Previous NBAA IOC’s
2013 Avionics Session Comments

• Avionics material was outstanding and very pertinent.
• Avionics mandate material was too much too fast. I was lost
• Less salesmanship – Ok, I promise
• HUD slides too busy, too technical, and not applicable to Int. Ops
• What does “FANS Equipped” mean? CPDLC, ADS-C, ADS-B?
• Suggestion – ADS-B and ADS-C for Dummies
Avionics Session Agenda

• Data Link and Associated Mandates
  – FANS-1A (CPDLC & ADS-C)
  – Link 2000+
  – ADS-B
  – TCAS Change 7.1
  – Platform Solutions

• Operational Examples of FANS in the Gulfstream
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 to Data Link
  – Oceanic – HF voice to Satcom (both voice & data)

• Navigation
  – Sensor-based (ex. Loc & GS) to Performance-Based Navigation (PBN) – GNSS, RNP, RNAV

• Surveillance
  – Radar to ADS-B (higher update rate) &ADS-C

• Air Traffic Management
  – Time-based operations to 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
• **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)***
# FANS 1/A
## Today’s Mandates

<table>
<thead>
<tr>
<th>Date</th>
<th>Mandate</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 2013</td>
<td>“Phase 1” FANS 1/A in the North Atlantic Track System (NATS)</td>
<td>Two center (most desirable) tracks, FL360-FL390 inclusive <em>(no exemptions)</em></td>
</tr>
<tr>
<td>January 2014</td>
<td>European DataLink (Link2000+) Services Implementing Rule (DLS IR) Exemption</td>
<td>Aircraft that are FANS equipped and have operational approval before, are <em>exempt</em> from the DLS IR mandate for the lifetime of the aircraft</td>
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<tr>
<td>2015</td>
<td>RLatSM trials in NATS</td>
<td>Two center (most desirable) tracks will have a $\frac{1}{2}$ degree track between them</td>
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# FANS 1/A

## Tomorrow’s Mandates

<table>
<thead>
<tr>
<th>Date</th>
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<tbody>
<tr>
<td>Feb 2015</td>
<td>“Phase 2a” Expanded FANS 1/A Airspace</td>
<td>All NAT Organized Track System (OTS) FL350-FL390 inclusive</td>
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<tr>
<td>Dec 2017</td>
<td>“Phase 2b” Expanded FANS 1/A Airspace</td>
<td><strong>All NAT Region</strong> FL350-FL390, inclusive</td>
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<td>Jan 2020</td>
<td>“Phase 2c” Expanded FANS 1/A Airspace</td>
<td><strong>ALL NAT Region</strong> FL290 and above</td>
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<tr>
<td>TBD</td>
<td>RLatSM &amp; RLongSM</td>
<td>Specified portions of FANS 1/A airspace</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
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 FL340 or FL350, 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

North Atlantic High Level Significant Weather Forecast  VT 0600Z 16 Aug 2013

FL390 Extended Routes ‘17

FL330-Higher Fuel Burn and Turbulence
FANS 1/A
Cost of Non-Compliance

North Atlantic High Level Significant Weather Forecast
VT 0600Z 16 Aug 2013

FL340-Higher Fuel Burn & Distance ‘15
FL380-Extended Routes ‘17
FL340-Higher Fuel Burn and Turbulence ‘15
FANS 1/A
North Atlantic ½ Degree Tracks

• Today’s Full Degree Tracks - Shorthand

- N 31 00.00
- W065 00.00

• The new “1/2 Degree” tracks are not in the NAV Database. Yet.

- Arinc has suggested a new naming convention, but it has not been accepted by ICAO and Jeppesen won’t add it to the database.
- N5275
- Full Lat/Long entry Until Resolved
ADS-C and/or CPDLC
Available in Many Oceanic/Remote Regions
Today
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/enroute/oceanic/data_link/](http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/enroute/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
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
- For “N” registered aircraft, Letter of Authorization required from the FAA
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
(*UniLink®*)

(after subscribing to AOC services)

- Flight information services (airport dependent)
  - D-ATIS
- Pre-Departure Clearance
- Expected Taxi Clearance
- Push Back and Oceanic Clearances
- TWIP (Terminal Weather Information for Pilots)
- Capable of Iridium or Inmarsat ACARS Data Link
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 (not interoperable with FANS-1/A)
LINK 2000+
Summary of Requirements

• Applies to all IFR aircraft flying in European airspace above FL285
• Applicable to new aircraft delivered as of Jan 2011
• Existing aircraft retrofit complete by 2015 (most likely delayed until 2016)
• FANS operational aircraft delivered before January 2014 will be exempted, but will have to use voice operations
• 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 2017
    • WAAS/LPV will be the next big push in EU
• ANSPs must implement ground systems before end of 2013 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
- Exempt Aircraft Issues could be based on Individual Air Traffic Service Unit:
  - Delayed Clearances
  - Non-Direct Routings
  - Undesirable Altitudes

<table>
<thead>
<tr>
<th>Country</th>
<th>Status</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>Not ready</td>
<td>Estimate Q4/2014</td>
</tr>
<tr>
<td>Belgium</td>
<td>Ready</td>
<td>Served by MUAC above FL 285*</td>
</tr>
<tr>
<td>France</td>
<td>Not Ready</td>
<td>Q4/2017 – Q4/2018</td>
</tr>
<tr>
<td>Germany</td>
<td>Not fully Ready</td>
<td>Since 2012** (except Rhein UIR – ARINC)</td>
</tr>
<tr>
<td>Ireland</td>
<td>Not ready</td>
<td>Estimate Q1-Q2/2014</td>
</tr>
<tr>
<td>Italy</td>
<td>Not ready</td>
<td>Estimate Q4/2015-Q1-2016</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>Ready</td>
<td>Served by MUAC above FL 285*</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>Ready</td>
<td>Served by MUAC above FL 285*</td>
</tr>
<tr>
<td>Spain</td>
<td>Not Ready</td>
<td>Estimate Q4/2015</td>
</tr>
<tr>
<td>Switzerland</td>
<td>Ready</td>
<td>Since 2012</td>
</tr>
<tr>
<td>Portugal</td>
<td>Not ready</td>
<td>Estimate Q4/2015</td>
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<tr>
<td>United Kingdom</td>
<td>Not ready</td>
<td>Estimate Q4/2013-1Q2014</td>
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</tbody>
</table>
## DLS-IR (Link 2000+) Data Link Mandates

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</tr>
<tr>
<td>February 2015</td>
<td>DLS IR equipage (Link 2000+ FL 280 and above)</td>
<td>2013 for forward fit and 2015 for retrofit</td>
</tr>
</tbody>
</table>
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 (14 CFR §91.225)</td>
</tr>
<tr>
<td>2007</td>
<td>ADS-B Out NPRM*</td>
</tr>
<tr>
<td>2008</td>
<td>Final Rule Published</td>
</tr>
<tr>
<td>2009</td>
<td>ADS-B Out New Aircraft</td>
</tr>
<tr>
<td>2010</td>
<td>ADS-B Out Retrofit</td>
</tr>
<tr>
<td>2011</td>
<td>ADS-B Out Equipment 100%</td>
</tr>
<tr>
<td>2012</td>
<td>ADS-B Out FL 290+ Avionics 100%</td>
</tr>
<tr>
<td>2013</td>
<td>ADS-B Out Equipment 100%</td>
</tr>
<tr>
<td>2014</td>
<td>ADS-B Out FL 290+ Avionics 100%</td>
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<td>2015</td>
<td>ADS-B Out Equipment 100%</td>
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<tr>
<td>2018</td>
<td>ADS-B Out Equipment 100%</td>
</tr>
<tr>
<td>2019</td>
<td>ADS-B Out Equipment 100%</td>
</tr>
<tr>
<td>2020+</td>
<td>ADS-B Out Equipment 100%</td>
</tr>
</tbody>
</table>

**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 Equipment for entry FL350-FL400 Inclusive, eventually to FL290
- ADS-B Out Equipment 100%

**Others**
- Hong Kong & Singapore
- ADS-B Out FL 290+

*NPRM - Notice of proposed rulemaking.*
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
  - Radio controller needs to alert the pilot of loss of any ADS-B output parameter
TCAS 7.1 Mandate

European Aviation Safety Agency (EASA)

• TCAS Change 7.1 – Retrofit Aircraft December 2015
• Primary Changes to the TCAS are:
  – Reversal Logic Enhancements
  – “Level Off” Aural Alert
  – Change to Descend RA’s at Low Altitude
# 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>
</tr>
</thead>
<tbody>
<tr>
<td>Global 6000</td>
<td>Bombardier (4Q14)</td>
<td>Bombardier</td>
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<td>RCI Fusion</td>
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## Platform Solutions
### Dassault (certified or in progress)

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## Platform Solutions
Gulfstream (certified or in progress)

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# Platform Solutions

Other Platforms (certified or in progress)

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<th>FANS 1/A</th>
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<th>Equipment</th>
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<tbody>
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<td>B737 (BBJ)</td>
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</tr>
</tbody>
</table>
DEDICATED TO HELPING BUSINESS ACHIEVE ITS HIGHEST GOALS.