



Future Air Navigations Systems (FANS) 1/A+

White Paper

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	Definition
AC	Advisory Circular
ACARS	Aircraft Communications Addressing and Reporting System
ADS-B	Automatic Dependent Surveillance-Broadcast
ADS-C	Automatic Dependent Surveillance-Contract
AMOC	Alternate Means of Compliance
ARINC	Aeronautical Radio Incorporated
ATC	Air Traffic Control
ATS	Air Traffic Service
CDU	Control Display Unit
CMU	Communication Management Unit
CO ₂	Carbon Dioxide
Comm	Communications
Corp.	Corporation
CPDLC	Controller-Pilot Data Link Communications
CVR	Cockpit Voice Recorder
DO	Direct Order
EFIS	Electronic Flight Instrument System
FAA	Federal Aviation Administration
FANS	Future Air Navigation Systems
FDR	Flight Data Recorder
FIR	Flight Information Region
FL	Flight Level
FMS	Flight Management System
Global	Global Aerospace Design Corporation
GPS	Global Positioning System
HF	High Frequency
ICAO	International Civil Aviation Organization
ICS	Inter Communication System
IRS	Inertial Reference System
LOA	Letter of Authorization
MOPS	Minimum Operational Performance Standards
NAT	North Atlantic Tracks

Acronym	Definition
NOTAM	Notice to Airmen
NGSS	Next Generation Satellite System
OEM	Original Equipment Manufacturer
OPS	Operational Safety Section
PBCS	Performance-based Communication and Surveillance
RCP	Required Communications Performance
RLSM	Reduced Lateral Separation Minimums
RNP	Required Navigational Performance
RTA	Required Time of Arrival
RTCA	Radio Technical Commission for Aeronautics
SATCOM	Satellite Communications
SCN	Software Control Number
STC	Supplemental Type Certificate
TR	Tango Routes
TSO	Technical Standard Order
VDL	VHF Data Link
VHF	Very High Frequency

REFERENCES

Document	Rev / Date	Title
2017_001_Revision 4	July 9, 2019	NAT OPS Bulletin, NAT common DLM AIC
-----	January 24, 2021	The North Atlantic Datalink Mandate – What are the rules?
AC 20-140C	09/28/2016	Guidelines for Design Approval of Aircraft Data Link Communication Systems Supporting Air Traffic Services (ATS)
AC 20-150B	12/13/2014	Airworthiness Approval of Satellite Voice (SATVOICE) Equipment Supporting Air Traffic Service (ATS) Communication
AC 20-160A	09/28/2016	Onboard recording of Controller Pilot Data Link Communication (CPDLC) in Crash Survivable Memory
AC 25.1322-1	12/13/2010	Flight crew Alerting
FAA-2015-0289	03/02/2015	Policy Regarding Datalink Communications Recording Requirements
TSO-C159a	06/30/2010	Next Generation Satellite Systems (NGSS) Equipment
TSO-C160a	03/27/2012	Very High Frequency (VHF) Digital Link (VDL) Mode 2 Communications Equipment
RTCA DO-258A EUROCAE ED-100A	01/11/2008	Interoperability Requirements for ATS Applications Using ARINC 622 Data Communications (FANS 1/A Interop Standard)
RTCA/DO-281B	03/18/2014	Minimum Operational Performance Standards (MOPS) for Aircraft VDL Mode 2 Physical Link and Network Layer
RTCA DO-305A EUROCAE ED-154A	06/26/2007	Future Air Navigation System 1/A – Aeronautical Telecommunication Network Interoperability Standard (FANS 1/A – ATN B1 Interop Standard)
RTCA/DO-306 / ED-122 + Change 1	10/11/2007	Safety and Performance Standard for Air Traffic Data Link Services in Oceanic and Remote Airspace

1 ABOUT GLOBAL AEROSPACE DESIGN CORP.

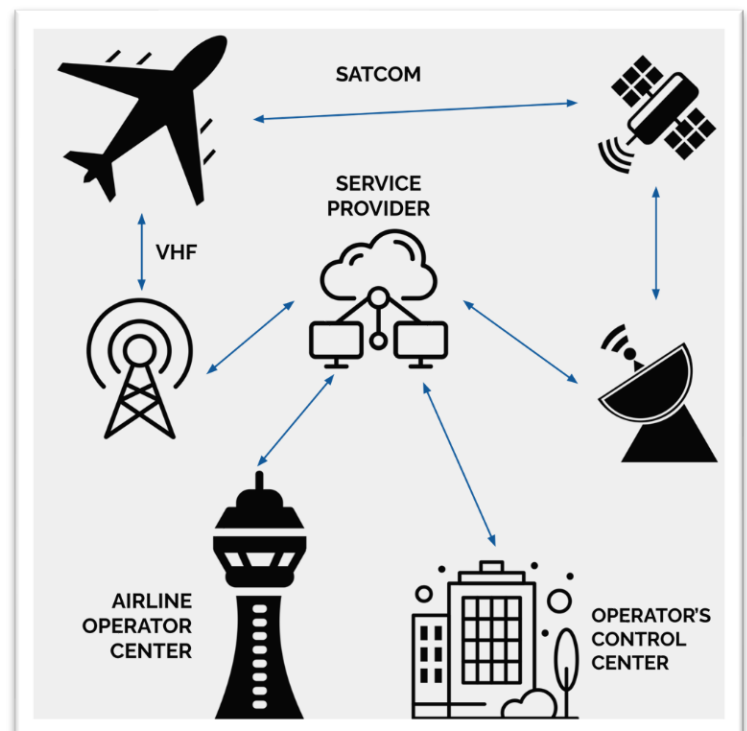
Global Aerospace Design Corporation (Global) is a technical services organization comprised of a highly experienced engineering staff focused on meeting your aircraft certification needs both in front of and behind the cockpit door. Our depth of experience with projects, ranging from full interior modification projects to complete cockpit upgrades, permits Global to provide technical solutions from nose-to-tail on any aircraft.

Comprised entirely of aircraft engineers, Global has the dedicated focus of maintaining positive cash flow while keeping overhead costs extremely low. This permits direct cost savings to our customers and maximizes our ability to outperform other integration services competitors.

2 FUTURE AIR NAVIGATION SYSTEMS (FANS)

2.1 Overview

For a long time, the only means of communication and surveillance for aircraft operating in remote or oceanic regions was high frequency (HF) communications. However, HF systems are problematic due to noisy transmissions caused by atmospheric conditions and language barriers. Over time, concerns began to arise regarding increased air traffic leading industry officials to address aging comm systems. In 1983, the International Civil Aviation Organization (ICAO) in partnership with Boeing, Airbus, Honeywell, and other industry leaders developed Future Air Navigations Systems (FANS) to allow aircraft to safely and efficiently utilize a given volume of airspace. FANS is used primarily in the oceanic regions taking advantage of both satellite communication and navigation to create a virtual radar environment for safe passage of aircraft.



The Boeing Company certified the first implementation of FANS in 1995, known as FANS-1. This system utilized existing satellite-based ACARS communications, to target operators in the South-Pacific. The deployment of FANS-1 was to improve route choice available to operators, resulting in efficiency and fuel savings.

Following the launch of FANS-1, Airbus developed FANS-A. The two technologies are often referred to as FANS-1/A; however, with the addition of minor enhancements, the technology is currently known as FANS-1/A+. Data Comm FANS uses ADS-C and CPDLC to directly communicate with the ATC over VHF or SATCOM to enable more efficient communication between operator and controller.

In short, it is worth highlighting that the two systems FANS-1 and FANS-A are very similar, however the main difference between them is the aircraft they are typically installed on:

- FANS-1: standard used on Boeing Aircraft
- FANS-A: standard used on Airbus Aircraft

2.2 FANS 1/A benefits:

FANS provides real-time constant position data to enhance the quality of communication between the pilot and controller, ultimately creating safer and more efficient airspace. There are many benefits to integrating FANS, including:

- **Optimized Airspace Capacity** – when determining the necessary airspace separation between aircraft errors in navigation and communication are considered. FANS equipped aircraft are enabled with CPDLC and ADS-C which dramatically increases the accuracy of navigation and communication for an aircraft, ultimately reducing separation and increasing airspace capacity.
- **Reduced Altitude Loss** – to avoid collisions, aircraft must be separated by a certain altitude when crossing tracks. This leads to aircraft operating below optimal altitude to cross a track. With increased navigational accuracy, the occurrence of this will be greatly reduced.
- **More Direct Routes** – as a result of the FANS mandate, non-FANS aircraft are unable to transition through or fly above the North Atlantic Tracks (NAT), resulting in undesirable, inefficient routes, it is to the benefit of any fleet to integrate FANS to use the most efficient routes.
- **Additional FANS Benefits:**
 - Workload reduction
 - Miscommunication error reduction
 - Faster communication
 - Improved flight safety
 - Reduced CO₂ emissions
 - Reduced aircraft operation costs

2.3 Routes

To alleviate route congestion, primarily in the North Atlantic routes, it is necessary to Reduce the aircraft Lateral Separation Minimums (RLSM). Certain routes, designated as “FANS routes,” reserves the best airspace for the best equipped aircraft. Refer to charts in the “Mandates” section for affected routes.

Airspace not included in FANS:

- ATS Surveillance Airspace – provided by radar and/or Automatic Dependent Surveillance-Broadcast (ADS-B).
- Airspace north of 80° North.
- The New York Oceanic Flight Information Region (FIR).

2.4 Communication

FANS utilizes Aircraft Communications Addressing and Reporting System (ACARS) over VHF and/or Satellite Communication (SATCOM) for message transmissions. Inmarsat and Iridium are approved for SATCOM FANS communication.

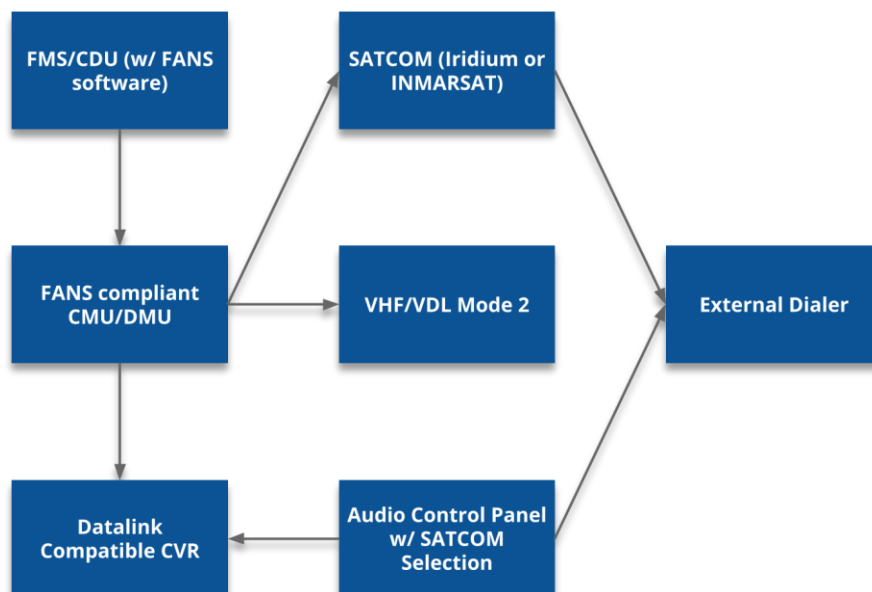
The use of VHF ACARS restricts the amount of air traffic on the system due to bandwidth limitations of the technology. The Federal Aviation Administration (FAA) is currently planning to utilize FANS 1/A+ over U.S. continental airspace in the initial Air Traffic Control (ATC) data link phase but will require operators to utilize VHF Data Link (VDL) Mode 2 radios for increased bandwidth.

2.5 Required Components

- **Flight Management System (FMS) / Control Display Unit (CDU)** – software updates/features necessary for FANS 1/A compliance.
 - Required Navigational Performance (RNP) – Global Position System (GPS) and Inertial Reference System (IRS) combined with FMS provide compliance with RNP mandates. RNP 4 and 10 are required to comply with FANS 1/A.
 - Required Time of Arrival (RTA) – gives the flight crew the ability to assign a time constraint to a waypoint. The cruise speed is automatically adjusted to achieve an accuracy of +/- 30 seconds.
 - Flight Plan Updates – FMS can update the flight plan based on revised clearances received by ATC via Controller-Pilot Data Link Communications (CPDLC). The flight crew would acknowledge the clearance and the active flight plan would be updated.
- **Communication Management Unit (CMU)** – CMU must be FANS compliant and will interface with the FMS. Unit may include an internal VHF VDL Mode 2 radio, supporting full ACARS messaging (ACARS over VHF).
 - **Automatic Dependent Surveillance – Contract (ADS-C)** - Transmits the position of the aircraft (via SATCOM or VHF data link) every one to five minutes to an ATC listening station. ADS-C maintains surveillance continuity through automatic handover across Flight Information Region (FIR) boundaries.
 - Data link application controlled by FMS.
 - Areas of Operation – Oceanic / Remote (North Atlantic, North Pacific, South Pacific).
 - Network – SATCOM and/or VHF ACARS
 - Equipment Requirements – FMS, SATCOM, VHF VDL (ACARS)
 - ADS-C is designed to be completely automated (except for emergency operations) with minimal input from the pilot and controller.

- **Controller/Pilot Data Link Communication (CPDLC)**
 - Data link application controlled by FMS.
 - Enables two-way communications between the cockpit and the ATC. It contains the set of predefined text messages for clearances, requests, and routine message traffic. Hands-on crew tool.
 - CPDLC is designed to use the ACARS network and is routed from the cockpit to ATC based on handling instructions within the aircraft CMU.
 - CPDLC data link software can be contained within the FMS.
- **Datalink**
 - **VHF Transceiver** – Must include the VHF Data Link (VDL) specification. VDL Mode 2 is the specification that is relevant to FANS compliance.
 - **SATCOM** – approved by the FAA to ensure ATCs can monitor aircraft outside the range of ground-based radar. The two available satellite networks available for FANS compliance are the Inmarsat (TSO-C132) and Iridium (TSO-C159a) networks. The FAA has stated that an Alternate Means of Compliance (AMOC) will be accepted for the short term for capable SATCOM systems without TSO approval. Reference AC 20-140(B) and 120-70(B) as guidance on recommended paths to achieving approvals for a Data Link system within the various sub-networks.
- **Annunciators** – FANS solutions require annunciation for datalink messages on Electronic Flight Instrument System (EFIS) displays or separate annunciator in the forward field of view and aurally to alert crew when a message has been received.
- **Cockpit Voice Recorder (CVR)** – must be compliant with TSO-C177 to record datalink communications.

Future Air Navigation Systems (FANS) 1/A+ System Diagram



2.6 North Atlantic Track Mandate

Mandates for FANS began in 2013 for the most efficient tracks in the North Atlantic Tracks (NAT). The mandate was expanded in 2015 to include all the NATs at optimal altitudes. As of December 7, 2017, all aircraft flying within the NAT between FL350 and FL390 were required to be equipped with FANS 1/A+, CPDLC, ADS-C, VHF data link or STACOM systems. Aircraft not equipped with FANS 1/A+/PBCS will not be able to transition through the NATs, resulting in less optimal routing. On January 31, 2020, the mandate expanded to all airspace FL290 and above, ultimately reserving the most efficient airspace for FANS equipped aircraft only.

The North Atlantic Flight Information Regions (FIRs) have published NOTAMs further expanding the North Atlantic Data Link Mandate.

The following extensions apply:

- October 09, 2020 – Reykjavik (BIRD)
- December 18, 2020 – Gander (CZQX)
- December 30, 2020 – Shanwick (EGGX)
- February 26, 2021 – New York Oceanic West (KZWY) and Santa Maria (LPPO)

The North Atlantic Data Link Mandate will remain suspended until February 25, 2021. Meaning aircraft not equipped with CPDLC and ADS-C can continue to operate across the North Atlantic between FL290-FL410 until that date. However, all aircraft wishing to fly in the North Atlantic Tracks between FL290-FL410 must be equipped with CPDLC and ADS-C after February 25, 2021; however, the following exemptions apply:

- Any aircraft flying north of 80° North
- New York Oceanic East FIR
- Tango Routes T9 and T290
- ATS surveillance airspace, where surveillance is provided by means of radar and or ADS-B coupled with VHF

Currently, there are no FANS mandates for the United States or European domestic airspace.

2.7 Upgrade Paths

- Global Aerospace Design Corp Solution: FAA STC ST04417CH
 - Spectralux Envoy™ Data Link
 - Rockwell Collins ICS-220A Iridium SATCOM
 - External Annunciator Panel
 - Aural Alerts

2.7.1 Certification

Aircraft approval for FANS Oceanic operations requires a Letter of Authorization (LOA) from the Federal Aviation Administration (FAA) and equipment under a Supplemental Type Certificate (STC) or OEM Service Bulletin in accordance with AC 20-140.

2.7.2 Training

For the operator to receive a LOA for FANS operations from the FAA, the flight crew must complete and applicable FAA approved training course:

- Create FANS Training Media (part of LOA)
- Create FANS Training Manual (part of LOA)
- Conduct Onsite and Virtual Training (part of LOA)

3 CONCLUSION

Future Air Navigation Systems were created to improve overall safety and efficiency, especially for aircraft operating in oceanic and remote regions. Integrating FANS 1/A+ can meet regulatory requirements and provide substantial cost savings for aircraft operating in these airspaces. Contact Global for more information regarding our FANS 1/A+ solution at info@gadc.aero or by visiting www.gadc.aero.

4 GLOBAL EXPERIENCE



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Located in Cincinnati, Ohio and established in 2012, by a group of talented ex-airline professionals with over 30 years of industry experience, *GLOBAL* is a highly talented engineering team dedicated to meeting all aircraft certification and modification needs.

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CABIN ELECTRONICS

GLOBAL is able to provide cabin electronics solutions as well. The *GLOBAL* team can provide system integration solutions for all cabin equipment and ensure that everything is fully qualified to be on the airplane.



T-PED TESTING

Transmitting Portable Electric Device testing demonstrates that an aircraft is tolerant to the use of portable electric devices from gate to gate. This testing is a necessary step for the integration of Wi-Fi and wireless in-flight entertainment.

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