AIREON SPACE-BASED ADS-B

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CNS/ATM Systems

› Communication

› Navigation

› Surveillance

Aireon – Global surveillance using satellites

› Air Traffic Management
Automatic Dependent Surveillance – Broadcast

- Aircraft transmissions at 1090 MHz
  - Position, Altitude and Velocity at indicated time
  - Accuracy & Integrity Bound for Position
  - Aircraft Identification (Flight ID)
  - Aircraft Class (size, wake category, etc.)
  - Emergency/Priority Status (radio failure, hijack, etc.)

- Automatic: Aircraft transmits data periodically, without interrogation
- Dependent: Position data comes from on-board GPS or Flight Management System
- Broadcast: Data transmitted to any listeners, including ATC ground stations, satellites, other aircraft
Aireon Joint Venture

› Iridium operates a satellite-based telecommunications service
  • Constellation of 66 Low Earth Orbit satellites provides global coverage
› Constellation to be replaced: Iridium NEXT
› Iridium NEXT satellites designed to support hosted payloads
  • Space-based ADS-B identified as an opportunity
› Aireon LLC formed as a joint venture between Iridium and four Air Navigation Service Providers
  • NAV CANADA, ENAV (Italy), NAVIAIR (Denmark), IAA (Ireland)
  • NATS (UK) has recently joined investor group
Iridium NEXT Constellation

› 6 planes of 11 active satellites (+ 9 on-orbit spares)
› Near-polar orbits
› 780 km altitude
› 100 min orbit period
› ADS-B payload on all satellites
› Data passed between satellites via crosslinks to the satellite currently over a ground station
Satellites

Dimensions: 3 m x 9 m (incl. solar panels), 860 kg
Prime Contractor – Thales Alenia Space
Aireon Payload – Harris Corp (Melbourne, FL)
Aireon Hosted Payload

› **Antenna**
  - Array of circular antenna elements on 5 panels
  - Elements are combined under software control to form simultaneous beams pointed in various directions

› **Receivers**
  - Bank of 1090 MHz receiver channels operating in parallel
  - Each receiver listens to signal from a different antenna beam
  - Combination of receiver channels and beam steering creates a composite satellite “footprint”
Aireon System Overview
Iridium & Aireon Facilities
Avionics Compatibility

› Baseline Transponder
  • RTCA DO-260B (EUROCAE ED-102A) MOPS for 1090 MHz Extended Squitter ADS-B
    › Class A1: 125 W with two antennas
    › Note – Almost all commercial aircraft equipage is ≥ 200 W
  • System accommodates other existing and future ADS-B message standards
    › DO-260 (Link Version 0), DO-260A (Link Version 1), and DO-260C (under development)
  • Not designed to support 978 MHz Universal Access Transceiver (UAT)

› Surveillance accuracy and integrity standards require GNSS as navigation source
Design Reference Standards

› System Performance
  • EUROCAE ED-129B – Technical Specification for 1090 MHz Extended Squitter ADS-B Ground System

› ANSP Interface
  • EUROCONTROL “ASTERIX” message specifications

› European Aviation Safety Agency (EASA)
  • Aireon is working with EASA to obtain certification as a ATM/ANS Service Provider Organization for Surveillance Services
Liftoff

› First launch of 10 Iridium NEXT satellites Jan 14, 2017, from Vandenberg AFB, California
› Six additional launches to date
› One more launch to complete constellation, scheduled for Dec 30
Iridium NEXT Constellation Status

› 60 Iridium NEXT satellites have been integrated into the constellation and are in operational service
› 5 other satellites are in place as on-orbit spares
ADS-B Functional Status

› ADS-B payloads of the 60 in-service NEXT satellites are delivering target data
  • Payloads are currently receiving well over 50 million unique aircraft position messages per day
› Aireon Processing and Distribution system is controlling payloads and generating surveillance messages
› System is currently configured for near-global coverage
› Partners participating in early test and demonstration activities are receiving real-time ADS-B data for designated test service volumes
Key Test Tools

› High-fidelity “white box” simulator with analysis toolset
› Ground-Based Reference Transmitter
› Dedicated flight tests
› Targets of opportunity
› Independent testing by participating ANSPs
  • NAV CANADA has participated in Aireon on-orbit testing since first launch
Ground-Based Reference Transmitter

- NAV CANADA hosts a Ground-Based Reference Transmitter for Aireon’s use in initial and ongoing testing of ADS-B payloads
- 4-channel transmitter feeding 4 directional antennas
- Calibrated and remotely adjustable RF output power
- Calibrated antenna patterns
- Supports direct comparison between satellite payloads
- Provides calibration data for simulation models
Ground-Based Reference Transmitter

- Site selected for low RF noise, low multipath and converging satellite orbits
NAV CANADA Flight Tests

- NAV CANADA has conducted several flight tests of Space-Based ADS-B
- Transponder power set at minimum standard of 125 W
- Position updates received well beyond range required for overlap of satellite footprints
- Observed position update rate < 4 s @ 95%
Aireon Data for NAV CANADA
Traffic over North Atlantic

(Image from NAV CANADA Engineering Display)
Pre-Operational ANSP Data Testing

NAV CANADA has been connected to pre-operational ADS-B test feed for Canadian test service volumes since first launch.

(Image from NAV CANADA Engineering Display)
ADS-B over North Atlantic

Targets shown here were directly under two satellite footprints.
But … these two satellites have not yet been launched.
Arrivals and Departures at Calgary

(Image from NAV CANADA Engineering Display)
Flight Test Aircraft (125 W)
Landing and Take-Off at Iqaluit
Looking Forward

› One more launch will complete Iridium NEXT constellation
› Final steps of formal Aireon system acceptance testing to follow
› Aireon is continuing to work with EASA to obtain formal European certification
› NAV CANADA plans to begin operational use of Space-Based ADS-B surveillance Spring 2019
   • High altitude en-route traffic in Gander Oceanic and Arctic
Questions?