Space-based ADS-B
ADS-B Seminar – Hong Kong
22 April 2014

Introduction of Aireon:
Value extraction from technical opportunity
Aireon LLC is a joint venture between NAV CANADA, IAA, ENAV, NAVIAR and Iridium to finance, develop, deploy and operate a global solution for tracking and monitoring aircraft anywhere in the world by using space-based ADS-B receivers.

Some of the Players

- Iridium - Owner/operator of satellite constellation
- Aireon - Joint venture of Iridium and NAV CANADA, created to establish ADS-B service
- Thales Alenia Space - Builder of satellites, under contract to Iridium
- Harris - Builder of ADS-B payloads, under contract to Aireon
- Exelis - Systems engineering support, under contract to Aireon and builder of processing and distribution subsystem, under contract to Aireon
- NAV CANADA - Investor in Aireon; launch customer for ADS-B service
ANSP Collaboration

NAV CANADA  IAA  ENAV  NAVIAIR

NAV Portugal  NATS  FAA

Aireon ADS-B via Low Earth Orbiting (LEO) Satellites

Iridium NEXT Satellite equipped with ADS-B receiver 1090 ES

Iridium Ground Control Network

ANSF ADS-B Infrastructure
Detection to controller display

- Iridium NEXT constellation
- 66 satellites (plus spares)
- ADS-B receiver payload on all satellites
- Launch schedule 2015 - 2017
Orbit Characteristics

- 6 orbital planes of 11 satellites
- Near-polar orbit at 780 km altitude
- Orbit period ~100 minutes
- Ground speed ~24,000 km/h
- An aircraft will be in view of a given satellite for no more than 9 minutes
ADS-B Payload Receiver

- Multiple beams (Current baseline is 33)
- Processed by up to 12 receivers
Global Coverage – 250 W

- Nominal coverage for 250 W aircraft
- North-South footprint spacing approx. 1970 NM or 9 minutes
- Cone of silence does not affect coverage
  - not depicted in video

(Video @ 60x actual speed)

Ability to support significant air traffic density

- Each Aireon payload is designed to support remote and oceanic regions that may also overlap high traffic areas
  - Ability to process over 1000 targets in the presence of 2000 additional targets in the same airspace footprint
  - Supports 10,000 simultaneous targets globally
- Meets current traffic and anticipated traffic growth and can be expanded to accommodate additional targets
Benefits

Global Air Traffic Patterns
Focus on North Atlantic Oceanic Airspace

- Organized Track Structure NAT OTS
- Eastbound Tracks take advantage of tail winds
- Westbound Tracks avoid head winds
- Procedural Airspace = large distances
- Changes to flight levels, routes, speed by exception
Gander/Shanwick Airspace Today

- **1,000** flights per day (1,300 peak summer day)
- **350,000** commercial flights per year
- +**23,000** military & GA flights per year
- **90%** of the flights are already ADS-B equipped
- **78%** of flights are Data Link (FANS 1/A) equipped
- **80%** are capable and use Controller Pilot Data Link Communications (CPDLC)

Current NAT Operations Without ADS-B
Current NAT Operations
With Ground Based ADS-B

Overview of Traffic on Tracks and No Tracks
Application in the NAT: Principles

- Initially, no change to the Organized Track System (OTS) or Oceanic Clearances
- Initial application on core tracks in same direction only
- Use a phased approach - similar to Data Link
- Apply priority handling

Operational Validation

- Data collection on ADS-B and communications
- Collaboration with stakeholders on final implementation CONOPS
- GAATS+ deployment in Prestwick
Initial Application in the NAT

- Late 2017: application of 15 NM longitudinal separation (with RLatSM) between surveillance-identified aircraft operating on the NAT OTS.
- Early 2018: 15 NM longitudinal separation expanded to aircraft operating off the NAT OTS.

Future Procedure Changes in the NAT

- Mid 2018: allowing surveillance identified aircraft to operate on all tracks which do not intersect (still RLatSM).
- Late 2018: use of ATS surveillance to maintain 15 NM lateral separation between the tracks of surveillance-identified aircraft operating on non-intersecting tracks;
- Early 2019: application of 15 NM separation between surveillance-identified aircraft
Annual Gander/Shanwick Benefits

- A conservative estimate of fuel savings of 450 litres per NAT flight. Over 600 flights were simulated.
- Consistent with IATA members’ savings from the variable speed/Flight Level ENGAGE project
- Represents less than 2% of the ocean portion of fuel per flight (450/26,000 litres)
- Year one benefits estimated at $127 m for 2018

ICAO Regions
Initial Oceanic Assessment

- High level assessment of 7 additional areas
- Based on 1,000’ climb fuel savings
- Up to 3 climbs per flight
- Vetted with IATA airline member familiar with oceanic operations
- Considered conservative and achievable

Oceanic Assessment Benefits

Estimated $439 million in 2018

<table>
<thead>
<tr>
<th>Major Oceanic FIRs</th>
<th>Commercial IFR Flights (000s)</th>
<th>Total Fuel Climb Savings (000s)</th>
<th>GHGs (000s Tonnes CO₂ Equiv)</th>
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<tbody>
<tr>
<td>Pacific</td>
<td>131</td>
<td>$169,776</td>
<td>446.4</td>
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<tr>
<td>Shanwick / Gander</td>
<td>390</td>
<td>$127,000</td>
<td>332.8</td>
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<tr>
<td>New York-Santa Maria</td>
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<td>$64,584</td>
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<td>US Coastal</td>
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<tr>
<td>Mumbai</td>
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<td>$1,337</td>
<td>3.5</td>
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<tr>
<td>North Atlantic above 65°</td>
<td>46</td>
<td>$21,528</td>
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<tr>
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<tr>
<td><strong>Total</strong></td>
<td><strong>904</strong></td>
<td><strong>$438,742</strong></td>
<td><strong>1,152.4</strong></td>
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</table>

Opportunities for phased developments in other areas similar to the NAT
Work Underway and Moving Forward

Recent Collaboration Progress


- NAT Surveillance Corridor – A joint effort between NAV CANADA and ISAVIA to develop ATS surveillance procedures appropriate for NAT operations.

- Meeting with IAA (Irish Aviation Authority) to discuss CONOPS, Technical Review, Regulatory Roadmap and Collision Risk Modelling. (Feb 17, 2014)

- Meeting with FAA to discuss CONOPS and Business Case reviews. (Feb 19, 2014)
Recent Collaboration Progress – con’t

- NATS is collaborating with NAV CANADA on developing the Collision Risk Estimate models
- NAV CANADA is now contributing to the FAA’s Technical Specifications Development Team for ADS-B
- Annual meeting with IATA OPC and regular collaboration with RCG
- ANSPs, NAV CANADA/NATS/FAA, met April 1&2 to discuss technical and operational initiatives associated with Space Based ADS-B
- NAV CANADA/IAA/NAVI/AIR/ENAV meeting April 15-17 to discuss the same
- First Space Based ADS-B Advisory Committee (SAAC) meeting October 14
Regulatory Roadmap

Focus on 4 Areas:

1. ICAO North Atlantic (NAT)
2. ICAO Global Assemblies and Panels
3. International Telecommunication Union (ITU)
4. Other Stakeholders – Transport Canada, CPWG (Cross Polar Working Group), ADS-B 4G, etc.

1. ICAO North Atlantic (NAT)
   - NAT SPG contributory groups (NAT IMG, NAT SOG & NAT EFG) have received initial CONOPS briefings
   - NAT Economic and Financial Group (EFG) also received Benefits Analysis
   - NAT EFG is further exploring overall NAT benefits
   - Next contributory group meetings in May and June
     - Will focus on support and work to be done.
     - Will present high level safety plan (to NAT Safety Oversight Group – NAT SOG)
2. ICAO Global Assemblies & Panels

- Presentations made to ICAO regional groups on the initiative
- Separation and Airspace Safety Panel (SASP) provided input on how to approach collision risk modelling
- CONOPS presented to new ICAO Air Traffic Management Operations Panel (ATMOPSP) in April
- ICAO Position for the International Telecommunication Union (ITU) World Radiocommunication Conference 2015 (WRC-15) currently DOES NOT include protection for 1090 MHz for aircraft to satellite
- Updated ICAO Position may include information about space-based ADS-B frequency allocation requirements

3. International Telecommunication Union (ITU)

- Goal is that the ITU will approve allocation of 1090MHz for Aircraft to Satellite ADS-B signal at the World Radio Conference (WRC) in November 2015
- Industry Canada submitted a proposal that CITEL (a Regional ITU Group) recommend this subject be included in ITU Regional Director’s Report so it can be added to WRC-15 agenda
- Supporting Proposed Draft New Report (PDNR) has been developed by ITU Working Parties and may be included in updated ICAO Position
- Briefing planned at Asia-Pacific Telecommunity (APT) Preparatory meeting for WRC-15
- Working with as many ITU Regions as possible on the frequency allocation/WRC-15 agenda issue
4. Other Stakeholder Updates

Transport Canada
- Regular coordination meetings on ICAO working papers
- Good cooperation on numerous initiatives, particularly frequency spectrum issue

Cross Polar Working Group
- Presentation made on the Space Based ADS-B initiative with positive feedback from participants.

ADS-B 4G meeting in Ottawa February 2014.
- Presentation on concept positively received

A partnership opportunity
- History of collaboration
- Unique opportunity to map the way forward together.
- Outcome will deliver dividends for safety, customer efficiency and the environment.
Actions Going Forward

- Continue to collaborate with ANSPs, IATA/industry and ICAO/regulator to demonstrate and validate incremental improvements.
- Leverage existing technology and continue to improve service, e.g., RLongSM and RLatSM.
  - Operational trials involving airlines/ANSPs will be used to demonstrate capabilities and support the safety case.

Aireon space-based ADS-B Summary

- Global ADS-B Surveillance is a “Game Changer” for aviation offering opportunities for improved safety and efficiency, providing significant fuel and GHG savings.
- Fits with NEXT GEN / SESAR
- Avoids ADS-B ground based replacement or some initial installation costs
- Benefits to domestic traffic can be realized in remote areas or through improved air traffic flow management to and from oceanic airspace
- Public will benefit from safer + more expeditious flights in remote, polar and oceanic airspace worldwide
- Opportunity to boost aviation innovation & the environment globally
Questions?

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