Agenda

• CNS/ATM
• FANS 1/A
• Link 2000+
• ADS-B
CNS-ATM
Global Trends

- Global Air Traffic Growing 4-5% per Year (IATA)
- Increase Airspace Capacity = Improved Aircraft Equipage and Ground Infrastructure
- **Communication**
  - Domestic VHF voice
  - Oceanic HF voice
- **Navigation**
  - Sensor-based (ex. Loc & GS)
- **Surveillance**
  - Radar
- **Air Traffic Management**
  - Time-based operations

Data Link
Satcom (both voice & data)
Performance-Based Navigation (PBN) – GNSS, RNP, RNÁV
ADS-B (higher update rate)
Trajectory and Performance-based
FANS 1/A (Future Air Navigation System)

- Primary Goal – Improve Safety through Better Communications in Remote and/or Oceanic Areas (vs. HF Radio)
- Developed in 1980’s
- International Civil Aviation Organization (ICAO) & Boeing
- First Implementation - ‘90’s
FANS 1/A
What is it?

• Provides Data Link Communication with ATC through Satcom (Inmarsat or Iridium) or VHF

• **AFN Logon:** Air Traffic Service Facilities Notification Logon
  • Provides the air traffic service unit with aircraft information (ADS-C, CPDLC, Tail Number, ACARS Address, correlation with flight plan, etc.)

• **ADS-C:** Automatic Dependent Surveillance-Contract
  • Provides digital **automatic position reports** to ATC

• **CPDLC:** Controller Pilot Data Link
  • Provides digital communication for **requests and intervention**
FANS 1/A
What is it?

- Iridium Satcom approved for FANS 1/A operations by the FAA, check with state AIPs (aeronautical information publications) for other areas
- Provides a higher level of performance, which will lead towards reduced separation initiatives
- Proven Solution for Communication and Surveillance
- Also planned for use in US NextGen System using VDL Mode 2 as early as 2015
FANS 1/A
North Atlantic

- Approximately 1400 North Atlantic Track Crossings per Day and increasing (6% Corporate)
- Approximately **60%** of all North Atlantic Track Crossings are FANS 1/A Equipped and increasing
- Current Separation 10 minutes in trail, 60 nm (1 degree) lateral and 1000ft vertical
- **Approaching Airspace Saturation**
FANS 1/A
North Atlantic

- **Primary Goal: Improved Safety**
- **Secondary Goal: Reduced Separation**

- Reduced Longitudinal Separation Minimum (RLongSM)
  - Proposed separation 5 minutes in-trail
  - Provides aircraft the ability step climb for greater fuel efficiency

- Reduced Lateral Separation Minimum (RLatSM)
  - Proposed separation 1/2 degree (30nm) lateral
- **Both require approval for FANS (ADS-C & CPDLC) & RNP 4 (using GNSS)**

- **Can you apply for an exemption for FANS airspace?**
<table>
<thead>
<tr>
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<th>Mandate</th>
<th>Details</th>
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</thead>
<tbody>
<tr>
<td>February 2015</td>
<td>“Phase 2A” Expanded FANS 1/A Airspace</td>
<td><strong>ALL</strong> NAT Organized Track System (OTS) FL350-FL390 (inclusive and no exemptions)</td>
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<tr>
<td>Nov. 12, 2015</td>
<td>RLatSM in NATS (trials) Phase 1</td>
<td>Three center (most desirable) tracks will have a ½ degree track between them. <strong>RNP 4 required</strong></td>
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<td>Feb 4, 2016</td>
<td>MNPS Airspace Naming</td>
<td>Will be called “NAT High Level Airspace”</td>
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<td>Nov., 2016</td>
<td>RLatSM in NATS Phase 2</td>
<td><strong>All OTS</strong> FL350-FL390 will have a ½ degree track between them. <strong>RNP 4 required (except NY FIR)</strong></td>
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# FANS 1/A

Tomorrow’s Mandates

<table>
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<tr>
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<th>Mandate</th>
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<tr>
<td>Dec., 2017*</td>
<td>“Phase 2B” Expanded FANS 1/A Airspace</td>
<td>FANS1/A required in all ICAO NAT region FL350-FL390 (inclusive)</td>
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<tr>
<td>Jan. 30, 2020*</td>
<td>“Phase 2C” Expanded FANS 1/A Airspace</td>
<td>FANS 1/A required in <strong>all ICAO NAT region FL290 and above. MNPS standards no longer apply. Need RNP 2, 4, or 10 approval. RNP 4 required for RLAT</strong></td>
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</table>

*Will not apply if surveillance is available by radar or ADS-B (essentially, the Blue Spruce Routes”)
*Will not apply if above 80 degrees North
*Excludes NY FIR until FAA Regulations are updated
– Planning Recommendations:
For those aircraft that are capable of flying above the OTS airspace, flight planning service providers have taken a conservative approach and have stated that “if you do not meet the requirements to fly on the specified Data Link tracks, you shouldn’t plan to shadow those tracks above the OTS airspace.” The main reason is if they are unable to provide you with your requested flight level and you’re assigned a flight level within the OTS, they will have to re-route you on a different track due to lack of appropriate equipment and capabilities.
FANS 1/A
New York Oceanic

- Changes to Separation Minima in NY Oceanic Control Area (12-10-2013)
- Not a Mandate
- FANS Equipped Aircraft can be given Reduced Separation
  - RNP 4.0, CPDLC, ADS-C and LOA = 30nm Lateral, 30nm Longitudinal
- FAA Claims Operational and Safety Benefits
  - Enhanced weather avoidance
  - Enroute climbs and other operational flexibilities
  - Better communication between A/C and ATC
- Operational Training is Required, but Covered Under FANS LOA
FANS 1/A
Cost of Non-Compliance

• Many Long-Range Aircraft Optimum Altitudes are FL370-FL390
  – FL400 is not achievable if temps are too hot (ISA +10) at gross weight
  – FL420 is not available due to non-RVSM airspace above (2k separation)
  – At FL330 or FL340, aircraft will burn at least 10% more fuel
    • Higher cruise speed to keep up with airliners
    • Less flexibility for weather/turbulence

• Result:
  – By 2015, aircraft not FANS 1/A equipped will have to fly around the OTS, and
    transitioning through the OTS on a “random route” will be unlikely
  – By 2017, aircraft not FANS 1/A equipped will have to fly the “Blue Spruce Routes” if ADS-B is available or below FL350
  – By 2020, aircraft not FANS 1/A equipped will have to fly the “Blue Spruce Routes” if ADS-B is available or below FL290
FANS 1/A
Cost of Non-Compliance

2015, FL330=Higher Fuel Burn and Turbulence

2017, FL390=Extended Routes
FANS 1/A
Cost of Non-Compliance

2015, FL340=Higher Fuel Burn & Distance

2015, FL340=Higher Fuel Burn and Turbulence ‘15

2017, FL380=Extended Routes
FANS 1/A
North Atlantic ½ Degree Tracks

- Today’s Full Degree Tracks - Shorthand
  - N 31 00.00 W065 00.00
  - Or 3165N

- The new “1/2 Degree” track waypoints are not in the NAV Database.
  - Naming convention originally used – N5275
    - Resulted in large increase of Gross Navigational Errors
  - Naming convention now suggested – 5275”H”
  - Full Lat/Long entry Until Resolved
ADS-C and/or CPDLC
Available in Most Oceanic/Remote Regions Today

Air Traffic Services (ATS) Data Link Map

June 2014

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FANS operational
FANS planned
FANS & LINK 2000+ operational
FANS & LINK 2000+ planned
LINK 2000+ operational
LINK 2000+ planned

2012 Flight Information Region (FIR) boundaries are provided by ICAO. Nominal ATS data link service availability is depicted to the best of Boeing’s knowledge. Service is not necessarily available throughout an indicated FIR.
FANS 1/A
Operational Benefits

• Significantly Improved Communications
  • Large quantity of HF traffic is no longer an issue
  • Poor quality of HF is no longer an issue
  • Language barrier is no longer an issue due to message set

• Deviation from Flight Plan Clearance can be Detected Sooner
• Lower stress on crew
• Resulting in Increased Safety!
FANS 1/A
Guidance Material

- FAA Data Link Website
  - [http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/enrout/oceanic/data_link/](http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/enrout/oceanic/data_link/)
  - AC 120-70B - Operational Authorization Process
  - Data Link Approval Checklist
  - Operator Guide to Data Link Approval
  - GOLD – Global Operational Data Link Document, Rev. 2
    - ICAO Document developed for **operators and air traffic service providers** as a global standard
    - Operators should review Chapter 1, 2, 5, & App E
  - AC 91-70A – Oceanic and International Operations
  - New York CPDLC NOTAM (31 May, 2006)
  - Data Link News – non-FAA site with good data link Information
- Be aware the link name might be different than the actual document title and file name
- What document should operators become familiar with?
  - GOLD
FANS 1/A
How Do I Get It?

- Install FANS 1/A equipment under STC or OEM Service Bulletin (AC 20-140b)
  - WAAS FMS Update (required by most solutions)
  - Communications Management Unit (Unilink)
  - Annunciator “cube” or integrated into displays
  - Aural Alert
  - Data Capable CVR Required (AC 20-160)
  - Level “D” Satcom system
  - Letter of Authorization from the FAA
FANS 1/A
Letters of Authorization

- In 2013 the FAA processed 7 FANS LOA's

- In 2014 the FAA processed 107 FANS LOA requests, which took 6-9 months on average

- Universal Avionics is predicting close to 3000+ LOA requests over the next three years

- Recommendation – Install sooner rather than later…..
FANS 1/A
Additional Installation Benefits

WAAS/SBAS FMS
• LPV Approach capability (3364 in U.S)
• LPV Approaches used as an ILS back-up at many U.S. and Canadian Airports
• Key Element in FAA and Eurocontrol roadmap
• WAAS accuracy needed for new ADS-B out transponders (TSO-166b)

Data Capable CVR
• Required in Europe in Jan. 2016

CMU
• Traditional ACARS Functionality
• Growth to Link 2000+ Mandate (Unilink)
FANS 1/A
Additional Capabilities with a CMU (*UniLink*)

**After subscribing to AOC services**
- Hi-res weather graphics
- Textual based data – e.g. weather, change in flight status, etc. (based on service offering)
- Aircraft tracking and ground-to-air messaging from any Internet connection
- Flight information services (airport dependent) such as:
  - Flight plan uploading (AOC)
  - D-ATIS
  - Pre-Departure Clearance
  - Expected Taxi Clearance
  - Push back and Oceanic Clearances
  - TWIP (Terminal Weather Information for Pilots)
LINK 2000+

- EUROCONTROL – 40 Member States
- Single European Sky Initiative (SES)
- Link 2000+ part of this plan
- The Eurocontrol SES Data Link Services Implementing Rule (DLS-IR) is the legislation that made it a mandate
- Aeronautical Telecommunication Network Baseline 1 (ATN-B1) – standard for interface services between aircraft and ground networks
- Is Link 2000 interoperable with FANS?
- NO, it is a different message set
LINK 2000+
Summary of Requirements

- Applies to all IFR aircraft flying in European airspace above FL285
- Applicable to new and retrofit aircraft in 2020
- Required aircraft capabilities:
  - CMU with VDL Mode 2 Radio
  - Link 2000+ Message Set (ATN-B1)
  - WAAS FMS (UASC Aircraft)
    - Meets ADS-B accuracy requirement by 2020
    - WAAS/LPV will be the next big push in EU
- ANSPs must implement ground systems before February 5th, 2018 in the Link Region
LINK 2000+
Status Today

- Only 5 Group “A” Countries Ready
- Having Issues with “Provider Aborts” where more than 10% are disconnected
- Exempt Aircraft will be able to operate normally with voice
  - Exemption list could be reduced since mandate has slipped
- Exempt Aircraft Issues could be based on Individual Air Traffic Service Unit:
  - Delayed Clearances
  - Non-Direct Routings
  - Undesirable Altitudes
## Data Link Mandates

### Link 2000+

<table>
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<tr>
<th>Date</th>
<th>Mandate</th>
<th>Details</th>
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<tbody>
<tr>
<td>February 2020 for forward and retrofit aircraft</td>
<td>Data Link Services Implementing Rule (DLS IR) equipage (Link 2000+ FL 285 and above) in Western Europe (Eurocontrol Airspace)</td>
<td>Not interoperable with FANS-1/A due to difference in message set. UASC will have a software update to the UniLink in 2016 to meet this requirement</td>
</tr>
</tbody>
</table>

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![Map of Europe](image)
ADS-B Current Implementation

Figure 1: Worldwide Status of ADS-B Implementation in Feb 2012  (multiple references)
## Worldwide ADS-B Timeline

<table>
<thead>
<tr>
<th>Year</th>
<th>Events</th>
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<tbody>
<tr>
<td>2006</td>
<td>FAA rule (14CFR §91.225)</td>
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<tr>
<td>2008</td>
<td>ADS-B Out NPRM*</td>
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<tr>
<td>2009</td>
<td>Final Rule Published</td>
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<tr>
<td>2010</td>
<td>NAS-Wide Infrastructure Deployed</td>
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<tr>
<td>2012</td>
<td>ADS-B Out Avionics Equipage 100%</td>
</tr>
<tr>
<td>2013</td>
<td>ADS-B Out New Aircraft</td>
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<tr>
<td>2014</td>
<td>ADS-B Out Retrofit</td>
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<td>2015</td>
<td>ADS-B Out New Aircraft</td>
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<td>2016</td>
<td>ADS-B Out RetroFit</td>
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<td>2017</td>
<td>ADS-B Out Avionics Equipage 100%</td>
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<tr>
<td>2018</td>
<td>ADS-B Out FL 290+ Avionics 100%</td>
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<tr>
<td>2019</td>
<td>ADS-B Out Avionics Equipage 100%</td>
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<tr>
<td>2020+</td>
<td>ADS-B Out Avionics Equipage 100%</td>
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</table>

*NPRM - Notice of proposed rulemaking.*

- **Europe**
  - 1090 Only
  - ADS-B Out Rule Consultation
  - Final Rule Published
  - ADS-B Out New Aircraft
  - ADS-B Out Retrofit

- **Australia**
  - WAAS GPS
  - Either TSO of 1090 Only
  - ADS-B Out NPRM
  - Final Rule Published
  - ADS-B Out FL 290+ Avionics 100%

- **Canada**
  - Hudson Bay ADS-B Ground Network ADS-B Out Equipage
  - Required for entry FL350-FL400 Inclusive, eventually to FL290
  - ADS-B Out Avionics Equipage 100%

- **Others**
  - Hong Kong, Singapore, Vietnam - ADS-B Out FL 290+
ADS-B Compliance

Hudson Bay (FL350-FL400, Inclusive-since 2010):

- Equipment must be installed by STC or OEM SB.
- AFMS statement to AC 90-114 or EASA AMC 20-24
- LOA required in Canada or if U.S. aircraft are operating outside the U.S. in ADS-B airspace
- Company crew and maintenance training is required
- If not equipped, FL350-FL400 can be provided if on the fixed route structure (although less efficient)
- “White List” of certified performing avionics

Aircraft capability example

- For the US & EU, transponders must be TSO-c166b compliant
  - This will require a **WAAS FMS** in most cases
  - Visual alerts needs to be in the pilots normal field of view for any loss of ADS-B output parameter
## Platform Solutions
Bombardier (certified or in progress)

<table>
<thead>
<tr>
<th>Aircraft</th>
<th>ADS-B Out (DO-260B)</th>
<th>FANS 1/A</th>
<th>Link 2000+</th>
<th>Equipment</th>
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</thead>
<tbody>
<tr>
<td>Global 6000</td>
<td>Bombardier (FF 2Q 15, RF 4Q15)</td>
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## Platform Solutions

Dassault (certified or in progress)

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## Platform Solutions
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# Platform Solutions
Other Platforms (certified or in progress)

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DEDICATED TO HELPING BUSINESS ACHIEVE ITS HIGHEST GOALS.