Global ATC Surveillance via LEO Satellites

ICAO ACP WG-F Spectrum Seminar for WRC-15

Thailand March 2014

Outline

- Expansion of ADS-B surveillance coverage in remote areas of Canada to date
- Air traffic control in oceanic remote regions today
  – an examination of the North Atlantic Tracks (NAT) as an example
- Global extension of ADS-B via LEO satellites
- Brief description of ADS-B sensors onboard LEO satellites
- Operational benefits Assessment using the NAT

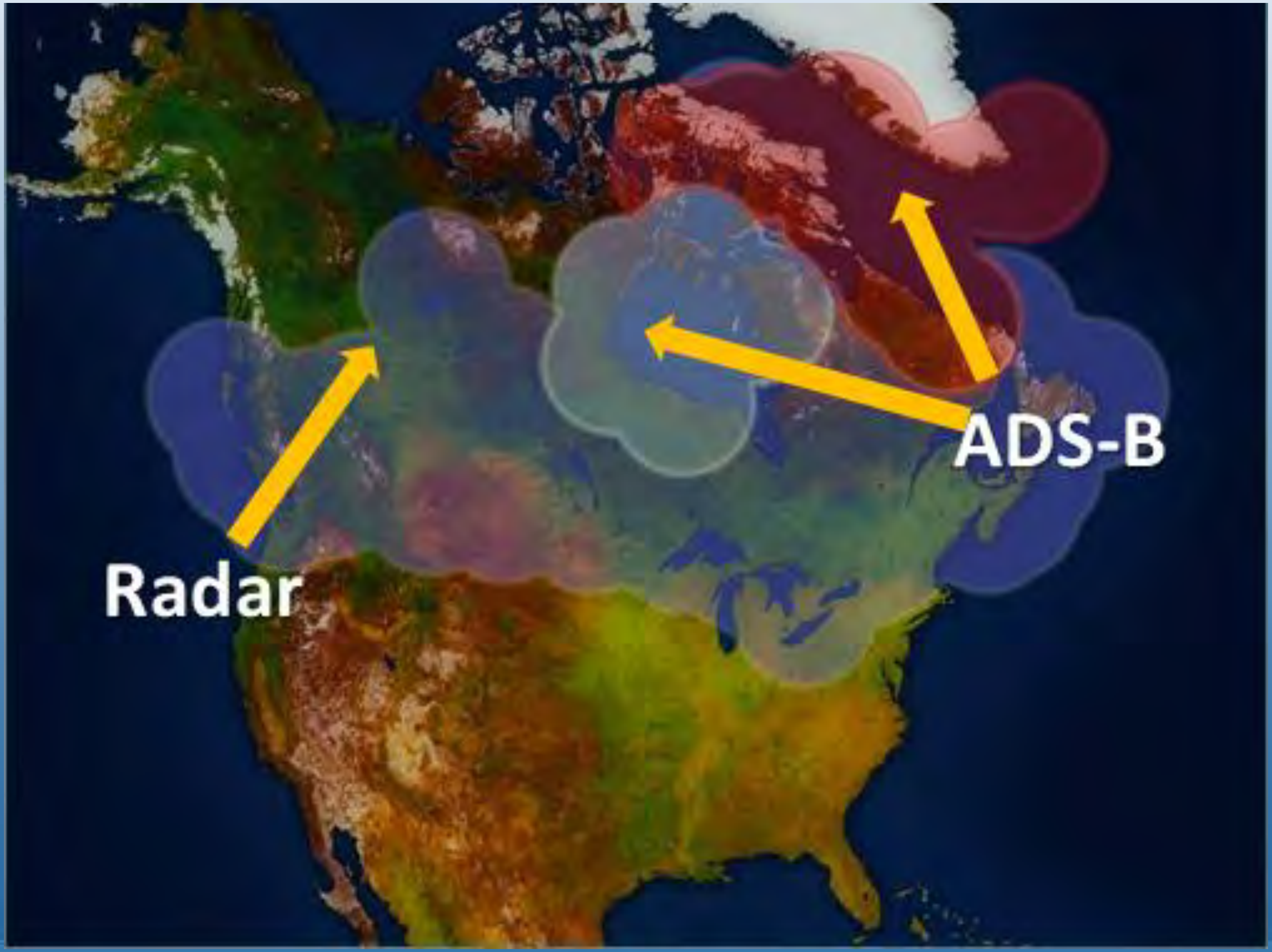
ADS-B deployment in Canada

- In 2009 first network of ADS-B commissioned in the airspace over Hudson Bay in Northern Canada.
- Five ground stations provided surveillance for the first time to 850,000 square kms of airspace used by approximately 35,000 flights a year.
- Annual savings of 18 million litres of fuel from this expansion alone.

ADS-B deployment in Canada

- November 2010, ADS-B installations along the northeastern Coast of Labrador and Baffin Island added another 1,920,000 sq kms of surveillance
- March 2012 ground stations in Greenland added another 1,320,000 sq kms of ADS-B surveillance over a portion of the North Atlantic.

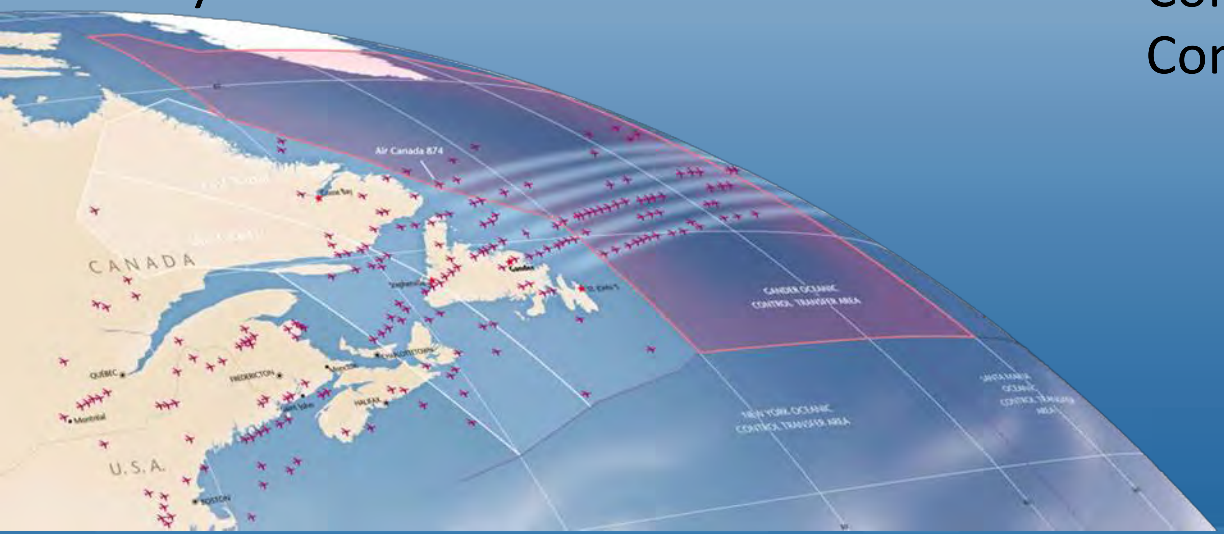
Surveillance – Radar + ADS-B



The NAT today

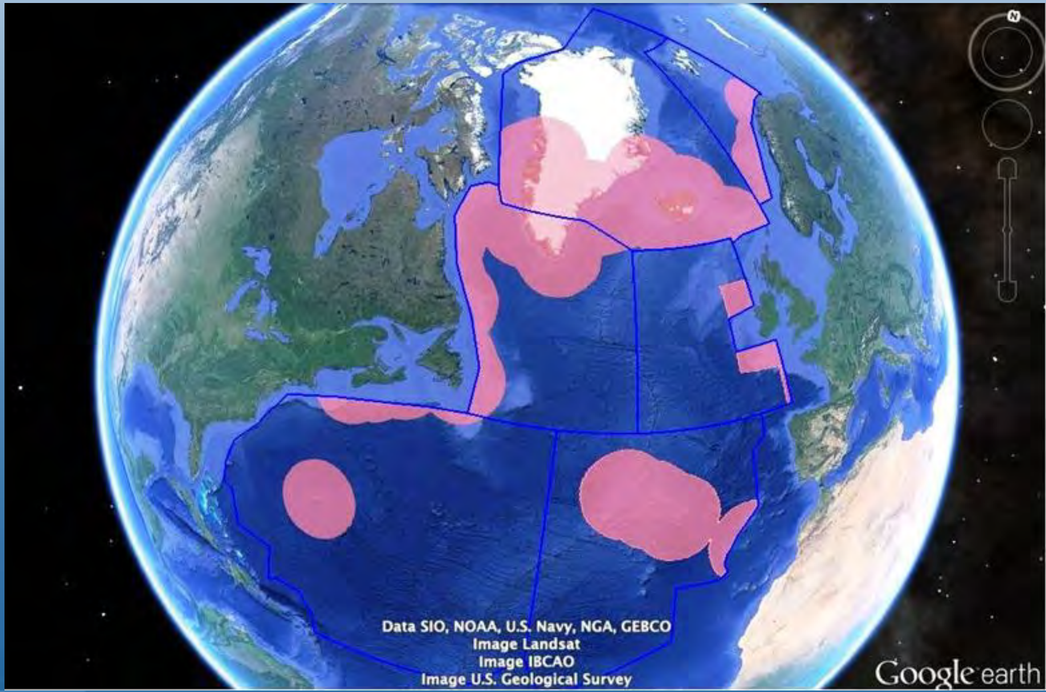
- **1,000** flights per day (1,300 peak summer day)
- **350,000** commercial flights per year
- **+23,000** military & GA flights per year

- **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)



Surveillance limitations on the NAT

- Even with specific initiatives by NAT ANSPs to lever ground based surveillance to the maximum potential, surveillance of this strategic and economically important area of airspace remains limited.

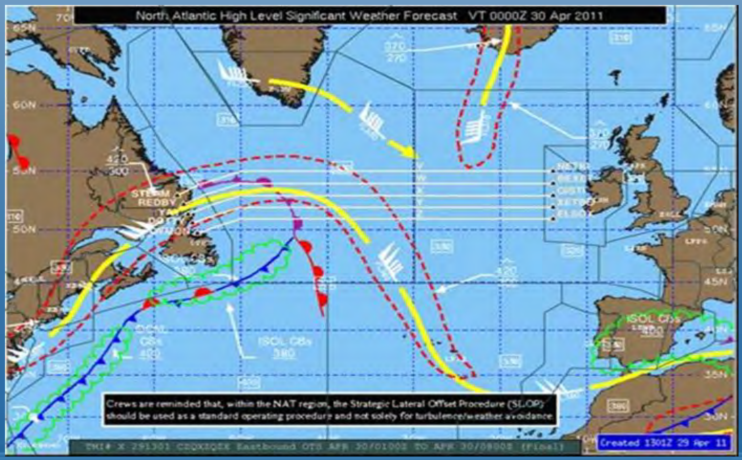


- Air traffic control must use procedural separation rules that often limit flexibility in order to maintain safety.

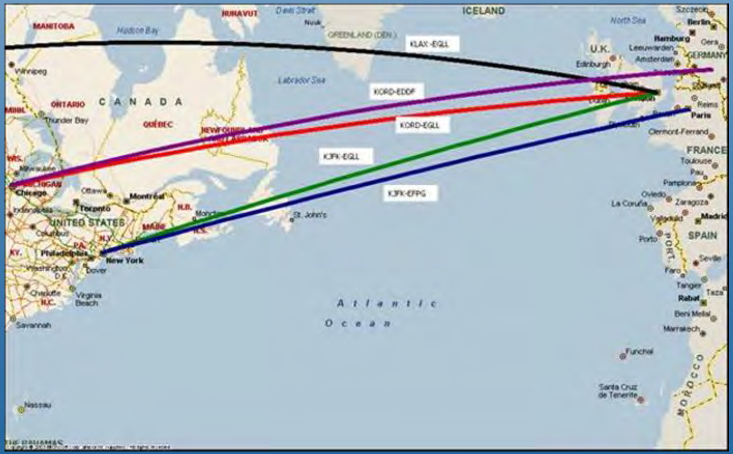
Current Separation Standards

Oceanic Operating Environment

- The Organized Track Structure (NAT OTS) is a series of parallel tracks that stretch across the NAT.
- 4 to 7 tracks are designed twice daily to take advantage of tail winds or avoid head winds for the East and Westbound flows respectively.
- Despite best efforts, it still results in an operating environment that is very structured – dynamic changes to aircraft altitude, speed are by exception.

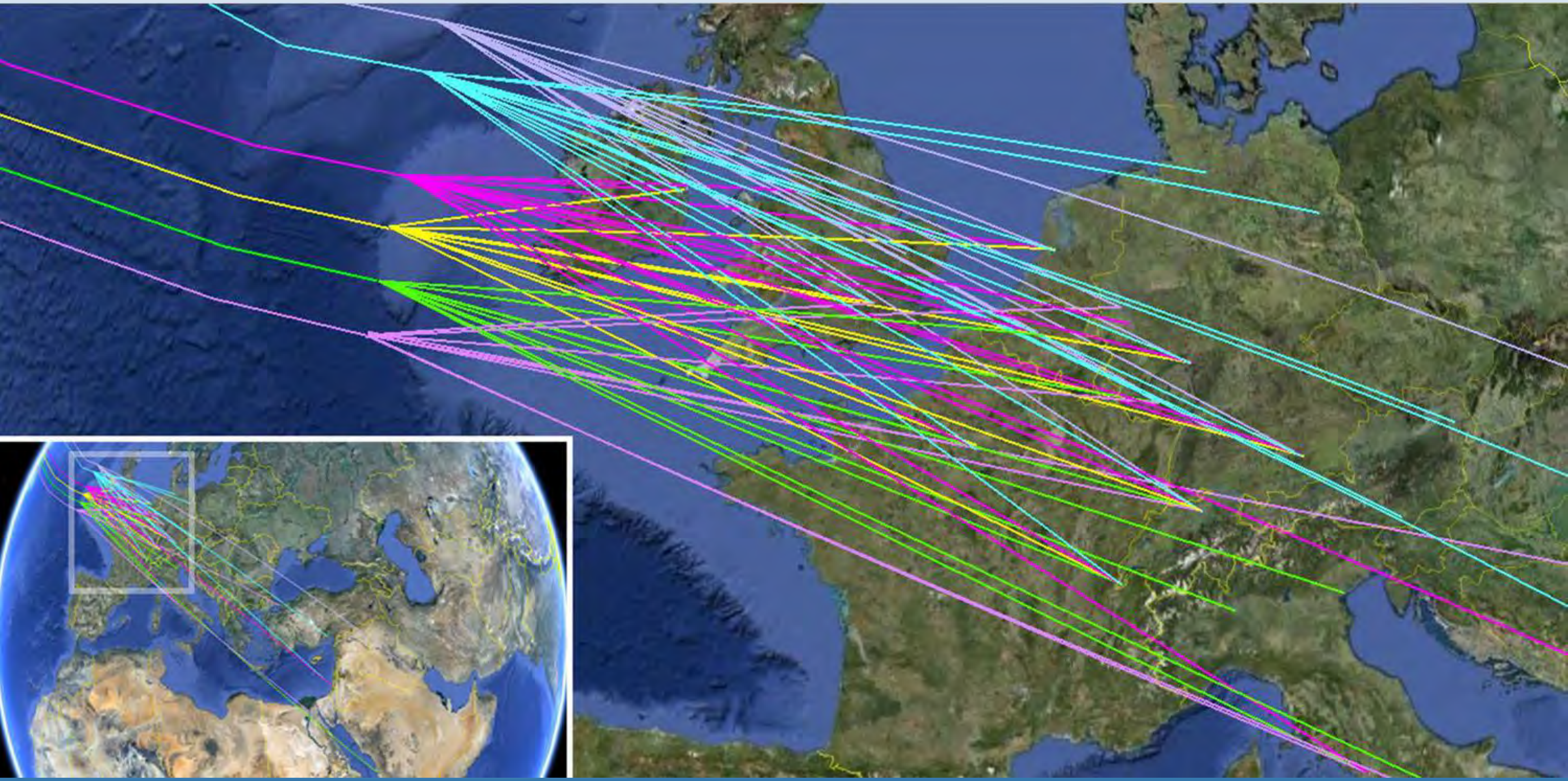


Current Track Structure



Great Circle Routes

Traffic to/from NAT OTS



The Opportunity

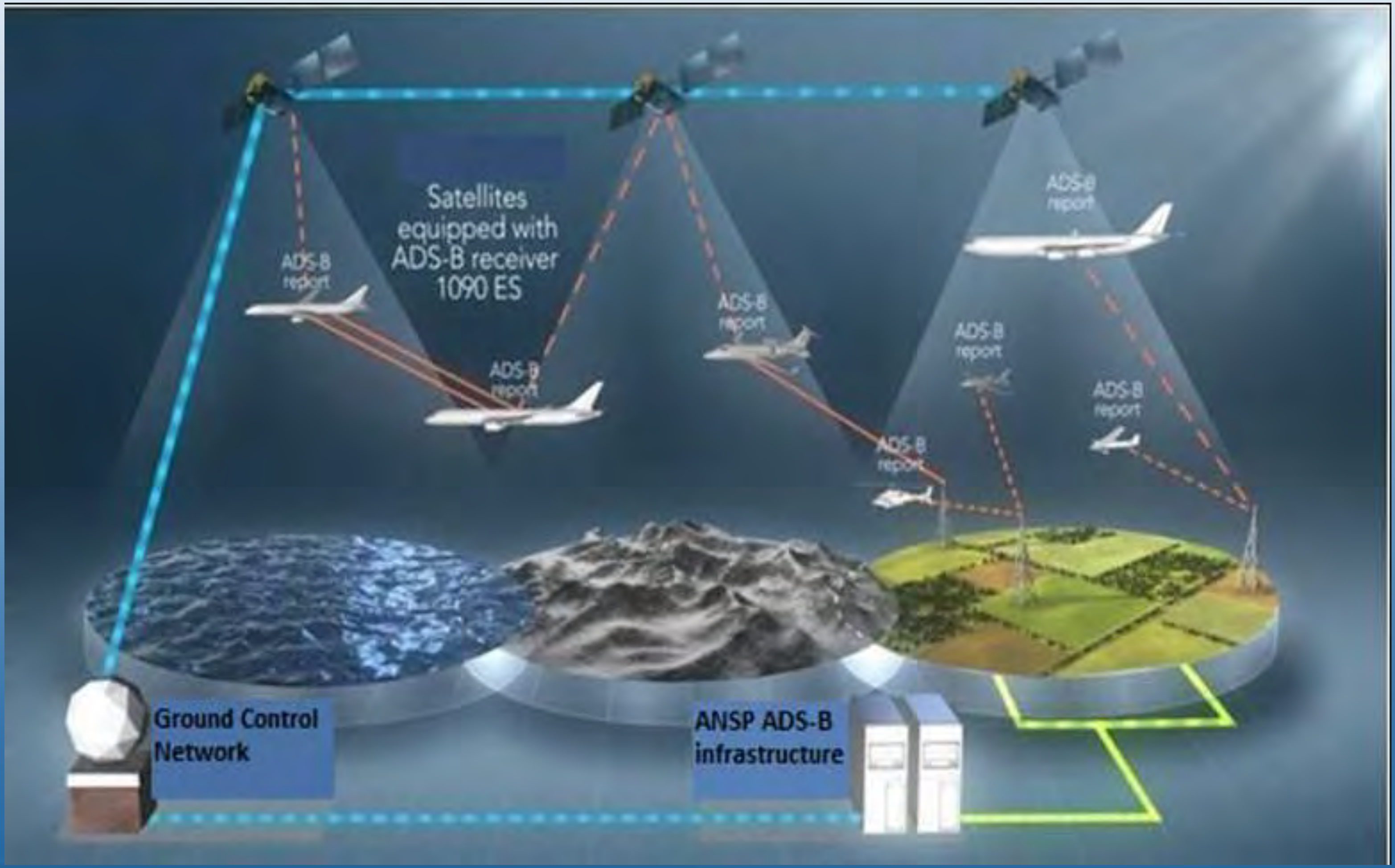
- The installation of ADS-B sensors on Low Earth Orbiting Satellites would enable the expansion of surveillance beyond the reach of ground based systems to cover the entire globe without additional aircraft equipage.

- Space-based ADS-B surveillance could replace the need for procedural separation standards between aircraft in oceanic and remote airspace, enhancing safety and significantly reducing flight times, fuel burn and greenhouse gas emissions.

Summary of technical analysis

- Stratospheric balloon experiments have been conducted carrying 1090 MHz sensors to characterize and demonstrate ability to detect signals
- Detection above 100,000 feet achieved, plus from aircraft in excess of 500 kms range
- ESA launched Proba V in May 2013 with ADS-B sensor
- Proba V will assess detecting signals from 820 kms up in orbit

Architecture concept



Sensor payload

- Payload receiver has some capability to de-garble multiple wanted against unwanted signals.
- No processing of data on the satellite, other than reception of the ADS-B message, all processing done at the ground network operations center.
- Design allows for capability of spot scan with reduced beam, also beam dwell and beam stare in target areas
- Up to 3000 targets can be processed within satellite beam

Benefits Assessment

- Simulation conducted based on 1,000’ climb with up to 3 climbs per flight to enable aircraft to reach higher, more fuel efficient altitudes and increase capacity on the more fuel efficient trajectories.
- Other efficiency initiatives assumed to already be in place (RLatSM, RLongSM)
- Assessment shows average fuel savings of 450 litres per NAT flight
- Represents a conservative assumption of saving less than 2% of the oceanic portion of fuel for a transatlantic flight (450/26,000 litres)
- **Annual benefits estimated at $127 million CAD.** Figure is for Oceanic airspace only, although benefits likely to accrue beyond

Benefits - Safety

- ADS-B via satellite provides real time aircraft surveillance
- Improves situational awareness, conflict detection and reaction/resolution
- Aircraft would have more flexibility in emergency situations
- Provides surveillance source separate from the communications (CPDLC) network sources
- More complete and accurate reporting of aviation occurrences, allowing better management of safety risk and better support of the Safety Management System

Benefits – Environment/Efficiency

- More efficient “domestic-like” flight trajectories in oceanic airspace (also Polar and remote terrestrial)
- More predictable airline cost planning
- Dynamic altitude availability and Mach speed to chase wind push and avoid headwinds
- Improve opposite direction and crossing traffic profiles
- Significant worldwide reductions in greenhouse gas (GHG) emissions and carbon footprint (ICAO objective)

Benefits – Predictability Reliability

- Access to ADS-B data could support traffic flow management-sequencing, merging and balancing for major cities in eastern North America and Western Europe (again using the NAT as one example, but will be global)
- Supports information sharing and collaborative process
- SWIM requires flight planning systems, dispatch, and airline gate-to-gate management to become more sophisticated and efficient. Surveillance via LEO satellite ADS-B will accommodate this.

Conclusion

- Satellite based ADS-B is a “Game Changer” for global aviation
- Significant fuel savings and GHG reduction
- Provides cost effective solution for areas without surveillance coverage and the only viable surveillance option for oceanic, Polar and other remote areas
- Benefits to domestic traffic can be realized through improved overall air traffic flow control management
- Public would benefit from safer and more expeditious flights in remote, polar and oceanic airspace worldwide
- Opportunity to boost aviation innovation and reduce environmental impact globally