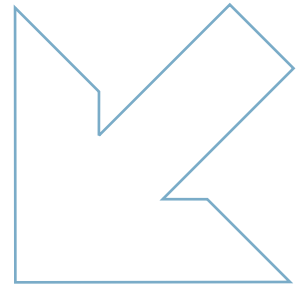




The Future Air Navigation System FANS B

Air traffic communications

enhancement for the A320 Family



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In today's busy Air Traffic Control (ATC) environment, and especially in high-density continental airspace, congestion on the voice channels used by air traffic controllers and pilots can be one of the limiting factors in sector capacity and safety.

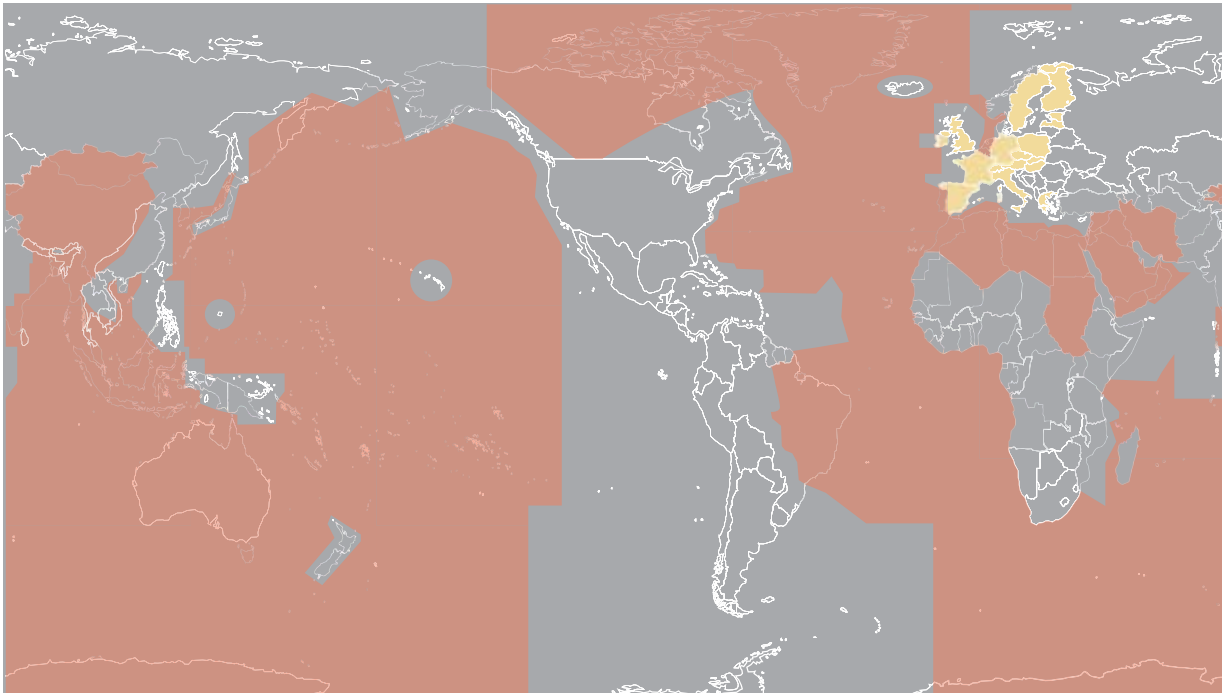
Most messages on the voice channels are for routine activities such as the transfer of voice communications, flight level requests and clearances, route and heading clearances and requests, speed clearances and Secondary Surveillance Radar (SSR) code changes. Pilots and controllers need to exchange information in a flexible, reliable and secure manner.

A Preliminary Eurocontrol Trial (PETAL), the Eurocontrol test of air/ground data link, a project at Airbus and the Maastricht Upper Airspace Centre (UAC), and its follow-on PETAL II, also conducted until the end of 2001 at the Maastricht UAC, demonstrated that the transmission of digital data via air/ground data link offers a reliable alternative to voice communications in relieving spectrum and ATC congestion and improving safety in air transport. The Maastricht UAC controls the upper airspace of Belgium, the Netherlands, Luxembourg and part of Germany, which carries a lot of Europe's air traffic.

The experience gained from the PETAL projects was used for a new project in Europe known as the Link 2000+ Programme, which provides air traffic controllers and pilots with a second communication channel: An air/ground data link, over an Aeronautical Telecommunications Network/VHF Data Link (ATN/VDL) Mode 2 infrastructure in the core area of Europe. VDL mode 2 compared to VDL mode A improves the data rate exchanges between aircraft and the ground station (data rate multiplied by ten, new modulation scheme, new communication protocol).

Current FANS 1/A data link services

2005-2011 Link 2000+ Programme data link services (FANS B)



2007 Worldwide air traffic data link services

1 | Link 2000+ Programme phased implementation

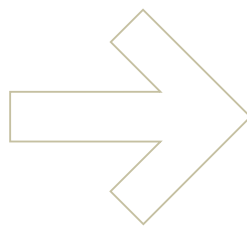
Link 2000+ Programme will start with a pioneer phase whose objective is to gain operational experience on ATC data link use, with pioneer airlines and pioneer ATC centres, to prepare for full deployment of ATC data link in Europe's upper airspace. The product needed for the Link 2000+ Programme pioneer phase requires a voice readback in accordance with European Organization for Civil Aviation Equipment (Eurocae) standard ED-110A, which provides an interoperability requirements standard for the initial implementation of the Aeronautical Telecommunications network (ATN), which supports several Air Traffic services.

The pioneer airlines are presently: Finnair, Aeroflot-Russian International Airlines, Air Berlin, Air Europa, Airbus Transport International, Alitalia, American Airlines, Federal Express, Niki, Hapag-Lloyd, Lufttransport Unternehmen, Lufthansa,

Lufthansa City Line, Malev, Scandinavian Airlines and SAS Braathens. Tarom-Romanian Air Transport is also considering joining. Currently, these airlines operate more than 600 Airbus aircraft and have committed more than 160 Airbus aircraft to the Link 2000+ Programme pioneer phase. Operator acceptance for the pioneer phase is planned to end during 2007.

Following the pioneer phase, the Link 2000+ Programme is currently investigating introducing incentives for those aircraft that are Controller Pilot Data Link Communications/Aeronautical Telecommunications Network (CPDLC/ ATN) equipped and operate in Link 2000+ Programme airspace. The intended follow-on from this incentive phase will be a 'mandate' phase where all aircraft operators flying in Link 2000+ Programme airspace will be required to equip with CPDLC/ATN avionics, subject to certain conditions.

Incentive and mandate phases will require an upgrade of existing products to be compliant with the Eurocae standard ED 110B to remove the requirement for voice readback.





2 Link 2000+ Programme applications and services

The Context Management Application (CMA)

This application provides the Data Link Initiation Capability (DLIC) service that is mandatory prior to any CPDLC connection. This function will typically be initiated when an aircraft is either at the gate in the pre-departure phase of flight, or before entering a new Flight Information Region (FIR) supporting data link communications. It provides the ground with the necessary information to make data link communications possible between the controller and the aircraft:

- Aircraft 24 bit address
- Aircraft flight identification
- Departure/destination airport
- Facility designation
- Information about available air applications

The Controller Pilot Data-link Communication (CPDLC) application

The CPDLC application provides direct pilot/controller communication using data link between an aircraft and the controlling ATC centre. A voice readback is required for any messages related to any changes of the aircraft trajectory.

This application provides a set of data link message elements corresponding to existing International Civil Aviation Organization (ICAO) phraseology.

Functions provided by the CPDLC application are:

- The ATC Communication Management (ACM) Service

- The ATC Clearance (ACL) Service
 - The ATC Microphone Check (AMC) Service
- Air Navigation Service Provider (ANSP) commitment

Maastricht centre (the pioneer ATC centre) has been controlling flights using CPDLC since 2005. Most of the European ATC centres have committed themselves to the Link 2000+ and their deployments are proceeding to schedule. Other ANSPs are split into two groups, those able to

ANSPs committed for 2008	
Country	ANSP
Germany	DFS
Switzerland	Skyguide
Italy	ENAV
Ireland	IAA

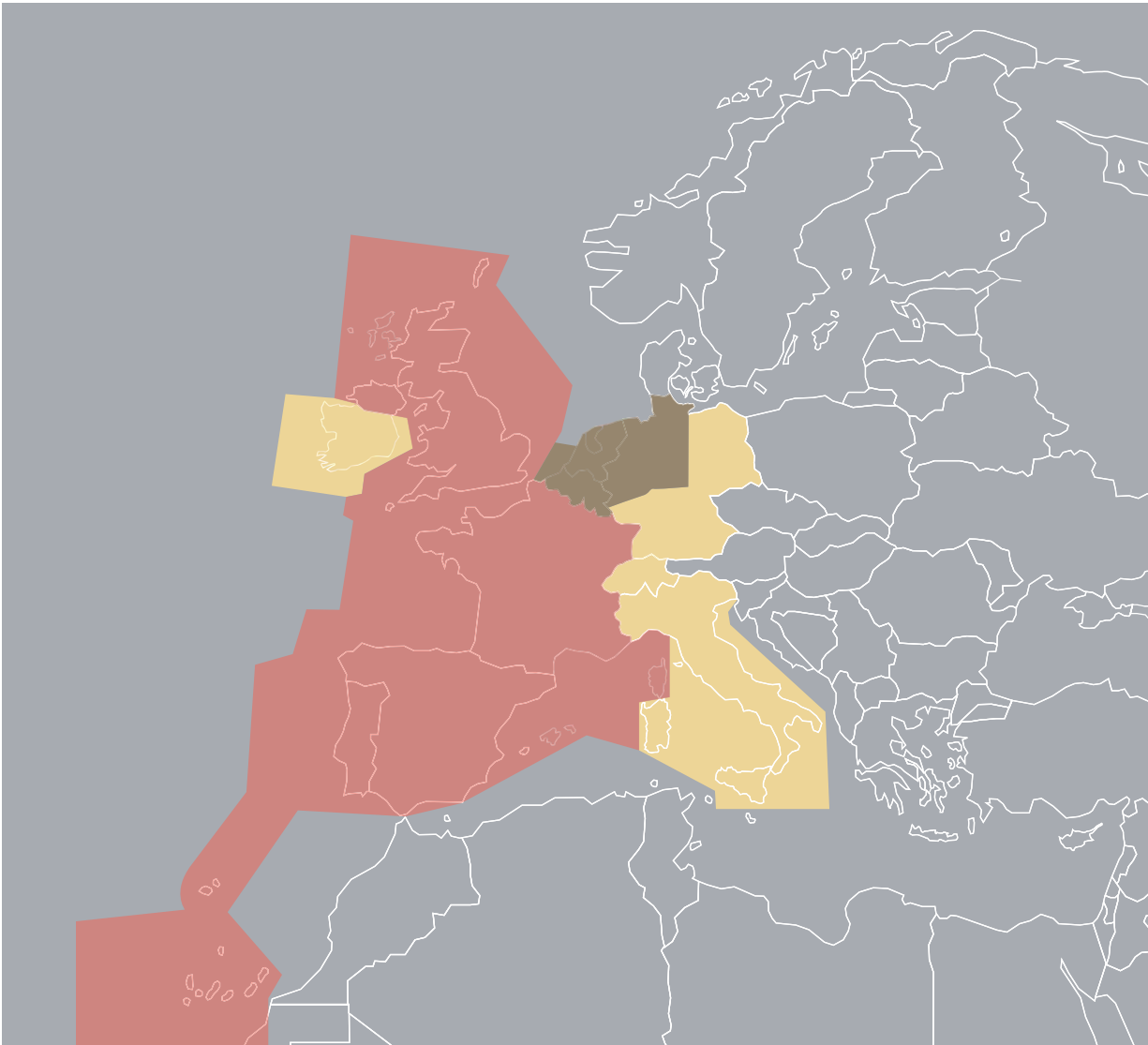
achieve by 2008 and the others able to achieve by 2011.

ANSPs committed for 2011	
Country	ANSP
Portugal	NAV Portugal
France	DSNA
UK	UK NATS
Spain	AENA

3 Future Air Navigation System B (FANS B)

The FANS B product is Airbus response to the Eurocontrol Link 2000+ Programme for utilization of ATC data link in continental areas (high density airspaces with radar surveillance) in the en-route phase, using the ATN air-ground communication network. As ATN is operational only in Europe, FANS B is proposed only on A320 Family aircraft for the time being.

The first FANS B package allows airline participation in early implementation phases of the Link 2000+ Programme - the 'pioneer phase'. Airbus pioneer



ANSP implementation plan

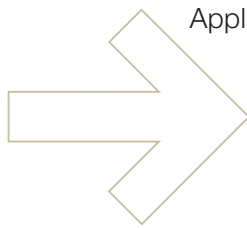
customers are Aeroflot-Russian International Airlines, Alitalia, Finnair, Niki, Lufttransport Unternehmen, Royal Jordanian, and Tarom-Romanian Air Transport.

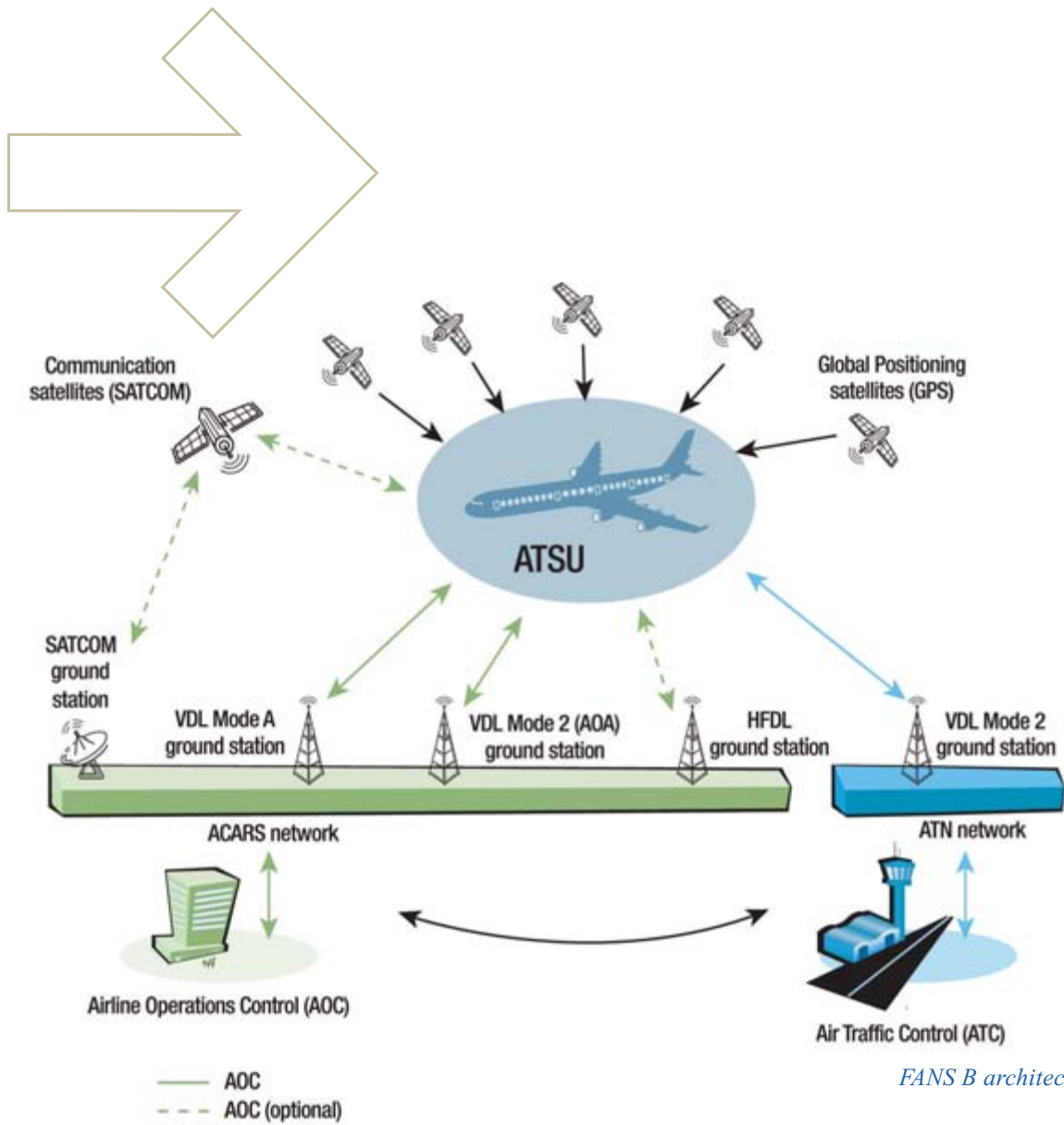
For the following phases Airbus is aiming at a single FANS B evolution enabling airlines to be eligible and benefit from the incentive phase, and also be compliant with the Link 2000+ Programme mandate. Airbus is closely cooperating with Link 2000+ Programme management to finalize

incentives and mandate conditions in the best interests of Airbus customers.

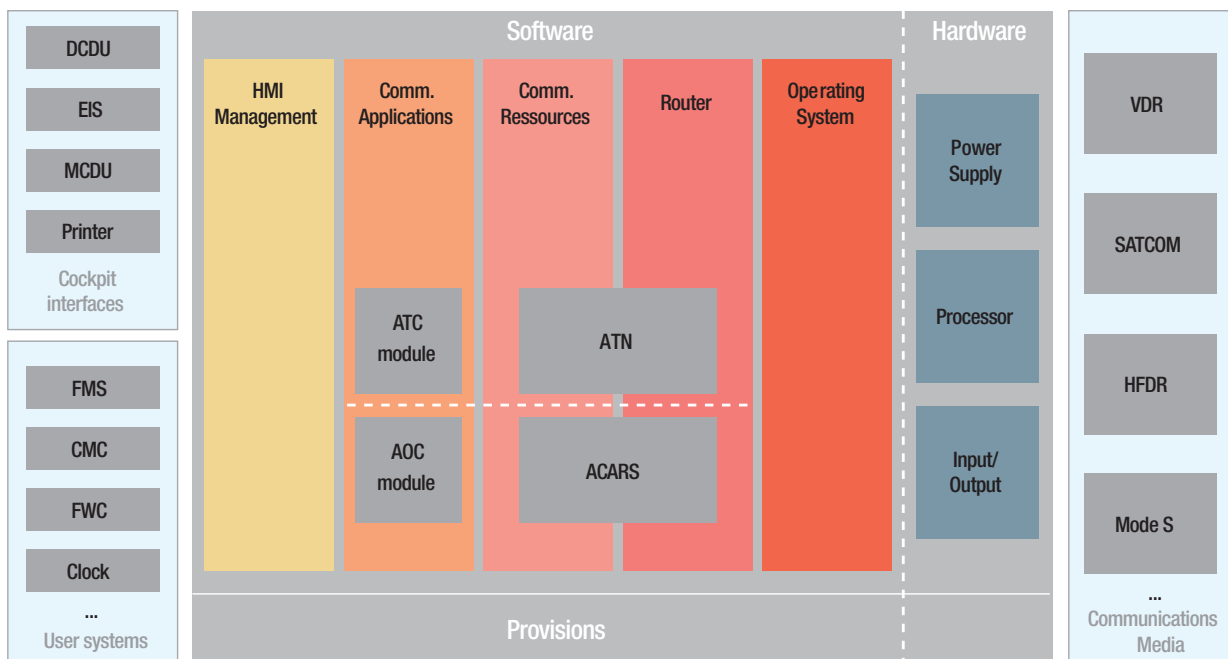
FANS B applications and services

The Airbus FANS B product offers, at aircraft level, over ATN air-ground communication network and through VDL Mode 2 sub-network, the data link applications and services (Context Management Application, Controller Pilot Data-Link Commu-





FANS B architecture



Air Traffic Services Unit - ATSU

nication application and ATC Communication Management, ATC Clearance, and ATC Microphone Check services) in accordance with Link 2000+ Programme specifications.

FANS B architecture

The FANS B architecture is the following:

- The airborne part with the ATSU (Air Traffic Service Unit), which is a modular hosting platform that centralizes all data communications (ATC and AOC/Airline Operations Communications) and manages the dedicated Human Machine Interface (HMI)
- The air/ground data link:
 - ACARS (Aircraft Communication Addressing and Reporting System) over VDL mode A/2, Satcom or HF DL (HF Data Link) are used to transmit AOC data. Satcom and HF DL for AOC are optional in the ATSU architecture
 - ATN over VDL mode 2 only, is used to transmit ATC data to the ground for communication purposes
 - The ground/ground data link: Two types of network have to be considered, the ACARS network for AOC messages and ATN network for ATC messages.

Data link communications between the aircraft and the airline operations centre optimize aircraft and crew management, improve data management like engine trend monitoring or maintenance reports, optimize spares management and speed up repairs.

On board equipment

The FANS B installation requires a minimum standard of the following equipment/installation:

- ATSU and Data link Control and Display Units (DCDU) provision
- Two DCDUs that allow the flight crew to read, and answer, to CPDLC messages received from the ground
- Two pushbuttons with 'attention getters' on the glare shield controlled by both Flight Warning Computers (FWCs)
- One VHF Data Radio (VDR 3) capable of VDL mode 2

- Two Multi Purpose Control and Display Units (MCDUs)
- Two Flight Warning Computers
- The Central Fault Display Interface Unit (CFDIU)

The FANS B Human Machine Interface (HMI)

The preceding product, FANS A+, has been in use for oceanic and remote area operations for several years (see information). The main HMI principles, defined on the A330/A340 and A320 Family FANS A+ installation, are also used on FANS B.

The HMI equipment used in the cockpit for FANS B functions are:

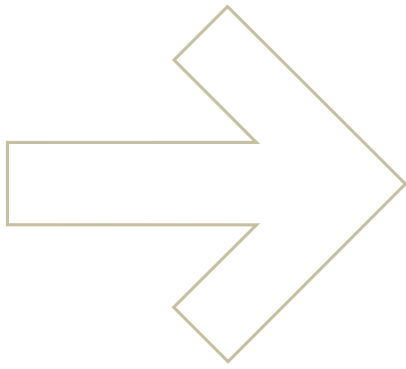
- Two DCDUs
- The MCDU to access the ATC message MENU
- Electronic Centralized Aircraft Monitor (ECAM) pages and alerts for FWC information about abnormal situations
- Two push buttons with visual attention getters, and the two associated aural ATC alerts
- The printer

A configuration with two DCDUs was chosen in accordance with safety studies and human factors studies, because of a clear dissociation of the ATC communication from other communications; absence of interference with the previously existing crew operational procedures; direct full time availability of ATC clearance messages; and its location in the forward field of view near the MCDUs.

The ATC alerts consist of:

- An aural alert: A specific sound named 'RING' (double brief ringing-phone-like alert)
- A visual alert: Two flashing lighted push-button switches labelled 'ATC MSG' (one for CAPT, one for F/O), located in the glare shield. The flashing period is one second.





1 Two visual attention getters

2 Two aural ATC alerts

3 FWC information about abnormal situations

4 DCDUs

5 ATC menu on each MCDU

Information

North Atlantic Region benefits from data link.

- In 2004, traffic levels exceeded pre-2001 levels
- NAV CANADA has reduced communication costs to users by 50%
- 55% of the fleet use either FMC (Flight Management Computer), WPR (Waypoint Position Reporting) or FANS A+ ADS-C for automatic position reporting

Pacific Sub-Region benefits from data link.

- Reduced separations to 50/50nm and 30/30nm (trials)
- User preferred routes and re-route (trials) for all city pairs in South Pacific
- Weather deviations
- Automatic position reporting
- 80% of the fleet in South Pacific use CPDLC (Controller-Pilot Data-Link Communications) and ADS-C, based on FANS A+, 60% in the Central Pacific, and 30% on average in the entire Pacific

4 | Conclusion

The FANS B product is the first Airbus answer to ATN based data link operations. Highly inspired by the FANS A/A+ package, FANS B integrates the same interfaces and operational principles for denser airspaces and for the characteristics of the ATN environment (network architecture, technical acknowledgement timestamp, timers).

FANS B enables aircrew to manage data link communications between the aircraft and the ground Air Traffic Services, as well as communications between the aircraft and the AOC.

The availability of a second means of communication reduces communication errors, aircrew and controller workload and fatigue and will thus contribute to higher safety levels - radio voice communications have a number of drawbacks in today's busy traffic environment and pilots have to listen to each controller-initiated communication.

Other benefits are expected with the entry into operations of the data link technology in European airspaces such as an increase of airspace capacity by:

- 3.4% with a data link equipage rate of 25%*
- 8% with a data link equipage rate of 50%*
- 11% with a data link equipage rate of 75%*

The above benefits are thanks to improvements such as better task sharing between controllers.

The Link 2000+ Programme can only be successful with the wide involvement of air navigation service providers, communication service providers, airlines and of course controllers and pilots. This is now under way – a contribution to safer, on-time aircraft operations.

It is anticipated that other regions will deploy ATN data link capabilities in their environment. A strong international standardization effort, in which Airbus has a key role, is being made to have interoperable standards. In particular CPDLC is part of Federal Aviation Administration (FAA) Next Generation Air Transportation System (NGATS).

Link 2000+ Programme and FANS B are key components of the Single European Sky ATM (Air Traffic Management) Research (SESAR) concept for future European Air Traffic Management System. Any airlines interested in information about FANS B or in upgrading their aircraft to this standard are invited to contact Airbus Customer Services Upgrade Services at upgrade.services@airbus.com or consult the 'getting to grips with Fans B in high-density continental areas part III' brochure distributed by Airbus.

To ensure proper operation of FANS B aircraft in high-density continental data link airspaces an operator needs to ensure the following:

- a) A contract with a Data Service Provider, DSP (ARINC or SITA*) is signed
- b) The aircraft is declared to the data link service provider
- c) The aircraft and its FANS capability is declared to the ATC centres of the operated routes
- d) The aircraft's avionics are properly configured
- e) Operational approval is obtained

* ARINC: Aeronautical Radio INC
SITA: Sté. Internationale de Telecommunications Aéronautiques

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* Figures given in the Eurocontrol website



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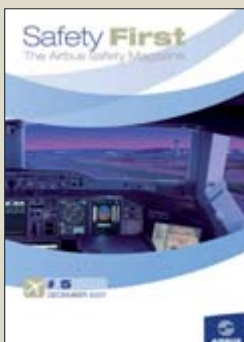
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