International Civil Aviation Organization
North American, Central American and Caribbean Office

INFORMATION PAPER

ADS-B/LEG — IP/04
22/11/18

Automatic Dependent Surveillance – Broadcast (ADS-B) Implementation and Regulation Meeting for the NAM/CAR/SAM Regions (ADS-B/LEG)

Mexico City, Mexico, 26 to 30 November 2018

Agenda Item 8: Other business

Integration of Space-Based Automatic Dependent Surveillance - broadcast (SB ADSB) Technology into the Canadian Air Navigation System

(Presented by Canada)

EXECUTIVE SUMMARY

This information paper describes the process by which NAV CANADA, the air navigation service provider (ANSP) responsible for sovereign Canadian Domestic Airspace and the Gander oceanic control air (OCA) of the North Atlantic (NAT) Region, has integrated automatic dependent surveillance – broadcast (ADSB) into its air traffic control system. This process includes impending expansion of the area in which ATS Surveillance Services can be provided, due to the availability of ADSB technology via the Aerion space-based platform.

Also described are the developments within ICAO to establish separation minima specific to space-based ADSB, thereby enabling ATS surveillance services into remote and oceanic areas where ground based networks have been either unavailable or unfeasible. NAV CANADA is working with its regulatory authority to make these separation procedures available in the 1st Quarter of 2019.

Strategic Objectives:	• Safety • Air Navigation Capacity and Efficiency
• References:	• ICAO Circular 311 (*now 326*) *Assessment of ADS-B to Support Air Traffic Services and Guidelines for Implementation* • Twelfth Air Navigation Conference (AN-Conf/12), Montreal, Canada

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1. Introduction

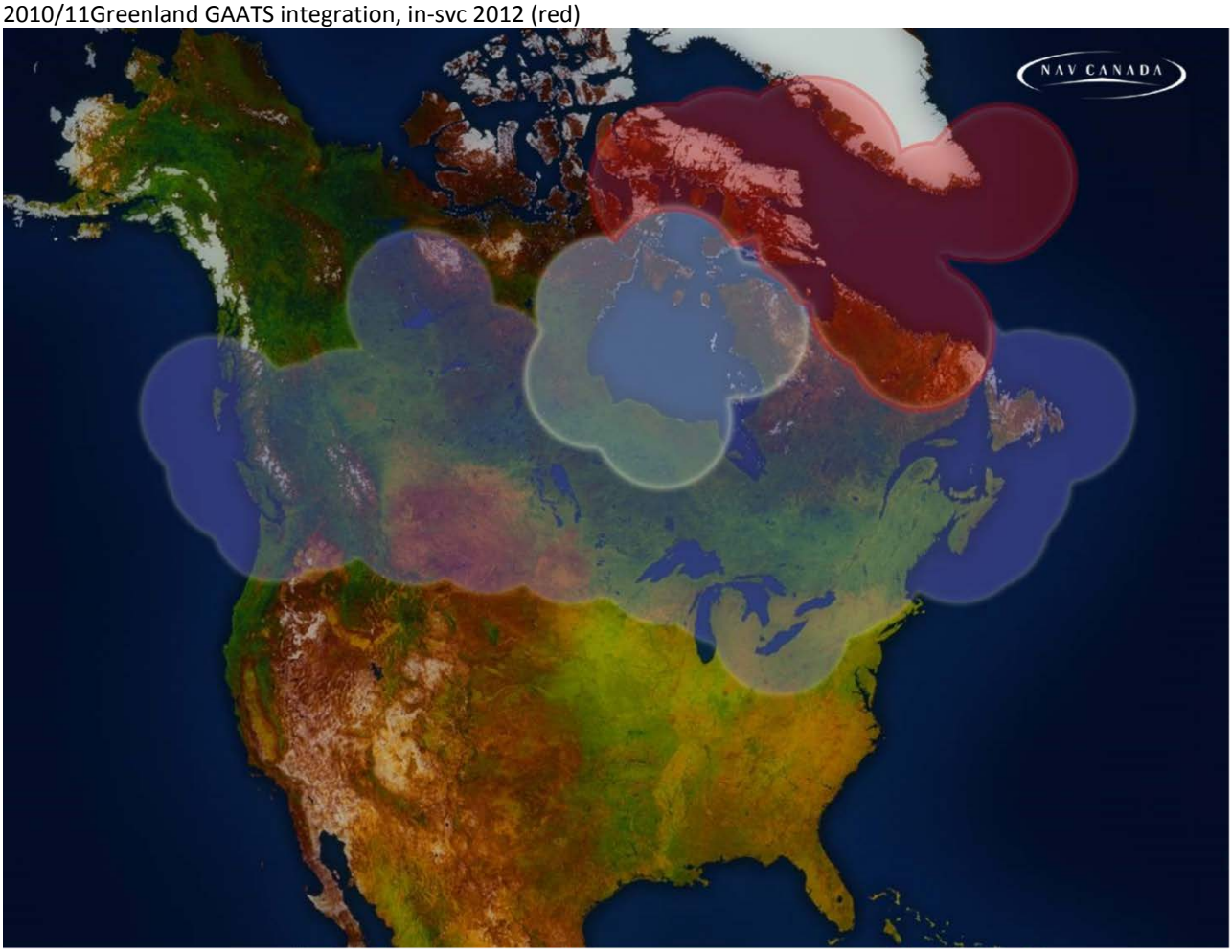
1.1 ADSB in Canada

1.1.1 NAV CANADA has been providing air traffic services using automatic dependent surveillance – broadcast (ADS-B) in Canadian Domestic Airspace (CDA) since 2009, beginning with 5 NM ADSB service over Hudson Bay. Logistically, implementation of ADS-B allowed for uninterrupted ATS surveillance over a previously existing “gap” which required transition to larger separation minima.

1.1.2 As ANSP for Canada, NAV CANADA requires specific approval from the State regulator, Transport Canada (TC), to implement services sanctioned under the Canadian Aviation Regulations (CARs), specifically Standard 821 - Canadian Domestic Air Traffic Control Separation Standards. These standards, consisting of regulations and advisory material, are the rules that govern civil aviation in Canada.

1.1.3 With approval via CARs exemption (#12482046), NAV CANADA controllers have been using ADS-B with VHF voice communications to apply the 5 NM radar separation standard as it exists in Standard 821.

Figure 1: SSR (blue) January 15, 2009 Hudson Bay service (white), East Coast Labrador/Baffin added 2010/11Greenland GAATS integration, in-svc 2012 (red)



1.1.4 The approval to use ADSB as a source of surveillance came with technical and operational conditions which included:

- The requirement to complete all necessary equipment and system tests or evaluations to ensure the ADSB performance will comply with RTCA DO 303 “Safety, Performance and Interoperability Requirements Document for the ADS-B Non-Radar-Airspace Application”.

- The requirement to establish a post-implementation safety assessment process in accordance with ICAO Circular 311 (*now 326*) *Assessment of ADS-B to Support Air Traffic Services and Guidelines for Implementation* to determine continuing total system safety including monitoring, reviewing and updating any element of ADS-B operations and systems. This includes monitoring avionic performance requirements and ADS-B messaging for compliance with RTCA DO 303 and the functional criteria of EASA AMC 20-24, Section 7, for all aircraft.

1.1.5 Subsequent and in addition to meeting the initial conditions of the approval specific to the Hudson Bay area, TC approved the expanded use of ADSB into other areas (see Figure 1) based on continued adherence to those conditions plus satisfaction of the following safety assessment components for each new ADSB facility:

- Purpose and executive summary
- Background information
- Hazard identification and risk assessment
- Mitigations
- System testing plans
- ATS implementation plan, and
- Training plans

1.2 Policy

1.2.1 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.

1.2.2 With the “eligibility list” in effect, NAV CANADA encouraged operator participation through initiation of priority handling for ADS-B eligible aircraft to allow preferred access to optimal routes, speeds and flight levels.

1.2.3 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.

1.2.4 Current aircraft equipage levels above FL290 in Canadian Domestic Airspace and Gander Oceanic Control Areas are above 90%.

2. Expansion via Aerion SB ADSB

2.1 At the Twelfth Air Navigation Conference (AN-Conf/12) 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 SB ADS-B as a surveillance enabler and for the development of supporting Standards and Recommended Practices and guidance material.

2.2 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.

2.3 Initial efforts from the SASP suggested that it could be possible to expand the direction to develop SB ADS-B procedures to include other technologies.

2.4 Performance data made available 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, which for SASP meant that the separations would be available for implementers using other ATS surveillance systems (e.g. radar and multi-lateration) as well.

2.5 In May 2018, SASP finalized recommended separation minima using ATS Surveillance systems where VHF voice communications are not available as follows. Position information is to be derived from an ATS Surveillance system with downlinked ADS-B position performance level at NIC ≥ 4 and NACP ≥ 5 (NUCP ≥ 4) with communications requiring RCP 240 (CPDLC is eligible with PBCS authorizations). Eligible aircraft must also be authorised to RNP 4.

Longitudinal Separation

- 14 NM longitudinal separation of aircraft operating on same identical tracks or intersecting tracks provided that the relative angle between the tracks is less than 45 degrees;
- 17 NM longitudinal separation of aircraft operating on intersecting tracks provided that the relative angle between the tracks is less than 90 degrees; and
- Opposite-direction aircraft on reciprocal tracks may be cleared to climb or descend to or through the levels occupied by another aircraft provided that the aircraft have reported by ADS-B having passed each other by 5 NM.

Lateral Separation

- 19 NM lateral spacing between parallel or non-intersecting tracks.

    - Lateral conformance monitoring shall be ensured by the use of lateral deviation warning using ATS surveillance system data with a warning threshold set at 3 NM; and

o The ATS ground system shall prioritize and enable immediate recognition by the controller of any such lateral deviations.

- 15 NM provided either:

  i) the density of traffic in the airspace, as measured by occupancy, is less than 0.6; or

  ii) the proportion of total flight time spent by aircraft off the cleared track does not exceed the following:

  a. for aircraft deviating 13.0 km (7.0 NM) or more off the cleared track, $3 \times 10\text{-}5$ per flight hour; and
  b. for aircraft deviating 20.4 km (11.0 NM) or more off the cleared track, $1.9 \times 10\text{-}5$ per flight hour.

2.6 NAV CANADA has leveraged this work into planning for implementation of the proposed separations for use in both northern Canada and the ICAO NAT Region. Because the service is near readiness, approvals to use the separations prior to November 2020 publication in ICAO Doc 4444 are being secured from Transport Canada, for use in Canadian Domestic Airspace, and the NAT Systems Planning Group (SPG), for use in the ICAO NAT Region.

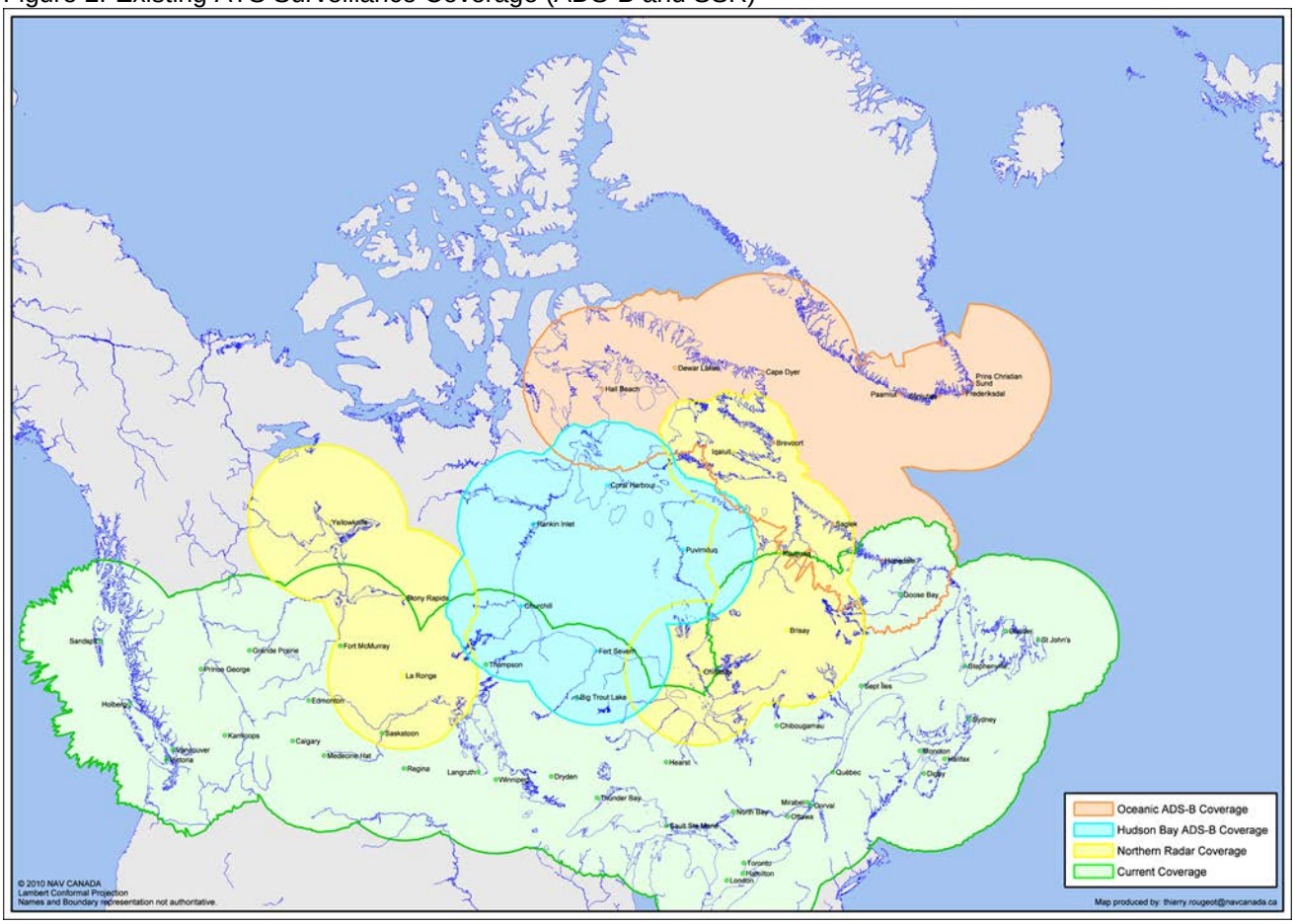
3. Canadian Domestic Airspace

3.1 NAV CANADA and Transport Canada have maintained an open dialog on Space-Based ADS-B, including sharing of preliminary test results as well as implementation plans and progress. Using Space-Based ADS-B will be authorized based on performance demonstration showing results generally consistent with ground-based ADS-B along with other appropriate safety case documentation.

3.2 TC has confirmed via written interpretation to NAV CANADA that, for the purposes of Exemption # 12482046, “ADS-B services are deemed to include those provided through Ground based or Space Based receivers for the purposes of applying ATC surveillance standards.”

3.3 This 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.

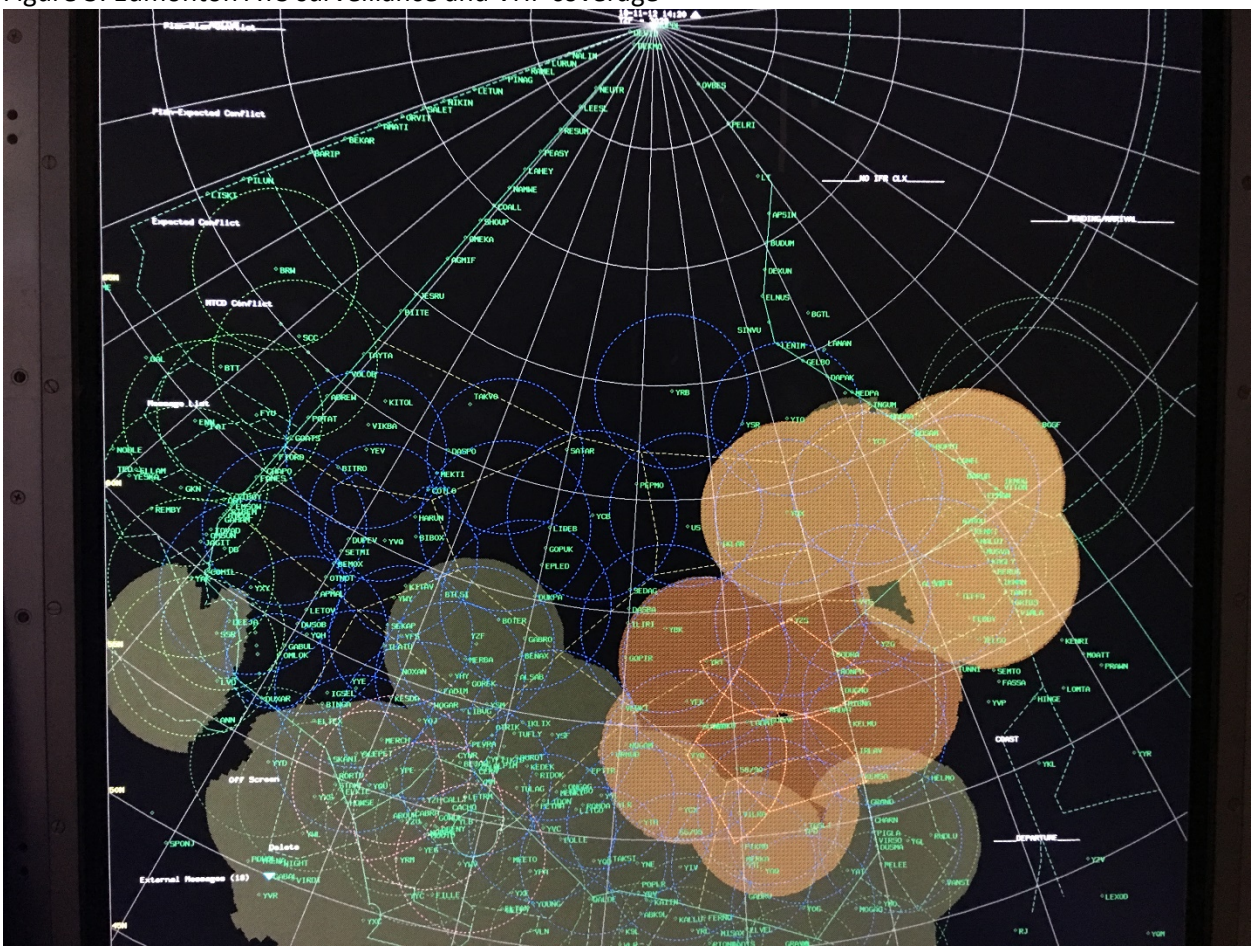
Figure 2: Existing ATS Surveillance Coverage (ADS-B and SSR)



Edmonton Flight Information Region (Phased Implementation)

3.4 Space-based ADS-B will be integrated into the Edmonton FIR to fill considerable airspace gaps where ground based ATS surveillance services have not considered feasible.

Figure 3: Edmonton ATS surveillance and VHF coverage



3.5 Approval request to use ADS-B with CPDLC

3.6 NAV CANADA has included in the training plan theoretical training for:

a) ATC Procedures for the use of ADS-B with CPDLC in the application of surveillance standards and associated procedures;
b) ADS-B with CPDLC systems and equipment operational systems and its limitations;
c) Overview of ADS-B using a satellite receiver as a surveillance system
d) Procedures to handle the loss of ADS-B, using satellite receivers in surveillance
e) Anticipated loss of surveillance resulting from planned system outage
f) Loss of surveillance of a single aircraft due to onboard equipment failure
g) Sudden and unexpected loss of surveillance
h) Total loss of service
i) Equipment-related training
    a. Changes in display and announcement of system alerts
    b. Display of CPDLC frequency serviceability

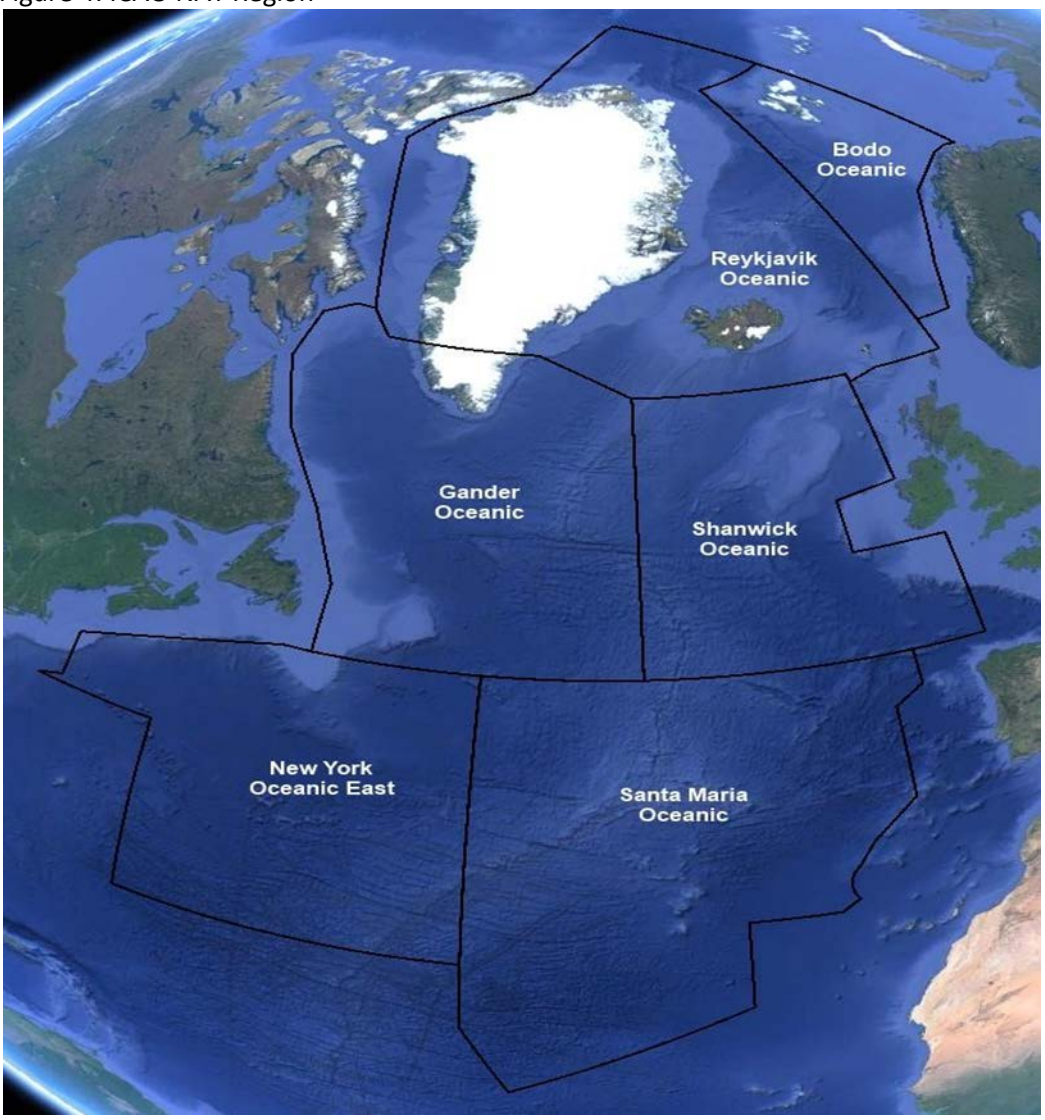
4. NAT Region – Gander Oceanic Control Area

4.1 NAT SPG Conclusion 50/07 (Space-Based ADS-B Initiative) supported the expanded use of Air Traffic Services (ATS) surveillance into the ICAO NAT Region.

4.2 An associated NAT Region Concept of Operations was developed to support the detailed technical planning necessary for NAT ANSPs/States to implement SB ADS-B based operations and this has been supplemented by a detailed implementation plan which follows the guidelines provided in ICAO Doc 9689 (Manual on Airspace Planning Methodology for Determination of Minima).

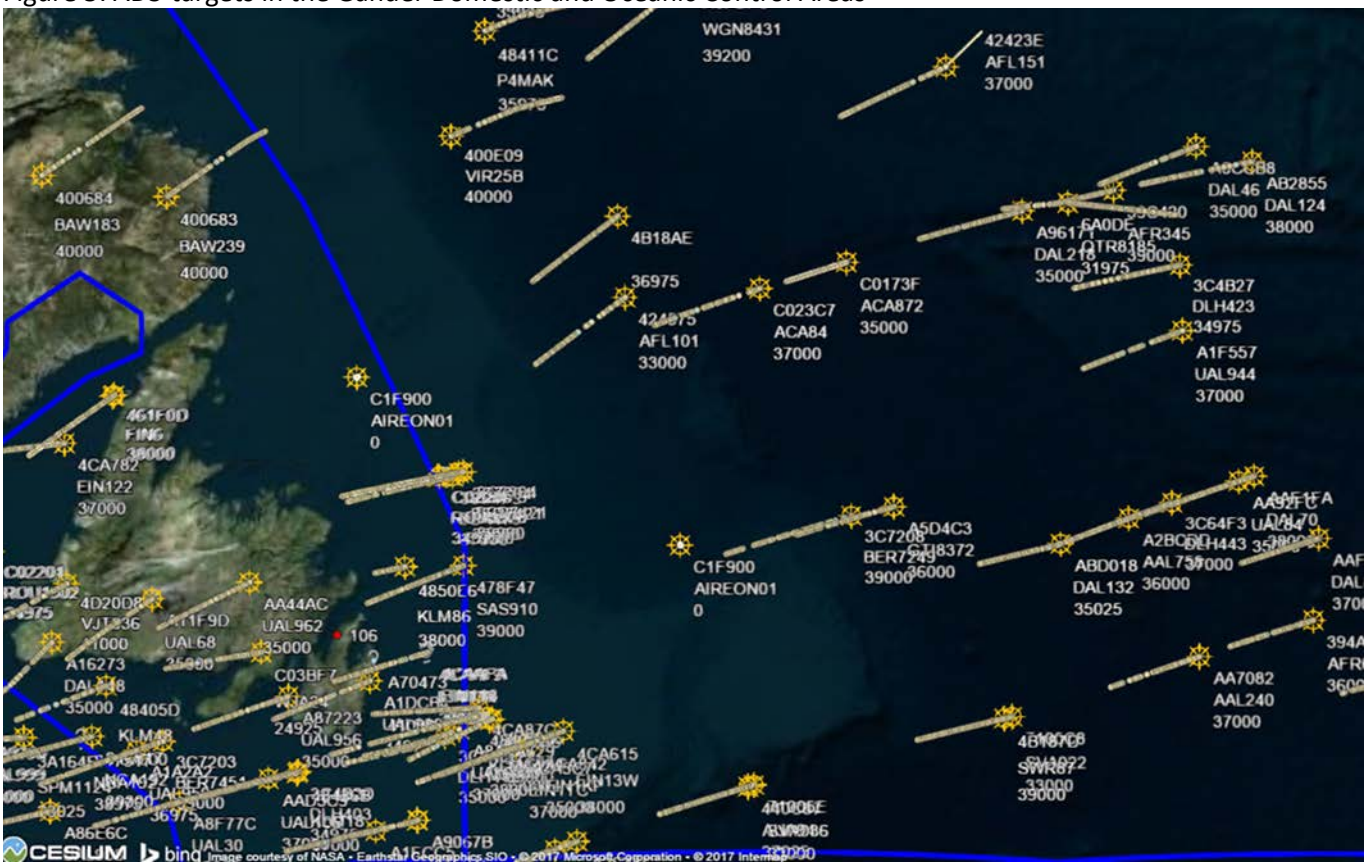
4.3 On 28 March 2019, in accordance with NAT SPG Conclusion 54/9 - Operational Trial of Advanced Surveillance Enhanced Procedural Separation (ASEPS) using Space-Based Automatic Dependent Surveillance-Broadcast (SB ADS-B) - Gander, Shanwick, and Santa Maria area control centres (ACCs) will commence an operational trial of the ATS Surveillance systems where VHF voice communications are not available

Figure 4: ICAO NAT Region



4.4 Addition of the space based signal will provide seamless ATS surveillance between Canadian Domestic and NAT Regional Gander oceanic airspace.

Figure 5: ADS-targets in the Gander Domestic and Oceanic Control Areas



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