enable reduced obstacle clearance or closer route spacing without intervention by air traffic control.

Certain RNP operations require advanced features of the onboard navigation function and approved training and crew procedures.

The performance required to fly an RNP route is generally specified in nautical miles, e.g. RNP 4 which implies that the total system error will be no greater than 4 NM for 95% of the time.

PBN

_Performance Based Navigation_ (PBN) includes both Area Navigation (RNAV) and Required Navigation Performance (RNP) specifications in a framework for defining navigation performance requirements (embodied in “navigation specifications”) that can be applied to an air traffic route, instrument procedure, or defined airspace.

Performance requirements are identified in navigation specifications, which also identify the choice of navigation sensors and equipment that may be used to meet the performance requirements. These navigation specifications are defined at a sufficient level of detail to facilitate global harmonization by providing specific implementation guidance for States and operators.

The PBN concept specifies that aircraft RNAV system performance requirements be defined in terms of the accuracy, integrity, availability, continuity and functionality, which are needed for the proposed operations in the context of a particular airspace concept. The PBN concept represents a shift from sensor-based to performance-based navigation.

Under PBN, generic navigation requirements are defined based on operational requirements. PBN provides a basis for the design and implementation of automated flight paths as well as for airspace design and obstacle clearance. Once the required performance level is established, the aircraft’s own capability determines whether it can safely achieve the specified performance and qualify for the operation.

Operators then evaluate options in respect of available technology and navigation services, which could allow the requirements to be met. An operator thereby has the opportunity to select a more cost-effective option, rather than a solution being imposed as part of the operational requirements.

As part of the future work of ICAO, it is anticipated that other means for meeting the requirements of the navigation specifications will be evaluated and may be included in the applicable navigation specifications, as appropriate.
Waypoint Position Reporting (WPR)

Automated Waypoint Position Reporting (WPR) is used by some larger aircraft within the Bodø, Gander, New York, Reykjavik, Santa Maria and Shanwick Oceanic Control Areas.

It is not available for Business Jet aircraft because of equipment limitations and will not become available due to overtaking technology.

WPR is not a FANS application but it is similar to Automatic Dependent Surveillance (ADS) in its practical application and is meant to only be an interim step in the evolution of future techniques.

WPR does facilitate a decreased workload for pilots and controllers. It also enhances safety and system integrity for all concerned.

The WPR provides an aircraft equipment/ground systems interface without requiring human intervention. The ground systems check to determine if the WPR meets the expectations of the Air Navigation Service Providers (ANSPs). The system checks for separation integrity and position verification in 4 dimensions.

Automatic Dependent Surveillance (ADS)

*Automatic Dependent Surveillance - Contract (ADS-C)* is a method of surveillance that is dependent on reports from an aircraft's avionics that occur automatically whenever specific contract-defined events occur, or specific time intervals are reached. The contract is established by the ground station.

The ADS-C application generally operates without flight crew interaction. The avionics automatically send a report to the ground system. The ADS-C reports are converted into an ADS-C track and presented on controllers’ situation displays to provide enhanced situational awareness.

ADS-C is primarily used in oceanic and remote airspace which is less congested than domestic airspace.

Automatic Dependent Surveillance-Broadcast (ADS-B)

*ADS-Broadcast (ADS-B)* is a method of surveillance which operates in a broadcast mode whereby the aircraft broadcasts positional information on a frequent basis. Any appropriately equipped facility, including other aircraft, can receive ADS-B reports from aircraft. The frequency of reports for ADS-B is significantly higher than ADS-C, which makes ADS-B a good candidate to use as a surveillance system primarily in domestic high-density traffic situations.

ADS-B has been implemented in the Hudson Bay area of Canada and is currently installed across the Australian continent in non-radar areas as a reliable form of surveillance. It is also intended to install ADS-B for use in southern Greenland for use over the North Atlantic in 2010.

ADS-B can be used over several different data link technologies, including Mode-S Extended Squitter (1090 ES), VHF data link (VDL) Mode 4, and Universal Access Transceivers (UAT).
Data Link Technologies

1090ES

In 2002, the FAA announced a dual link decision using both 1090 MHz ES and UAT as mediums for the ADS-B system in the United States. The 1090 MHz extended squitter ADS-B link would be used for air carriers and private/commercial operators of high performance aircraft. The Universal Access Transceiver (UAT) ADS-B link would be available for the typical general aviation user.

Europe has not officially chosen a physical layer for ADS-B. A number of technologies are in use. However, the influential Eurocontrol CASCADE program uses 1090ES exclusively.

With 1090ES, the existing Mode S transponder supports a message type known as the extended squitter (ES) message. It is a periodic message that provides position, velocity, heading, time, and, in the future, intent. The basic ES does not offer intent since current flight management systems do not provide such data – called trajectory change points. To enable an aircraft to send an extended squitter message, the transponder is modified and aircraft position and other status information is routed to the transponder. ATC ground stations and TCAS-equipped aircraft already have the necessary 1090 MHz (Mode S) receivers to receive these signals, and would only require enhancements to accept and process the additional Extended Squitter information.

Universal access transceiver

The UAT system is specifically designed for ADS-B operation. UAT has lower cost and greater uplink capacity than 1090ES. Although 978 MHz resides in the TACAN assigned portion of the aeronautical spectrum, in the US 978 is used for transmission of airborne ADS-B reports and for broadcast of ground-based aeronautical information. UAT users have access to ground-based aeronautical data and can receive reports from proximate traffic.

VDL mode 4

The VDL Mode 4 system could utilize one or more of the existing aeronautical VHF frequencies as the radio frequency physical layer for ADS-B transmissions.

VDL Mode 4 uses a protocol that allows it to be self-organizing, meaning no master ground station is required.

In November 2001 this protocol was published by ICAO as a global standard.

This medium is best used for short message transmissions between a large number of users.

Recent CNS/ATM Activity/Guidance

A mixed aircraft equipage environment will continue to exist in most jurisdictions for many years.

Mandatory requirements for FANS 1/A is not envisaged for the immediate future.

Eurocontrol has been working aggressively to expand the use of domestic data link capability (the LINK 2000+ programme) across adjacent ANSPs. Eurocontrol has been implementing ATN to primarily solve a sector frequency congestion problem and a number of European Airlines are equipping their domestic fleets with ATN equipment.

FANS-1/A currently remains the only data link option for oceanic traffic. The ICAO Data Link Steering Group (DLSG) had been trying to resolve a divergence of thinking, between Eurocontrol and the North Atlantic (NAT) operations service providers.
The DLSG became aware that the data link plan for core Europe, while likely to incorporate mandatory ATN-based CPDLC carriage requirements, will exempt aircraft currently equipped with FANS-1/A.

This has relieved the specific concern that aircraft that have been equipped with FANS-1/A, to benefit from such equipage in oceanic and remote areas, would be forced to incorporate or change to the ATN-based CPDLC equipment for flights into core Europe.

The DLSG was left with the need to only study the potential to accommodate the ATN-based CPDLC-equipped aircraft in the NAT Region.

The results of this study, concluded at the Accommodation Drafting Group (ADG) /5 (Brussels, 8 to 9 October 2007), included the following:

“it was not considered feasible to accommodate ATN-based LINK 2000+ CPDLC-equipped aircraft in the NAT Region, in terms of providing them with data link services, without some modifications to both ground and airborne systems; and due to the extensive changes that would be required on the aircraft, it was probably not economically feasible to provide accommodation of such modified airborne ATN implementations in the context of it being applicable to the NAT Region only.”

The issues outstanding did not support advancing an implementation plan to provide ATN-based CPDLC-equipped aircraft with data link services in the NAT Region.

Currently, only the FANS-1/A ADS-C application has been implemented (for use in oceanic and remote areas) and there are no current plans within the European programme to include ADS-C as part of the current CPDLC-only implementation in core Europe.

The DLSG has agreed that a strategy for data link harmonization should be developed. This work is in the last stages of completion and can be expected to result in updated guidance. Once the strategy is completed, the ICAO Secretariat will propose that it be circulated to States and international organizations via State letter.

Following coordination and in agreement with the European Air Navigation Planning Group (EANPG), the DLSG will be dissolved, noting that the work assigned to it has been completed.

The ICAO Secretariat is now of the view that a panel will be necessary to act as a focal point for the consolidation and development of global ATM data link operational requirements.

The current effort to establish technical groups outside of ICAO that will concentrate on the development of provisions for projects such as the Next Generation Air Transportation System (NextGen) and Single European Sky Air Traffic Management Research (SESAR) make it imperative that ICAO is well-positioned to support major projects that have global ATM implications.

The most expeditious mechanism available to the ICAO Secretariat is the reconvening of the Operational Datalink Panel (OPLINKP) and this was agreed by the Air Navigation Commission in March 2008.

**Outstanding Issues for the CNS/ATM AG**

The CNS/ATM AG supports ANSPs in their endeavors to minimize the need for HF. Some of the HF airspace will eventually need to be declared exclusive for aircraft with some other approved form of communication in order to force aircraft operators to equip with newer and more superior communication technologies.

The CNS/ATM AG supports the use of communication equipment such as SATCOM and/or CPDLC for the business aviation community who traverse HF airspace where these efforts are being made to implement communications other than HF.

The CNS/ATM AG advises operators to be aware of what is occurring in Global airspace relating to CNS/ATM activity.
Operators need to have their aircraft equipped and certified with at least SATCOM, FANS (for Bizjets) and ADS-C, if flying in airspace that will require this equipage in the near future, as well as having their flight crews trained and certified.

Operators should obtain ADS-B equipment and certification when it will be a benefit for their flight operations and to facilitate access to airspace. This will prevent exclusion from a particular airspace (e.g. Canadian Hudson Bay Region) which is now, ADS-B type airspace. The USA FAA intends to have significant ADS-B coverage by 2013 and Eurocontrol is mandating ADS-B by 2015.

Operators need to provide frequent flight crew refreshers on the operation of aircraft equipment and their associated operating procedures. This is particularly necessary if intercontinental flights are infrequent.

Operators should consult the IBAC CNS/ATM AG website to obtain information and access links which can provide further guidance.

Disclaimer

The above information is provided for guidance only.

It has been gathered from many sources and will not always be up-to-date and absolutely factual.

It is however a good reference document and should provide some insight and guidance for the business aviation community.

Some background is provided, explanation of terms and current technology is referenced as well as links to information sites.

Prepared By

IBAC (International Business Aviation Council) CNS/ATM Advisory Group

January, 2009

Version 1.0