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ADS-B Implementation and Regulation
Meeting for the NAM/CAR/SAM Regions
26 to 30 November 2018
Mexico City, Mexico

INTEGRATION OF SPACE-BASED (SB ADSB) TECHNOLOGY INTO THE CANADIAN AIR NAVIGATION SYSTEM

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NAV CANADA

OUTLINE

- ADS-B in Canada
  - Original Concept – Hudson Bay Area
  - Coordination and Approval – Transport Canada
  - Operator Participation – best equipped = best served
  - Increasing the Service Area – Labrador & southern Greenland
- Expansion via Space-Based ADS-B
  - ICAO Global → NAT Regional → Canadian Domestic Airspace
  - SB ADSB = ADSB = ATS Surveillance
    - ICAO Separation and Airspace Safety Panel
  - Operational Trials
    - Edmonton Flight Information Region
      - February 2019
    - NAT Region – Gander Oceanic Control Area
      - March 2019

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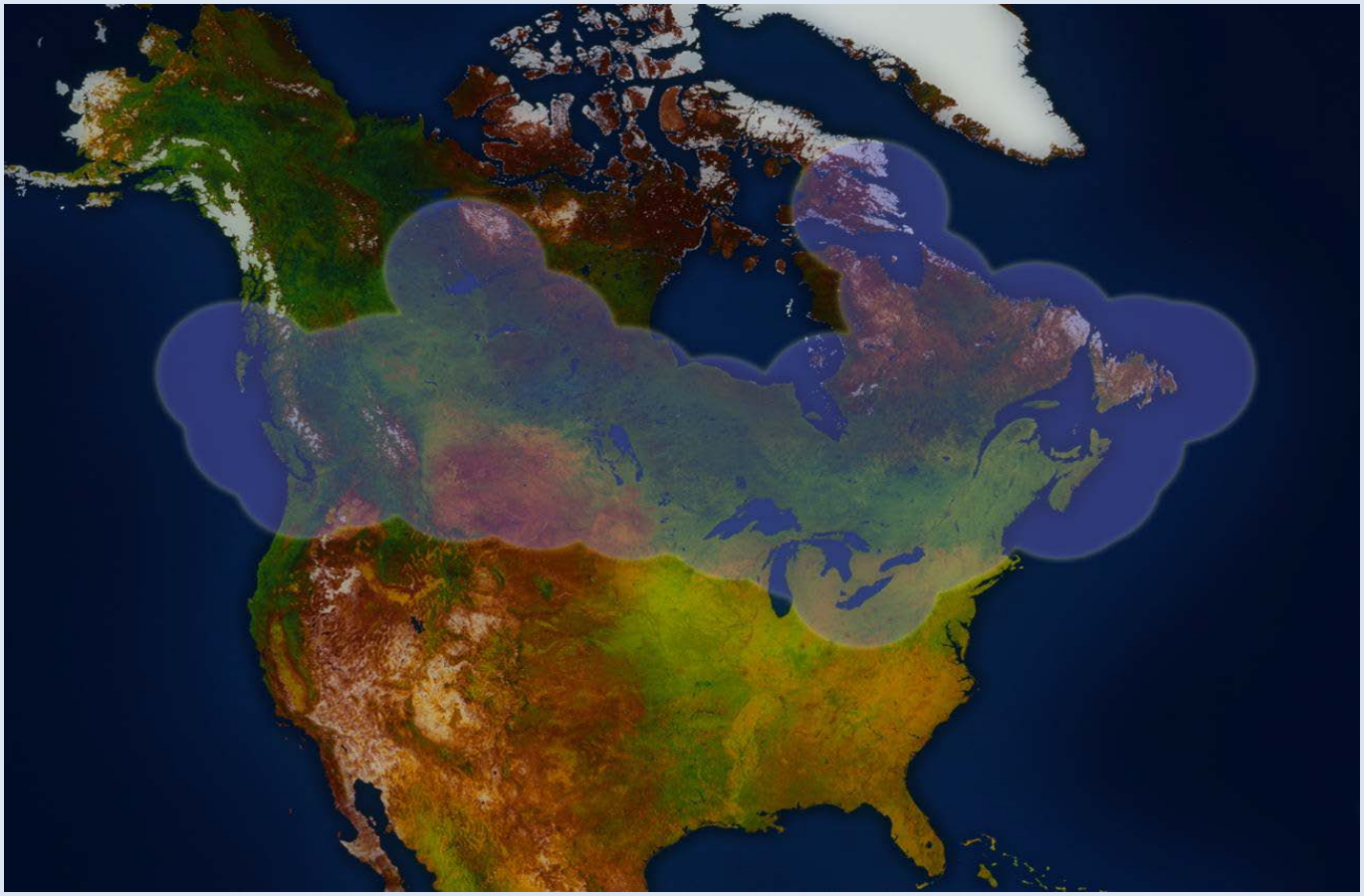
NAV CANADA SSR coverage area – 2004

Significant geographical limitations



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Proposal for Hudson Bay 2008/9

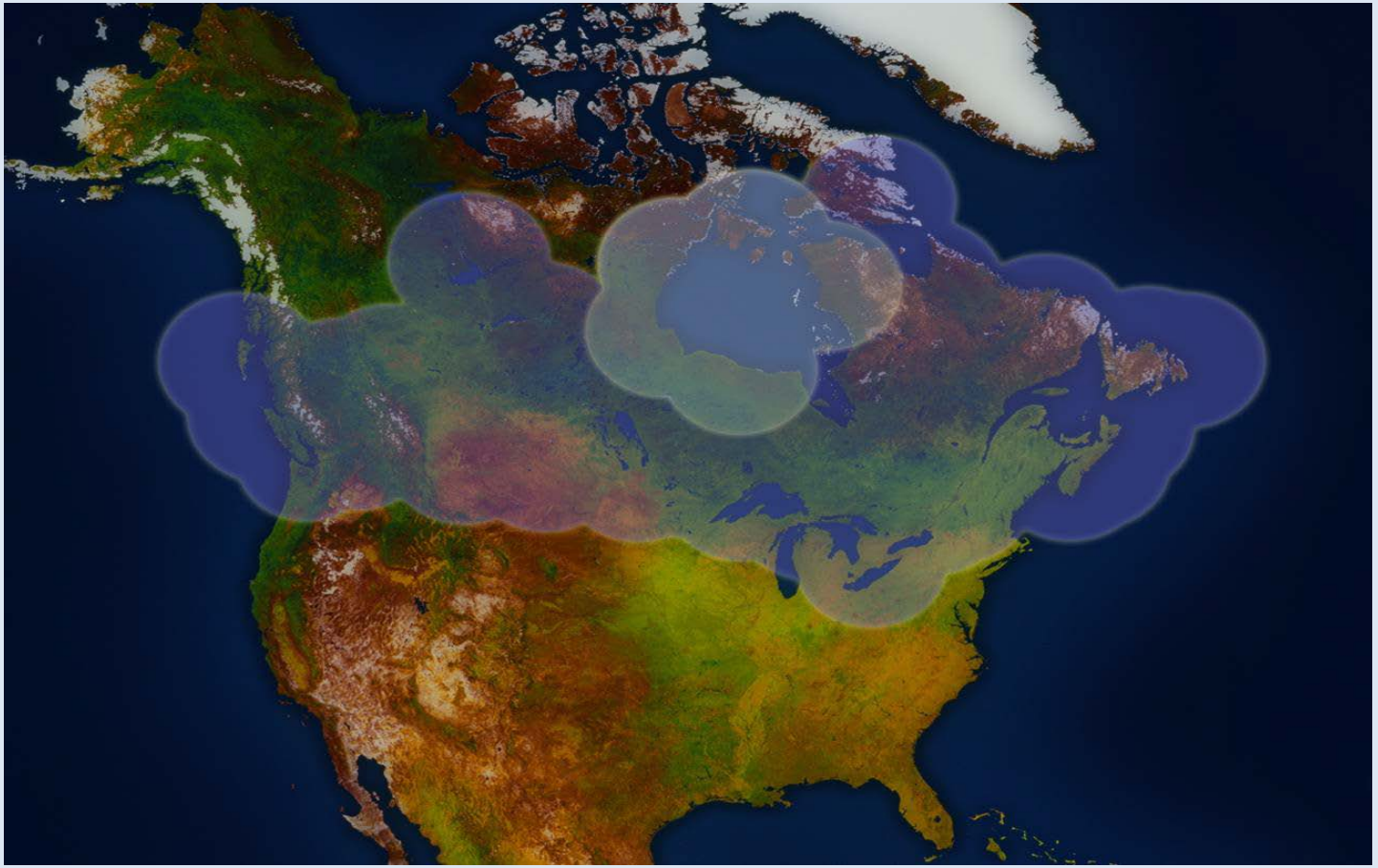
Regulatory Approval

- Canadian Aviation Regulations (CARs) - rules that govern civil aviation in Canada.
  - CARs Part VIII (Air Navigation Services) governs the application of air traffic control standards and procedures.
  - As air navigation service provider (ANSP) for Canada, NAV CANADA requires specific approval from the State regulator (Transport Canada) to implement services not already sanctioned in CARs
- Request - Use ADS-B as ATS surveillance for 5 NM separation
  - ADS-B performance must comply with RTCA DO 303 “Safety, Performance and Interoperability Requirements Document for the ADS-B Non-Radar-Airspace Application”
  - Ensure total system safety, including monitoring, reviewing and updating any element of ADS-B operations and systems in accordance with ICAO Circular 311 “Assessment of ADS-B to Support Air Traffic Services and Guidelines for Implementation”.

ADS-B IN CANADA

Hudson Bay 2009 - 850,000 sq kms

CARs exemption (#12482046)



ADS-B IN CANADA

Increasing Operator Participation

Aeronautical Information Circular 21/09

- Operator eligibility to receive ADS-B-based separation services was initially granted by registration of each aircraft's unique 24-bit transponder address with NAV CANADA and achievement of specific operations specifications.
- Based on customer consultation, agreement that increasing fleet capability will allow the maximum airspace capacity owing to the availability of the smallest separation standards between all aircraft.
- May 2009 - NAV CANADA initiated priority handling of ADS-B eligible aircraft.
  - assignment of flight planned route;
  - assignment of flight planned cruise altitude;
  - assignment of flight planned Mach number; and
  - approval of requests for en route dynamic rerouting

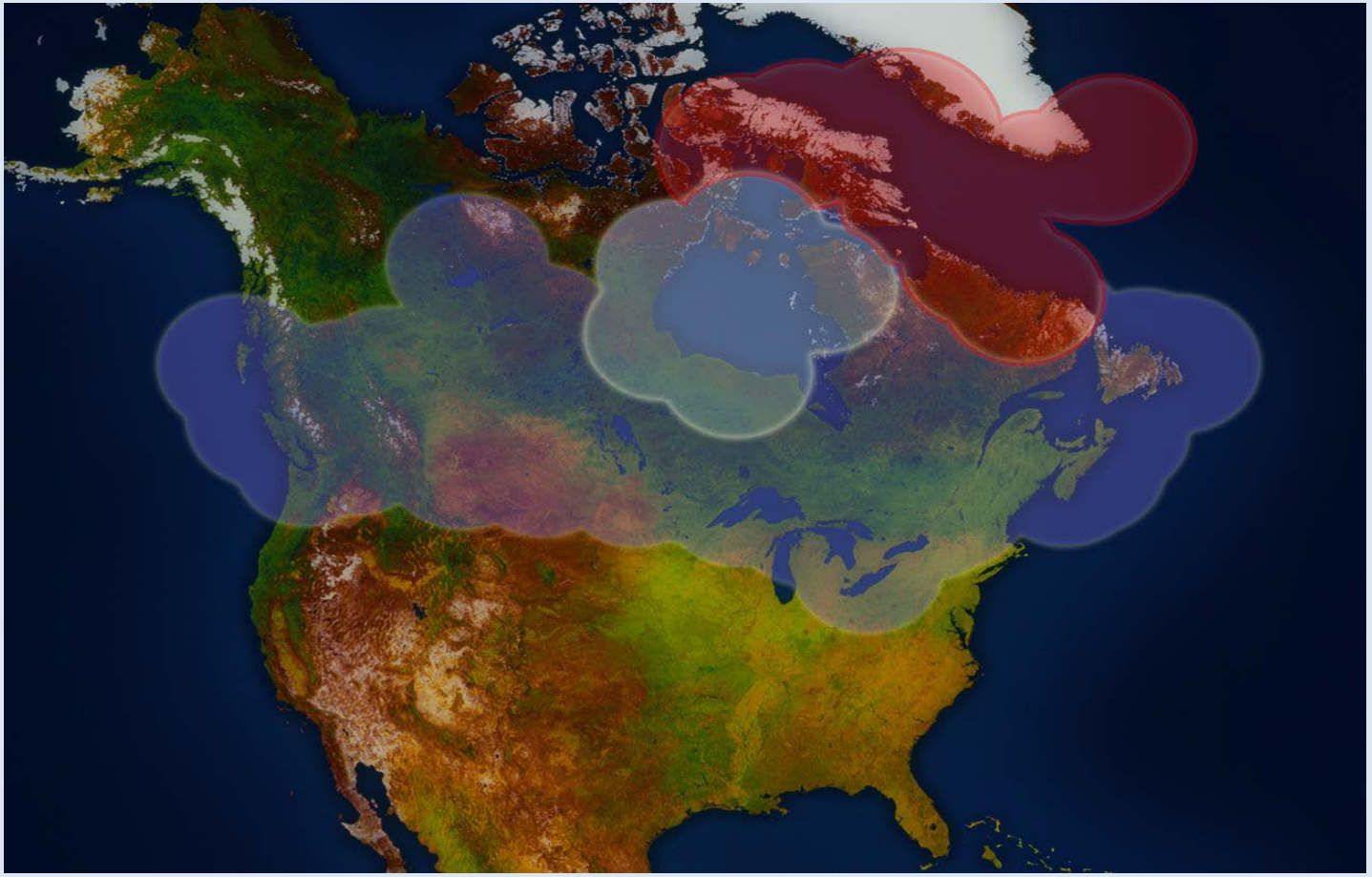
ADS-B IN CANADA

Request for Expansion

- Transport Canada approved the expanded use of ADS-B into other areas based on continued adherence to the CARs exemption conditions
- Plus satisfaction of the following safety assessment components for each new ADSB facility:
  - Hazard identification and risk assessment
  - Mitigations
  - System testing plans
  - ATS implementation plan, and
  - Training plans
- November 2010. Six ground stations in the northeast - 1,980,000 sq kms of ADS-B surveillance
- March 2012: Four ground stations in Greenland - 1,320,000 sq kms of ADS-B surveillance over the North Atlantic

ADS-B IN CANADA

15 ADS-B ground stations - over 4,000,000 sq kms



ADS-B IN CANADA

Increased Equipage Levels = Increased Service

- As equipage levels increased and system monitoring demonstrated performance reliability, NAV CANADA was able to remove the requirements for registration and achievement of the operations specification.
- Current aircraft equipage levels above FL290 in Canadian Domestic Airspace and Gander Oceanic Control Areas are above 90%

ADS-B IN CANADA

Proposed ADS-B Mandate – Canada

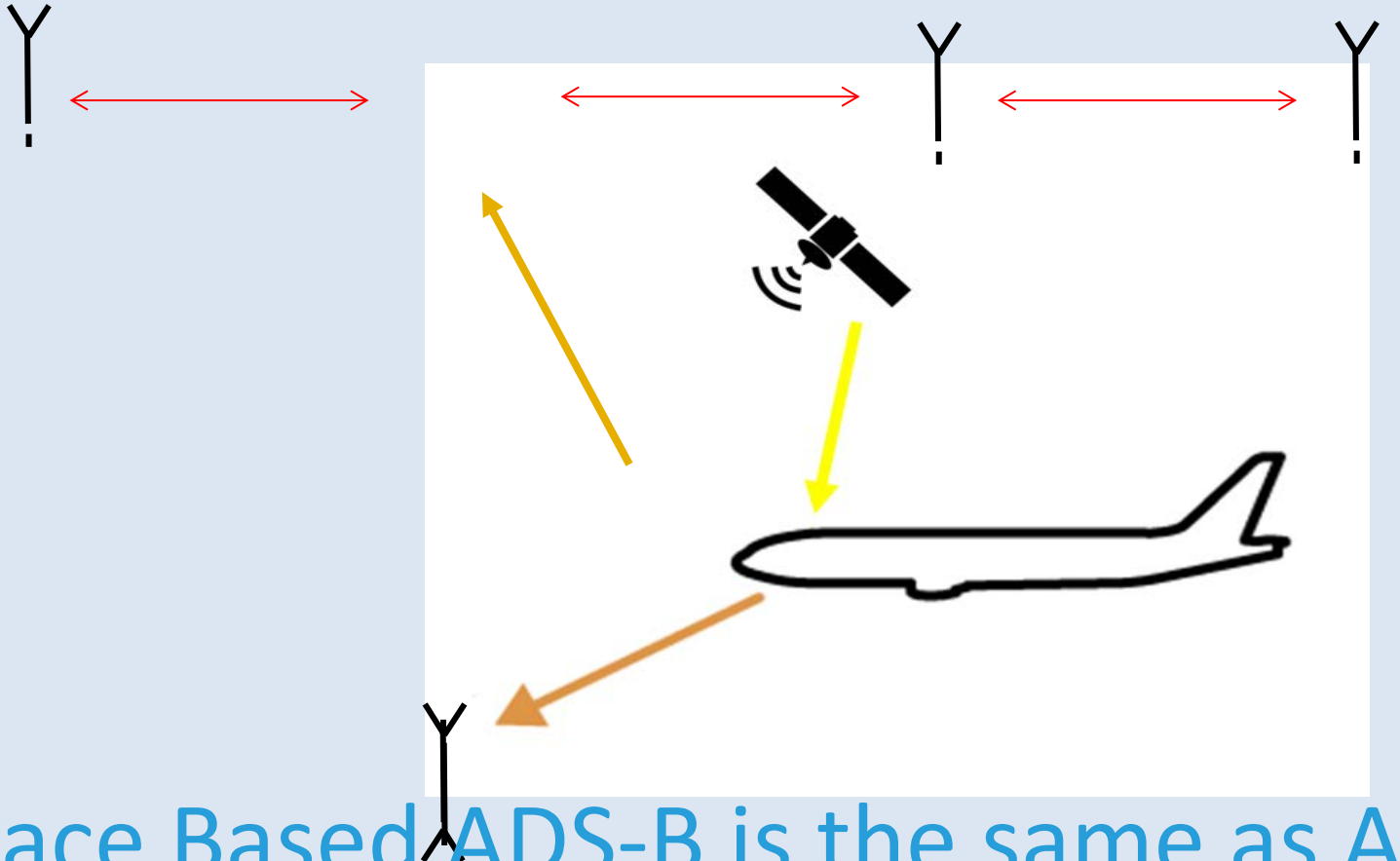
- Phase 1
  - implementation date is January 1, 2021, and is assigned to Class A airspace, which consists of the Southern, Northern and Arctic Control Areas from 18,000' and above, FL230 and above and FL270 and above respectively, and Class E airspace above FL600.
- Phase 2
  - implementation date is January 1, 2022, and is assigned to Class B airspace, which includes all low level controlled airspace above 12,500´ ASL to below 18,000´ ASL.
- The ADS-B Out avionics performance standards required for the start of Phase 1 and 2 are DO 260, 260A, or 260B or equivalent
- From January 1, 2024, implement the minimum avionics standard RTCA/DO-260B (equivalent to EUROCAE/ED-102A)

ADS-B IN CANADA

Space Based Platform = New Opportunities

- Performance data from the Aireon operational constellation
  - Confirmed the capability of an ADS-B system operated via a satellite based platform to fall within the parameters of an ATS surveillance system
- NAV CANADA and Transport Canada have maintained an open dialog on Space-Based ADS-B
  - Sharing of preliminary test results, progress of ground system development and implementation plans for the Edmonton and Gander FIRs
- Nov 22, 2017 - Transport Canada provided written notice to NAV CANADA that the approval conditions for ADSB services are deemed to include those provided through ground based or space based receivers for the purposes of applying ATS surveillance standards.
  - Clearly outlined the position of Canada that ADSB services, including separation, are to be assessed and applied uniformly regardless of the receiver platform thereby permitting 5 mile ATS surveillance separation using SB ADSB to be used in areas in northern Canada serviced only by VHF communications

Performance data from the Aireon constellation confirmed the capability of an ADS-B system operated via a satellite based platform to operate as an ATS surveillance system.



Space Based ADS-B is the same as ADS-B

ADS-B IN CANADA

Edmonton FIR

4 Major Phases

1 - Confirming Readiness – May – July, 2018

- Use new CAATS functions with existing airspace

2 – Application of 5 NM ATS Surveillance – Feb 2019 - 1 hour

- Use SB ADSB Signal to augment Ground Based ADSB
- Use within existing ADSB surveillance airspace only

3 - Expansion of 5 NM ATS Surveillance – Apr 2019 – 1 day

- Using SB ADSB signal
- Expand to all VHF DCPC airspace

4 - Application of SB ADSB Procedural - May – Sept – 2019 – 1.25 days

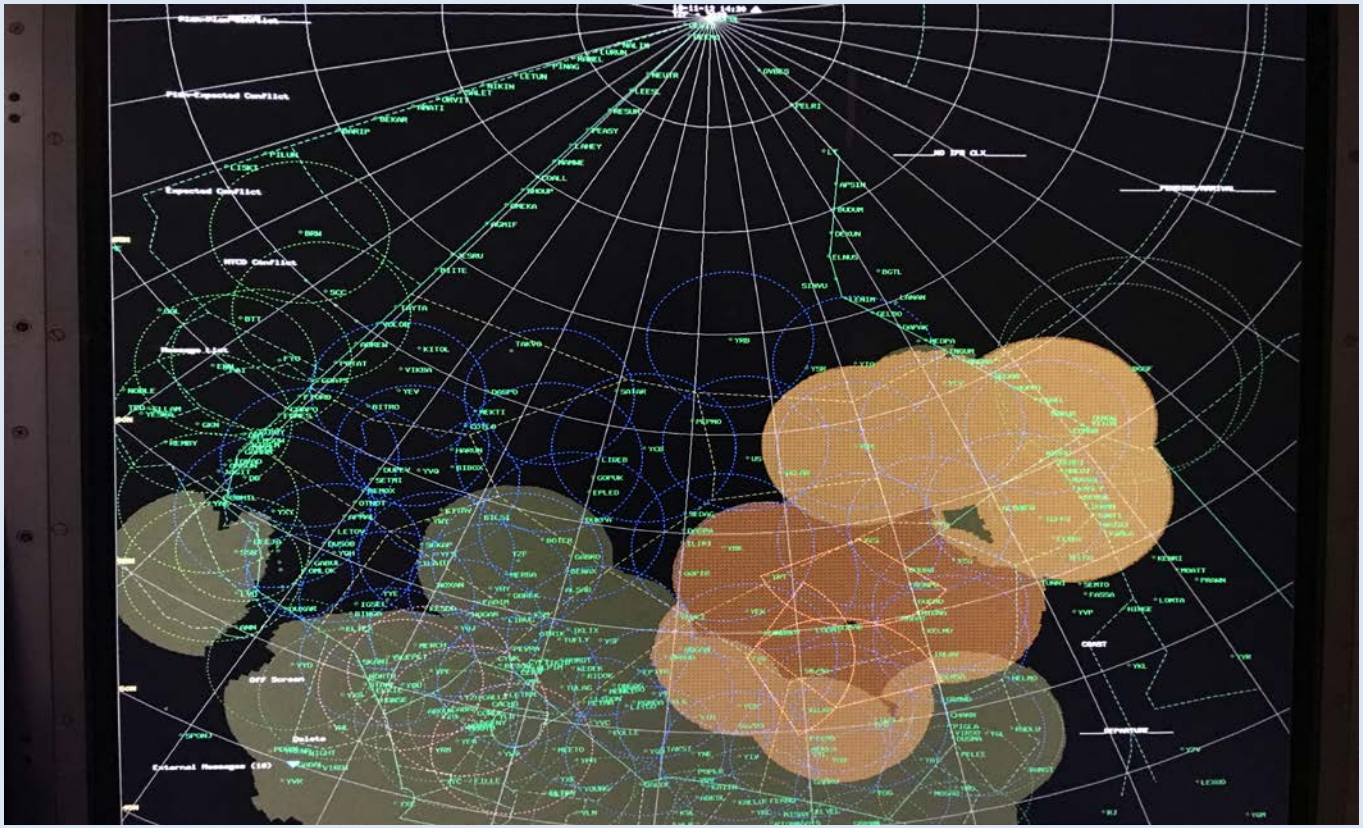
- New Procedural Standards Using CPDLC for communication

ADS-B IN CANADA

Edmonton FIR Phase 3

Expansion of 5 NM ATS Surveillance

Not an operational trial (SB ADS-B = ADS-B = ATS Surveillance)

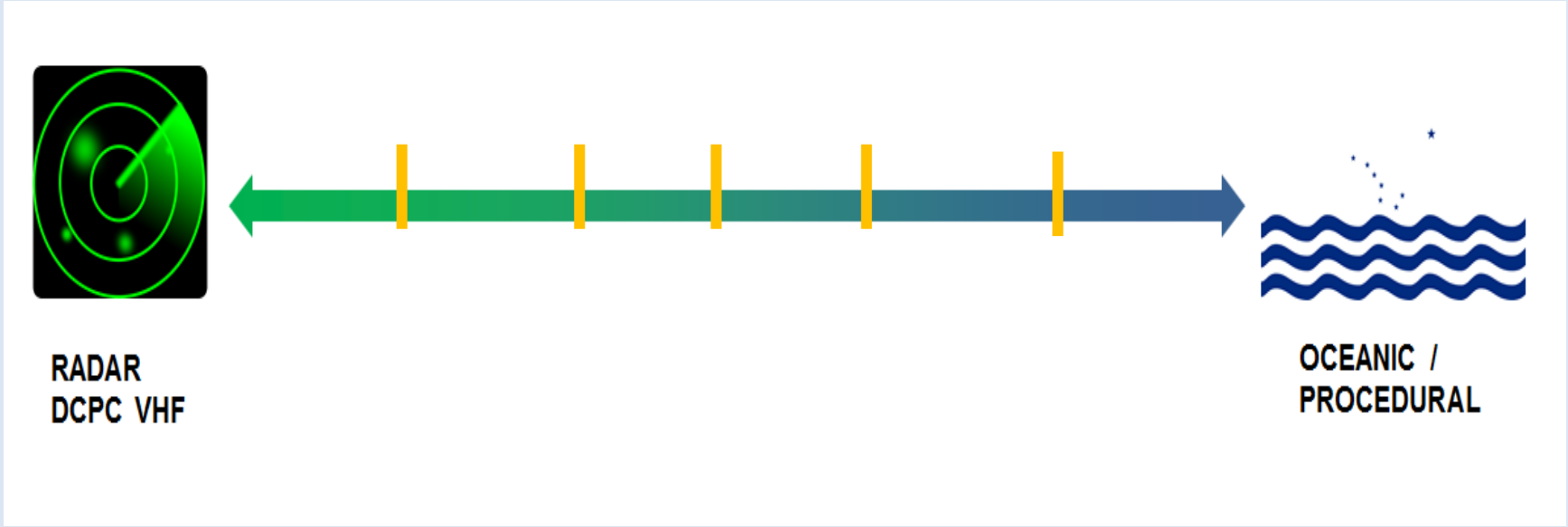


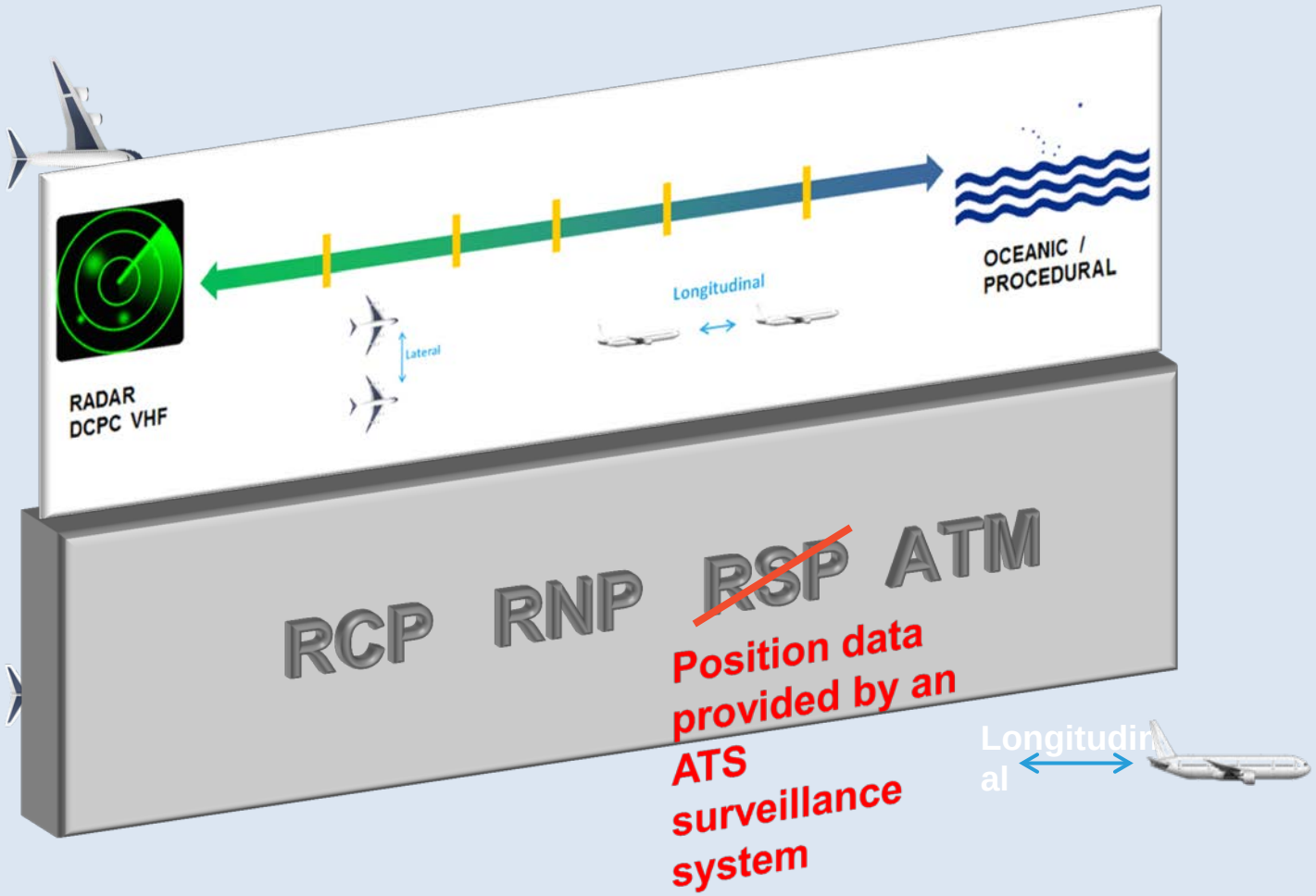
SB ADS-B - ICAO

Separation and Airspace Safety Panel

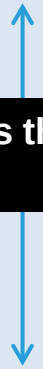
- 12th Air Navigation Conference in Montreal, Canada in November 2012,
- Recommendation 1/9 was endorsed to support the inclusion in the Global Air Navigation Plan of the development and adoption of space-based automatic dependent surveillance – broadcast (SB ADS-B) as a surveillance enabler and for the development of supporting Standards and Recommended Practices and guidance material.
- Subsequently the ICAO separation and airspace safety panel (SASP) commenced discussion on the development of space-based technology and systems and the possible use of these in supporting new separation minima.
- SASP finalized recommended separation minima for longitudinal and lateral application in May 2018.

Separation Standards filling in the Gaps between Surveillance and Procedural Separations




RADAR
DCPC VHF
Lateral
Longitudinal
OCEANIC /
PROCEDURAL
RCP RNP RSP ATM
Position data provided by an ATS surveillance system
Longitudinal

Lateral Separation



Not less than 19 NM

- **NAVIGATION : *RNP 4 or RNP 2***
- **COMMUNICATION : *RCP 240***
- **SURVEILLANCE : *An ATS surveillance system***

- lateral deviation alerts using conformance monitoring
- Nice airspace (Deviation rate or Occupancy)

Longitudinal Separation

Not less than 17 NM

- **NAVIGATION :** ***RNP 4 or RNP 2***
- **COMMUNICATION :** ***RCP 240***
- **SURVEILLANCE :** ***An ATS surveillance system***
- Same or crossing tracks less than 90 degrees
- ~~Same or crossing track less than 45 degrees~~

Opposite direction

- **NAVIGATION :** ***RNP 4 or RNP 2***
- **COMMUNICATION :** ***RCP 240***
- **SURVEILLANCE :** ***An ATS surveillance system***
- Surveillance position reports confirm they've passed

ADS-B IN CANADA

- Separate Approval Required
  - Public Interest
    - Airtraffic comprised mostly of international air carriers operating between North America and Europe. Growing traffic flow operating from eastern United States and mid-Canada airports to the Far East via the Polar Routes.
  - Socio-economic and Operational Benefit
    - Better direct routings closer to preferred profiles and an increased ability to respond to requests for altitude changes.
  - Environmental Benefit
    - Cut airline fuel costs by about C$9 million a year and result in a reduction of 25,000 metric tonnes of CO2 per year through more efficient routings and altitudes.
  - Aviation Safety
    - ADS-B has been a proven technology for approximately ten years during which NAV CANADA has maintained an exemption to the CARs to use such technology for surveillance purposes.

ADS-B IN CANADA
EDMONTON PHASE 2, 3, 4

Phase 2 – Existing Surveillance Airspace

Phase 3 – Remaining DCPC Airspace

Phase 4 – Polar Airspace (Operational Trial)

SPACE BASED ADS-B
ICAO NAT REGION
Concept Development – NAT SPG
2014

- **NAT SPG Conclusion 50/07 – Space-Based ADS-B Initiative**
- That:
- a) the NAT SPG support the expanded use of Air Traffic Services (ATS) surveillance in the ICAO NAT Region;
- b) the NAT Implementation Management Group (NAT IMG):
  - i) review and provide input, as appropriate, to the Space-Based Automatic Dependent Surveillance - Broadcast (ADS-B) CONOPS;
  - ii) identify all activities supporting the implementation of ATS surveillance services, including the associated communication requirements and operational trials in the ICAO NAT Region using space-based ADS-B; and
  - iii) propose amendments to procedures and documentation;
- c) the NAT Safety Oversight Group (NAT SOG) review updates on the conduct and results of the safety management activities supporting the implementation of ATS surveillance services in the ICAO NAT Region using space-based ADS-B;
- d) the NAT Economic and Financial Group (NAT EFG) review economic assessments concerning the implementation of ATS surveillance services using space-based ADS-B in NAT airspace; and
- e) the NAT IMG, NAT SOG and NAT EFG report progress to NAT SPG/51.

NAT SPG CONCLUSION 54/9

Operational Trial of Advanced Surveillance Enhanced Procedural Separation (ASEPS) using Space-Based Automatic Dependent Surveillance-Broadcast (SB ADS-B)

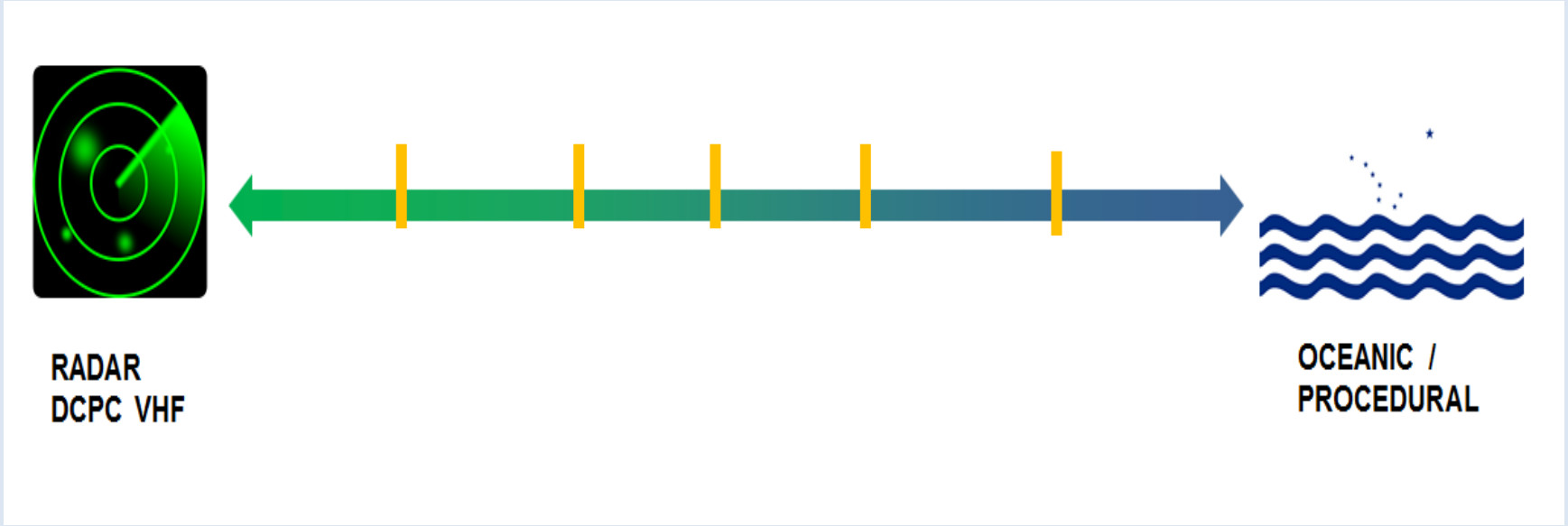
- a) the Implementation Plan and Task List for an operational trial ASEPS using SB ADS-B be approved by the NAT IMG/53 and the NATSOG/19 meetings, provided that the NAT IMG and NAT SOG have ascertained that all prerequisites of NAT SPG Conclusion 53/5 have been satisfied; and

- b) subject to the NAT IMG and NAT SOG approval, the operational trial be planned to:
  - i) commence on 28 March 2019 provided all prerequisites of NAT SPG Conclusion 53/5 have been satisfied; and
  - ii) continue until 5 November 2020 or the effective date of ASEPS provisions in the Procedures for Air Navigation Services - Air Traffic Management (PANS-ATM, Doc 4444), whichever is later.

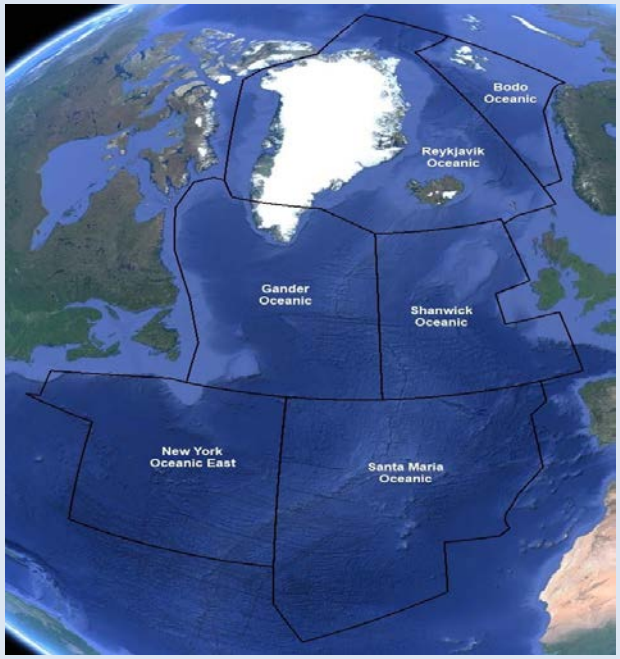
SB ADS-B within the existing NAT communications infrastructure has the potential to enable a significant safety benefit.

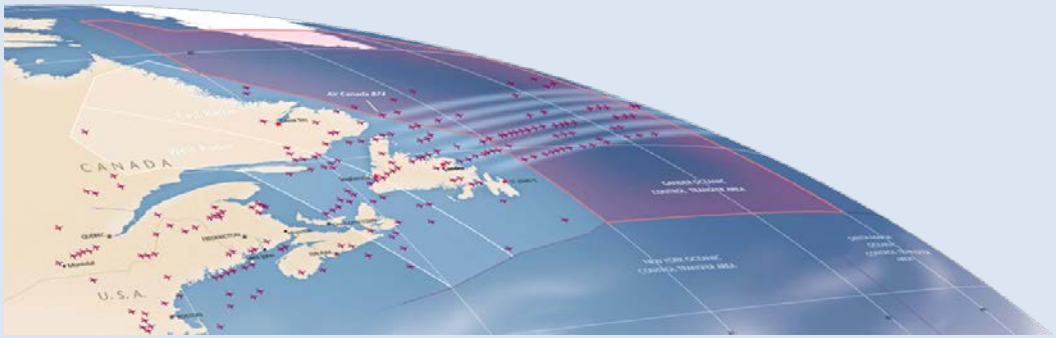
ICAO NORTH ATLANTIC REGION (CY 2016)			Un-cleared		Vertical Collision Risk (x 10^{-9} fapfh)	
SCENARIO		# Vertical Deviations	Duration (mins)	Flight Levels Crossed	Without SLOP	With SLOP
No ATS Surveillance (ADS-C only)		47	269	50	56.8	12.6
SB ADS-B	SFL-CFL only	26	244	25	49.9	11.0
	% Reduction from No ATS Surveillance	-45%	-9%	-50%	-12%	-13%
	SFL-CFL & Limited Duration	26	38	25	9.9	2.3
	% Reduction from No ATS Surveillance	-45%	-86%	-50%	-83%	-82%

Separation Standards filling in the Gaps between Surveillance and Procedural Separations



NAT Regional Trials – Gander Domestic → Oceanic





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QUESTIONS ?