



AIREON SPACE-BASED ADS-B

2018 Transport Canada Delegates Conference

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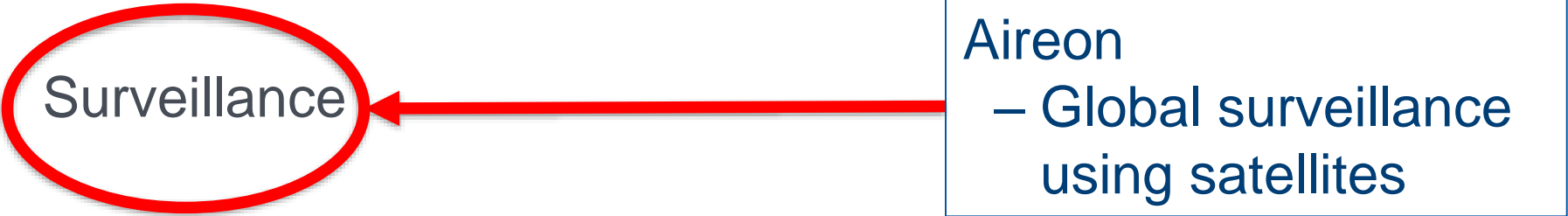
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CNS/ATM Systems

- › Communication
- › Navigation
- › **Surveillance**
- › Air Traffic Management



Aireon
– Global surveillance
using satellites

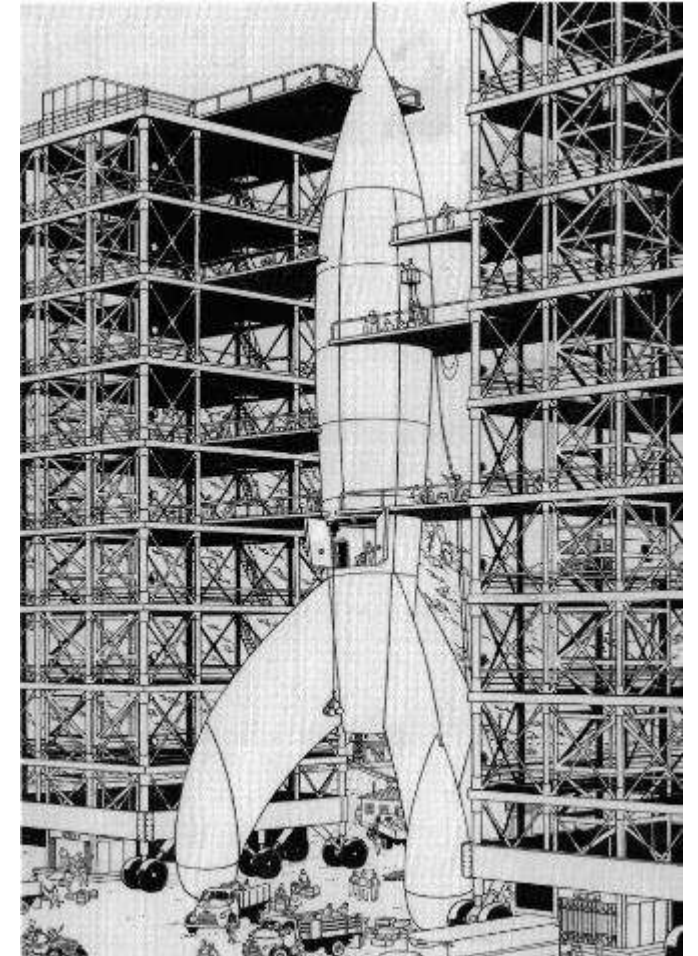
Automatic Dependent Surveillance – Broadcast

- › 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.)

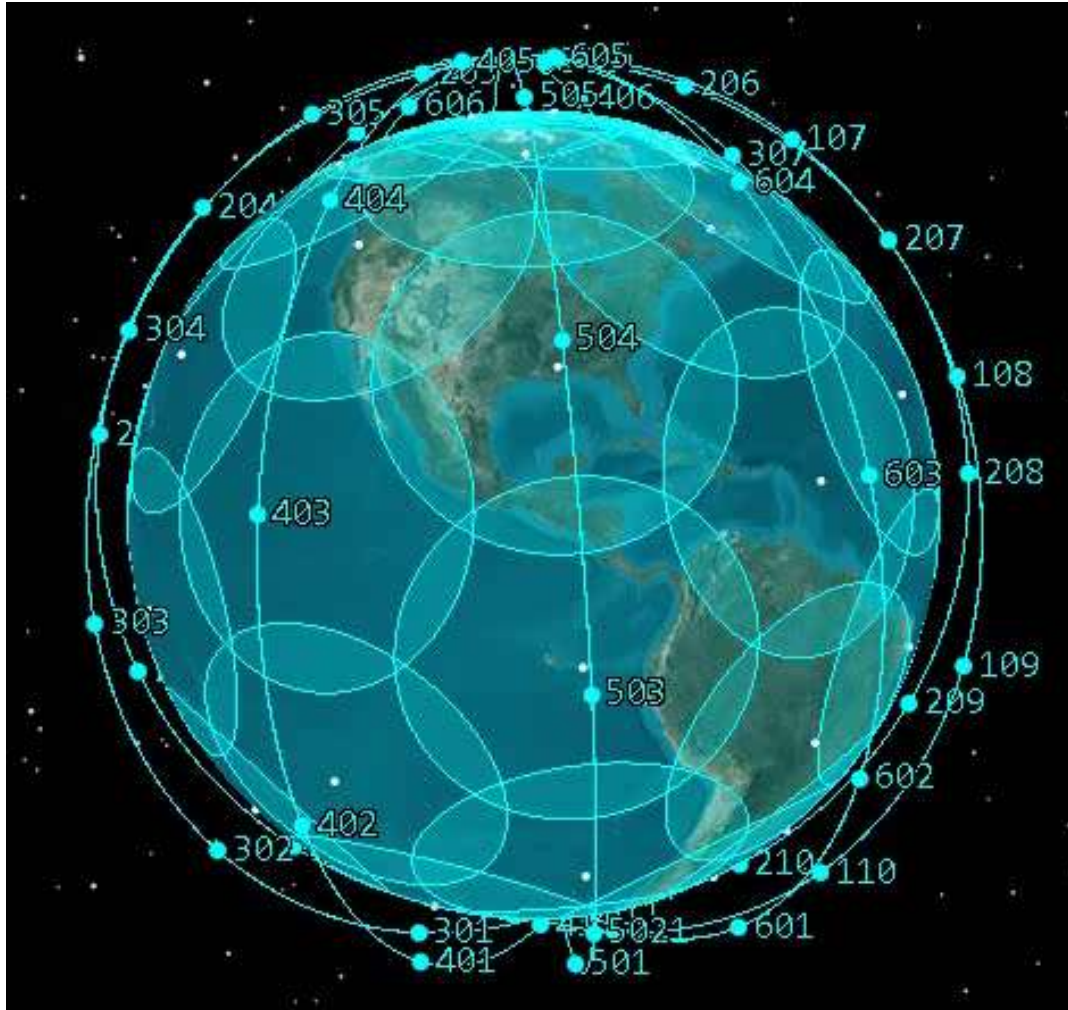
- › Automatic: Aircraft transmits data periodically, without interrogation
- › Dependent: Position data comes from on-board GPS or Flight Management System
- › Broadcast: Data transmitted to any listeners, including ATC ground stations, satellites, other aircraft

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

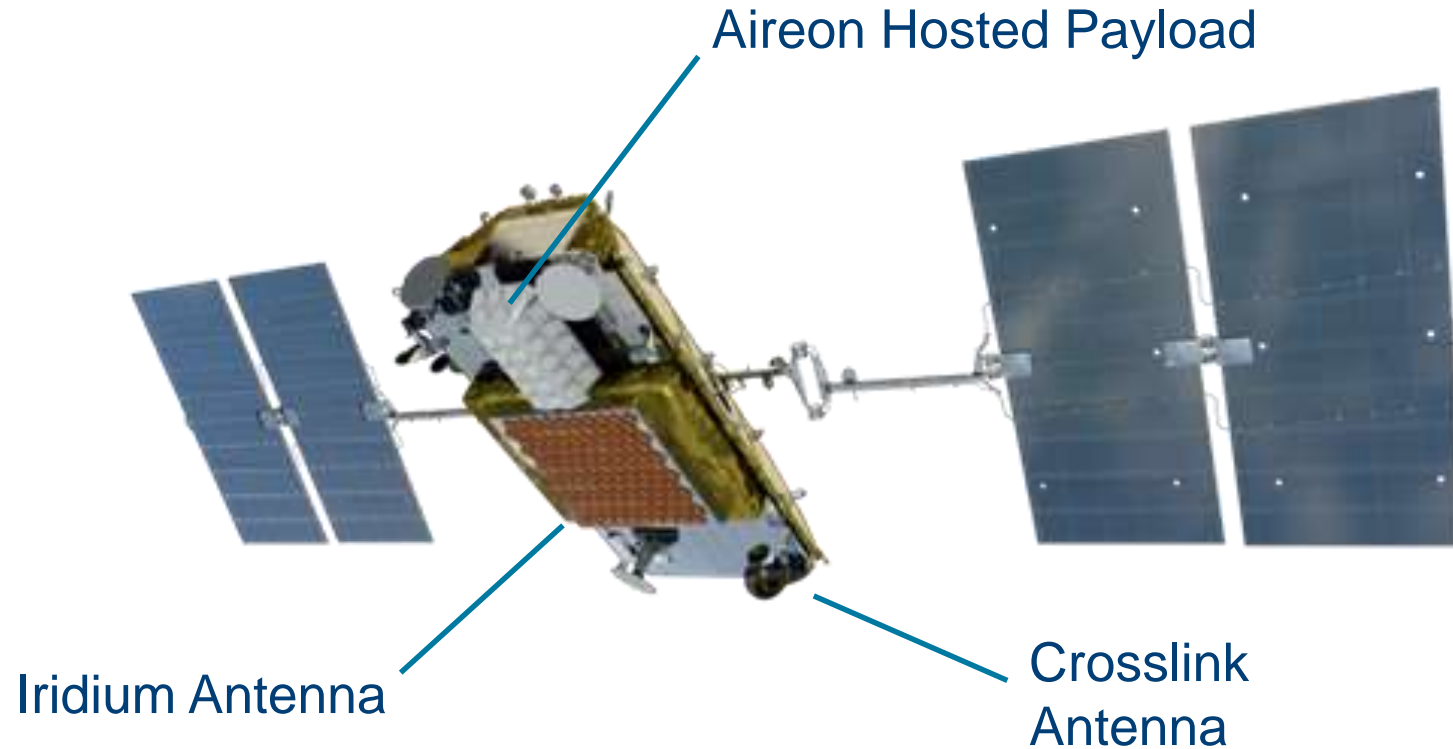


Iridium NEXT Constellation



- › 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)

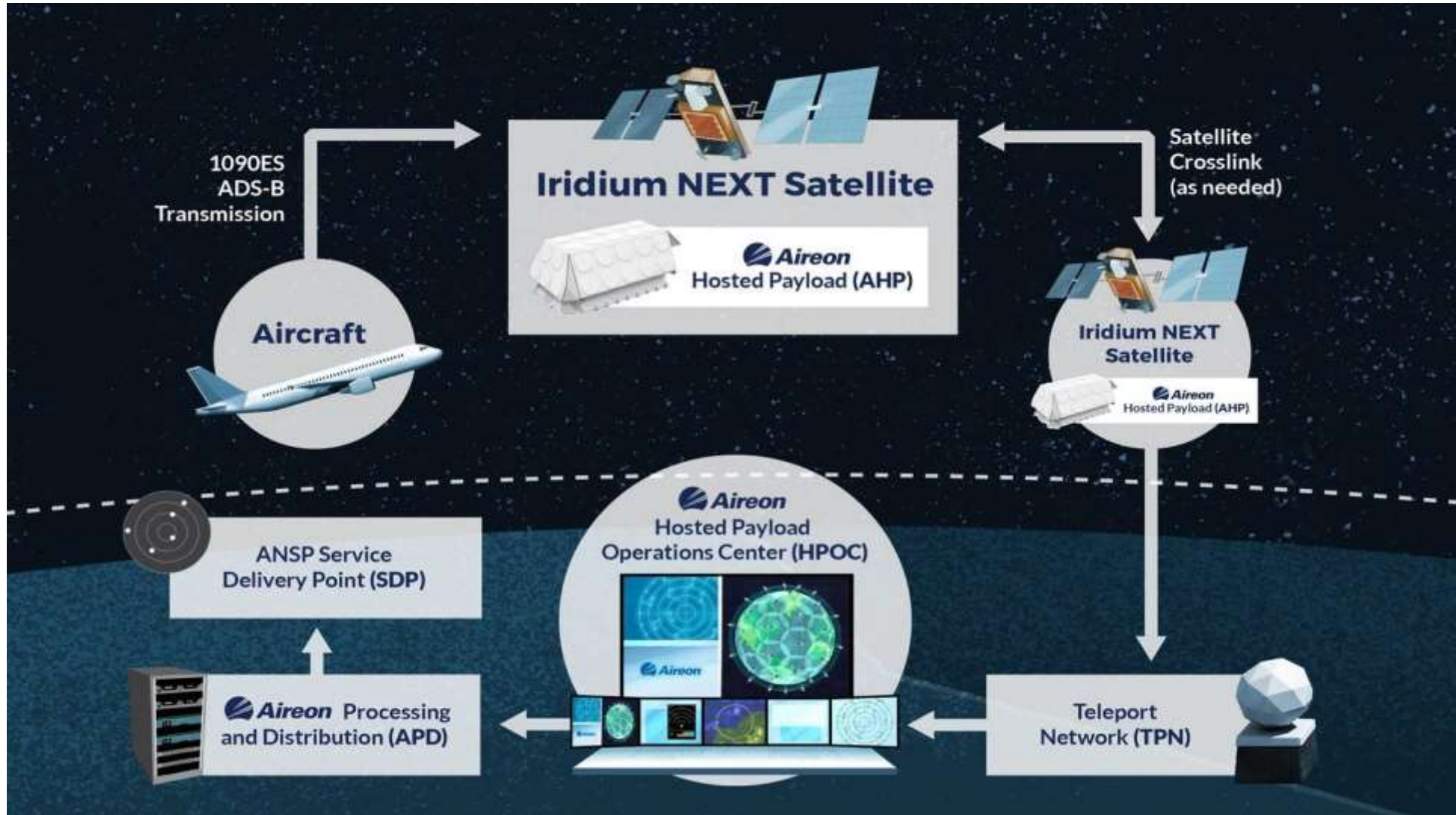
Aireon Hosted Payload

- › 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

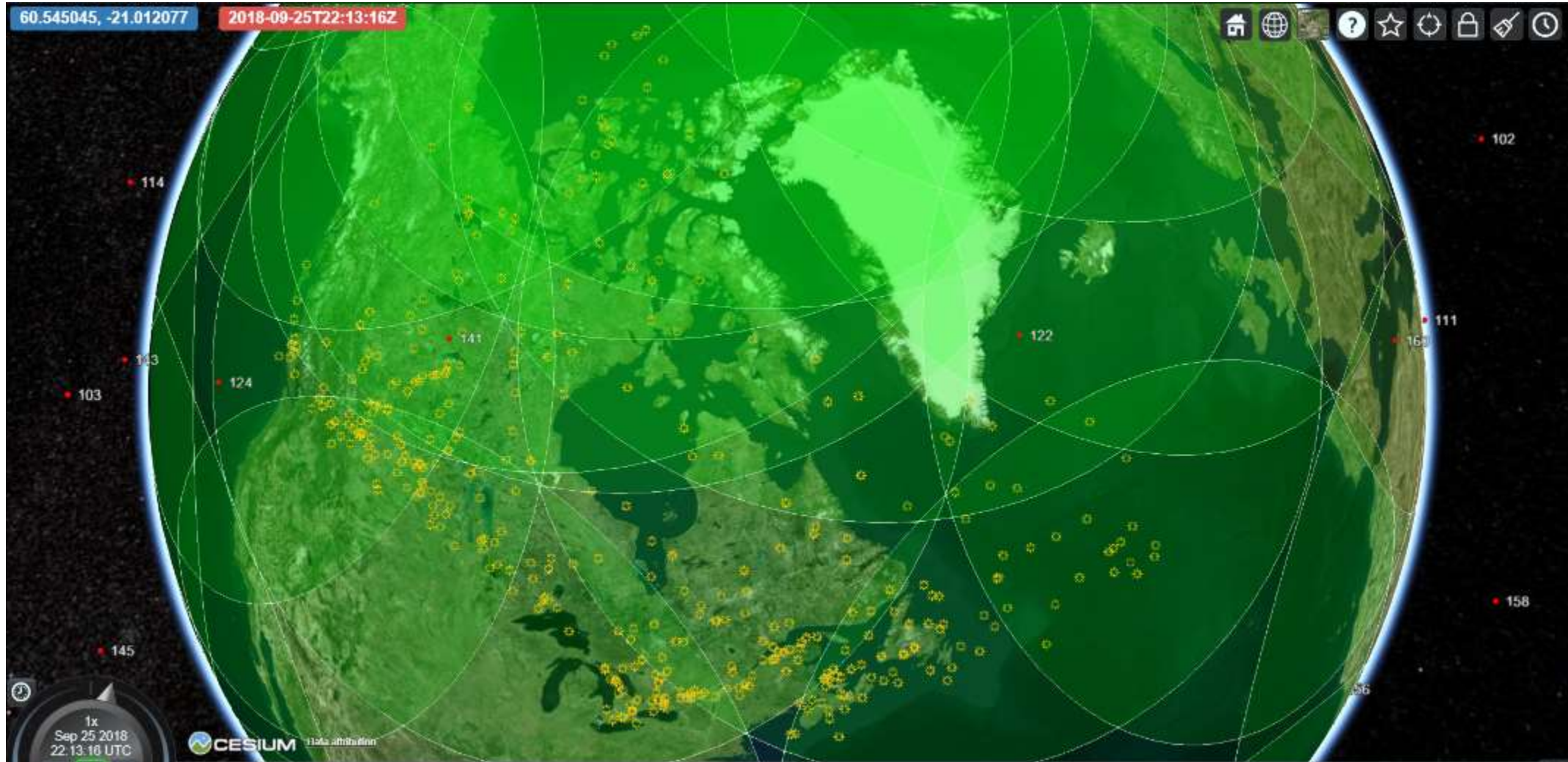


NAV CANADA Flight Tests

- › 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%

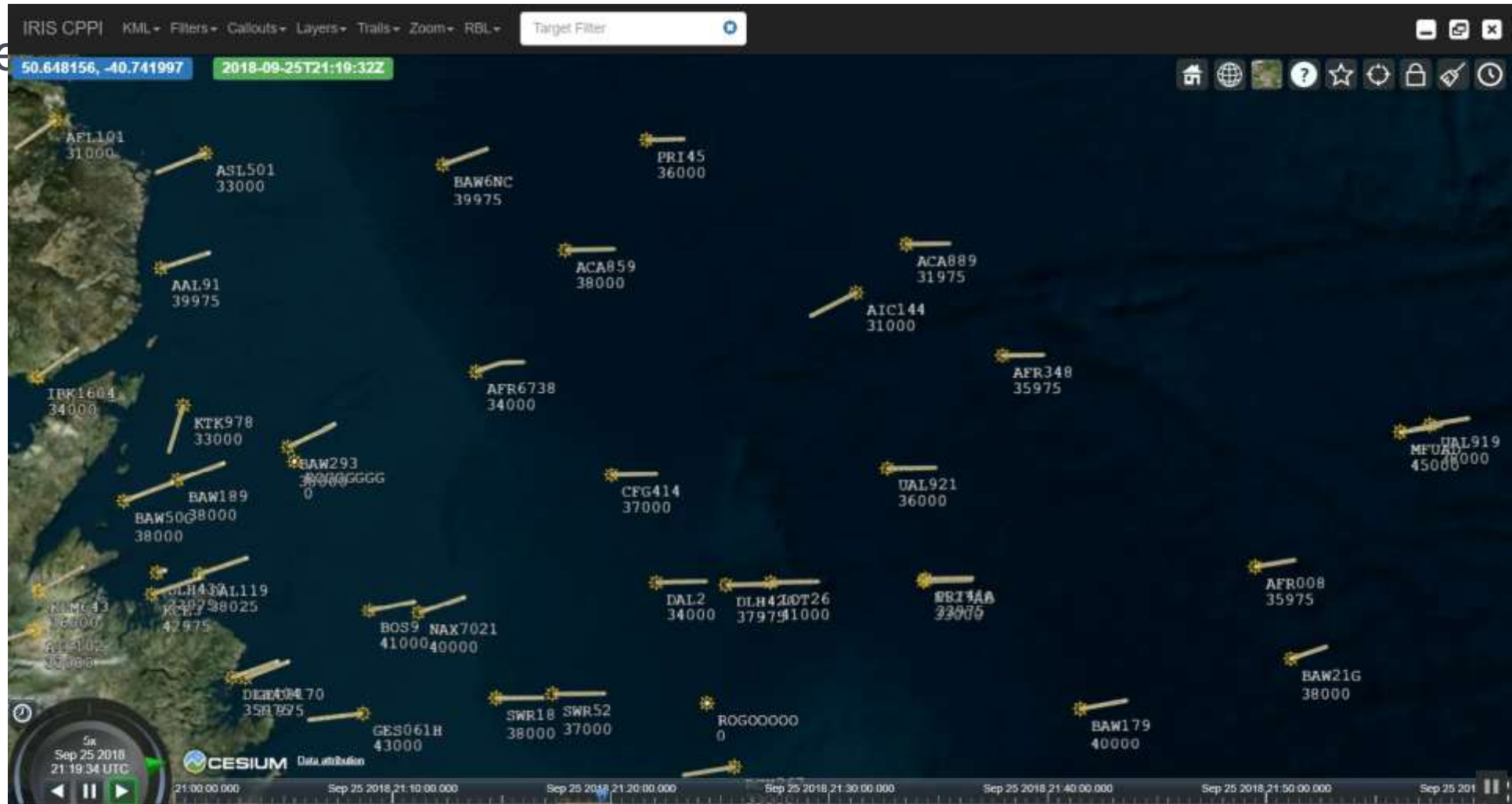


Aireon Data for NAV CANADA



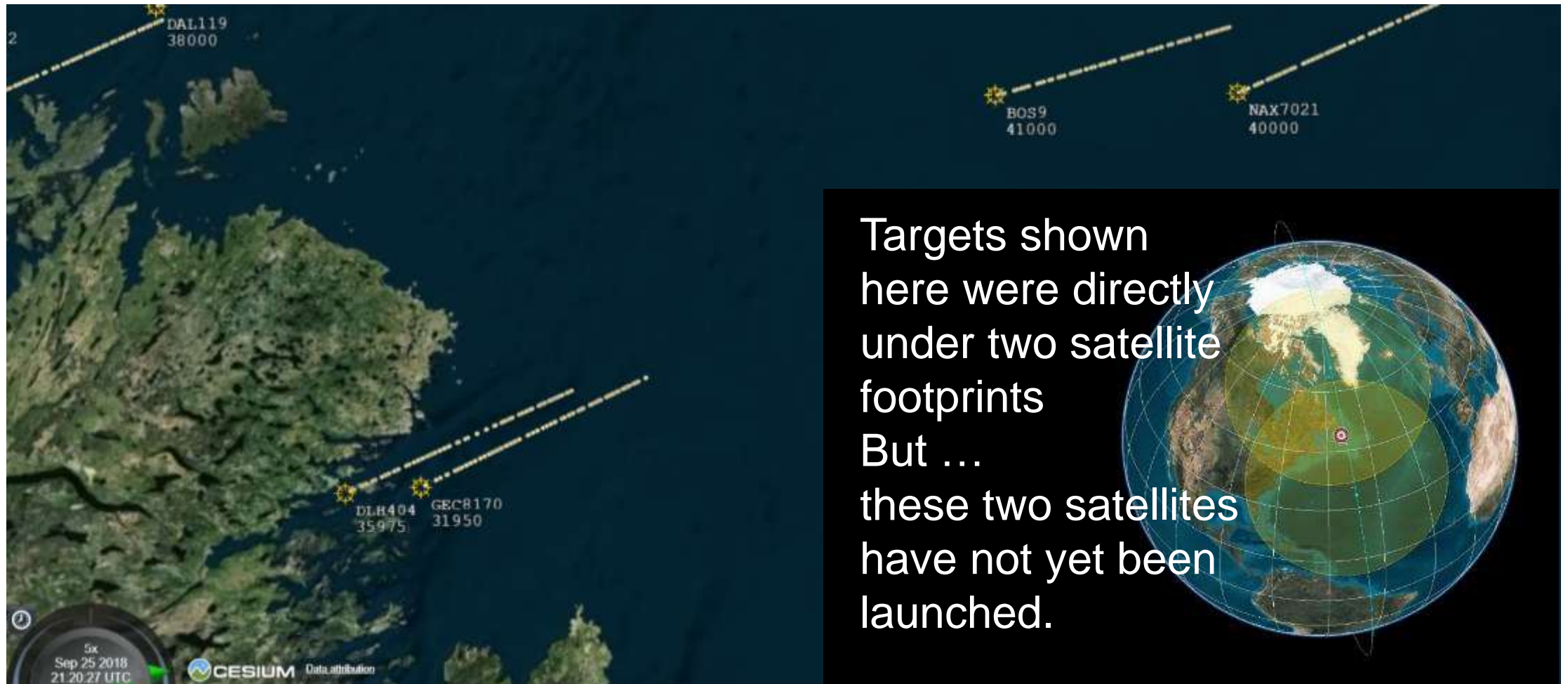
Traffic over North Atlantic

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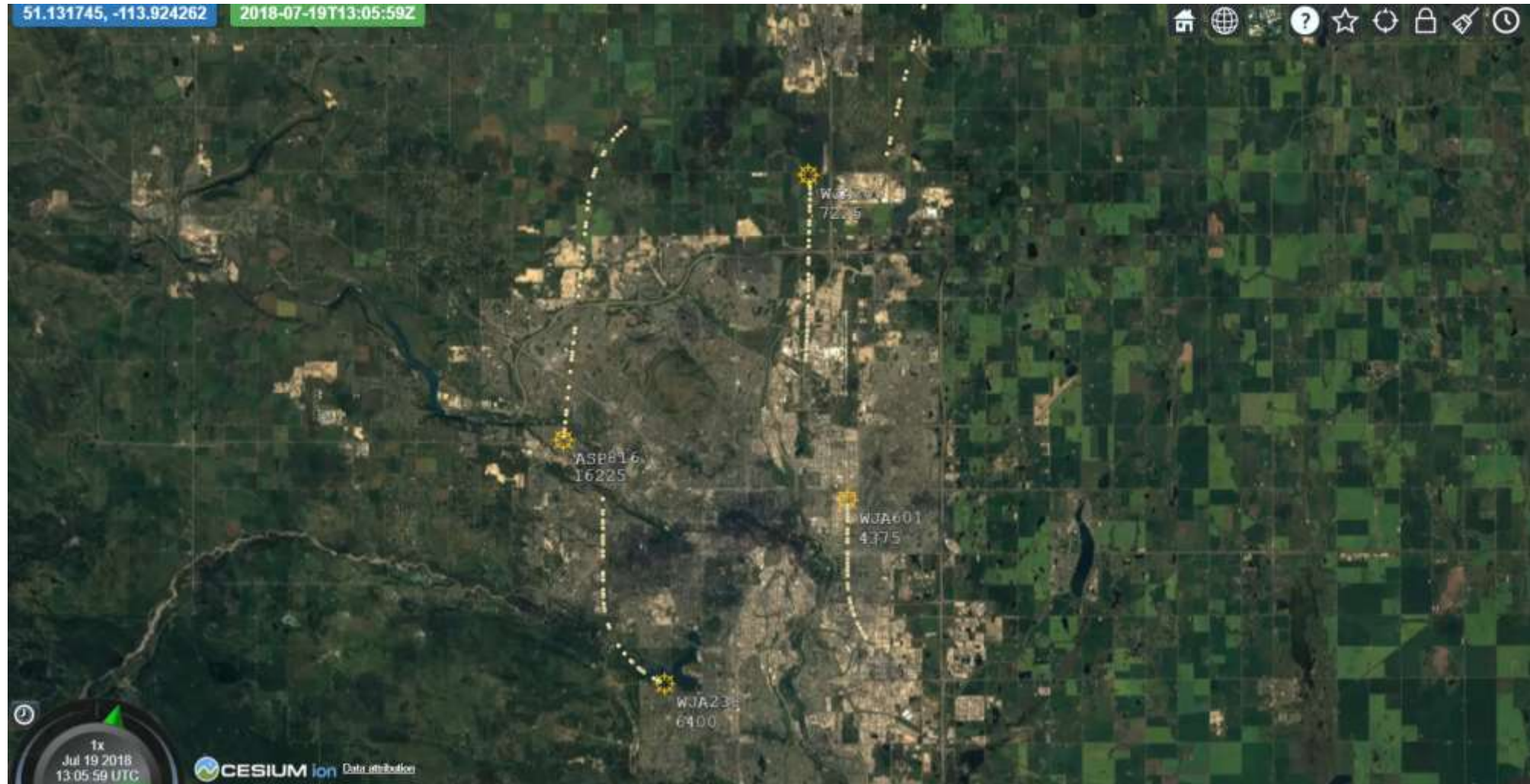


(Image from NAV CANADA Engineering Display)

ADS-B over North Atlantic



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?

