



Agenda Item 4: Air Navigation Matters

- 4.2 Follow-up on the Implementation of the NAM/CAR Regional Performance Based Air Navigation Plan (RPBANIP):
- Progress reports of the former Sub-regional Working Groups on AIM, ATM and CNS areas.

ADS-B VIA LOW EARTH ORBITING SATELLITES: BENEFITS ASSESSMENT

(Presented by Canada)

SUMMARY	
This paper presents an overview of the results of the Benefits Assessment performed to support NAV CANADA’s plans to implement ADS-B capability via LEOS.	
References:	
<ul style="list-style-type: none"> • Accompanying presentation • Working Document for the Aviation System Block Upgrades, issued 28 March 2013 	
Strategic Objectives	<i>This information paper is related to Strategic Objectives: A. Safety – Enhance global civil aviation safety C. Environmental Protection and Sustainable Development of Air Transport</i>

1. Introduction

1.1 NAV CANADA provides air navigation services in Canadian Domestic Airspace, via bi-lateral agreement some portions of United States domestic airspace and, within the ICAO North Atlantic (NAT) Region, the Gander Oceanic Flight Information Region (FIR) and the Gander Control Area. Along with other Air Navigation Services Providers (ANSP) around the world, NAV CANADA has been working to find ways to improve efficiency and service for oceanic and remote air travel and to increase capacity. NAV CANADA is participating in the formation of Aireon Limited Liability Company (LLC), a joint venture to finance, develop, deploy and operate a global solution for tracking and monitoring aircraft anywhere in the world by using space-based Automatic Dependent Surveillance – Broadcast (ADS-B) receivers. Other partners in this joint venture currently include Iridium Communications, Incorporated, with support from the United States’ Federal Aviation Administration (FAA) and suppliers Harris Corporation and IT Exelis.

1.2 NAV CANADA's initial goal from this joint venture is to reduce aircraft separation minima between aircraft operating within portions of the ICAO NAT Region through the use of Automatic ADS-B OUT via Low Earth Orbiting Satellites (LEOS).

2. Governance

2.1 NAV CANADA is a private sector, non-share capital corporation, whose board includes directors appointed by the Government of Canada, commercial air carriers, general aviation and NAV CANADA's unionized employees. In establishing new customer service charges or revising existing charges, NAV CANADA complies with the charging principles set out in the (Canadian) *Civil Air Navigation Services Commercialization Act*, which does not allow setting customer service charges higher than what is needed to meet the financial requirements for the provision of air navigation services. The aim is essentially to achieve breakeven financial results on an annual basis.

2.2 Aireon is forming an eight person International Advisory Committee that will consist of 1 IATA representative, 4 airline representatives appointed by IATA and 3 ANSP representatives. This structure will ensure that the needs of airlines and ANSPs are considered during deployment and long-term operations of the service. Along with providing transparency to Aireon customers, the International Advisory Committee will provide periodic briefings on program status, operational implementation, benefits analyses, pricing structures, global deployment and regulatory status.

3. LEOS ADS-B

3.1 ADS-B coverage will become global through the use of at least 66 Iridium NEXT satellites equipped with receivers capable of receiving signals from 1090 megahertz (MHz) Mode S extended squitter transponders. The satellite constellation will include in orbit spares and further spares available to be launched if required. The Iridium NEXT satellite constellation will provide global coverage, offering the possibility of monitoring ADS-B equipped aircraft anywhere in the world, augmenting the current ground-based ADS-B infrastructure. This will reduce the necessity to make potentially very costly investments to extend ADS-B coverage to oceanic, polar and other remote areas. It also could avoid some of the costs that would be required to replace or expand ground based Air Traffic Services (ATS) surveillance systems. The ability to provide ATS surveillance services would be an effective means for harmonizing ATS and supporting cost-effective improvements to safety and efficiency. This satellite based surveillance would be on a separate network from that supporting current FANS 1/A and equivalent Controller Pilot Data Link Communications (CPDLC) capabilities.

3.2 The initial focus of NAV CANADA's ADS-B over LEOS initiative will be to expand ATS surveillance coverage in the areas of the North Atlantic airspace where Canada has accepted the responsibility for providing ATS. France, Iceland, Ireland, Norway, Portugal, the United Kingdom and the United States also provide ATS in this airspace. ATS surveillance services are provided near the domestic interfaces, over Iceland and in parts of the Santa Maria Oceanic Control Area (OCA) through the use of radar, ground-based ADS-B and multilateration. Usually, the North Atlantic core traffic is outside the range of current ATS surveillance systems.

3.3 The North Atlantic airspace is the busiest oceanic airspace in the world, with significant traffic volumes moving between Europe and North America. To manage this traffic without the benefits of ATS surveillance and sometimes limited communication capability, approximately ½ the current traffic operates on the North Atlantic Organized Track System (NAT OTS), which is constructed twice daily to allow eastbound flights to take best advantage of the Jet Stream and for westbound flights to mainly avoid it.

3.4 The potential for ADS-B to improve services in the core areas of the North Atlantic can be foreseen by examining current equipage levels. 85% of the current population of aircraft operating in the Gander and Shanwick OCAs are already equipped. This percentage is expected to rise as a result of the European Commission's Implementing Regulation laying down requirements for the performance and the interoperability of surveillance for the single European sky ((EU) No 1207/2011) and the United States' Title 14 of the Code of Federal Regulations (14 CFR) part 91, §§ 91.225 and 91.227, which are required after 1 January 2020. The most recent assessment showed that 47% of the flights flown in the Gander OCA were by ADS-B certified aircraft.

3.5 The current separation minima applied to aircraft operating in the North Atlantic airspace limits flexibility for flights to operate on their preferred flight profiles. Aircraft wishing to cross the current main traffic flows, or operate opposite to them, frequently suffer significant vertical or routing penalties, which increase costs, fuel consumption and greenhouse gas emissions. Even with recent improvements, it is still the case that many vertical requests cannot be accommodated; neither is it possible to allow a significant number of aircraft to operate on variable speed or vertical profiles to maximize fuel savings. The on-going operational trial of a Reduced Longitudinal Separation Minimum of 5 minutes between Automatic Dependent Surveillance-Contract (ADS-C) equipped aircraft (RLongSM) and the ENGAGE trials have demonstrated that significant fuel savings can be achieved when such flexibility can be accommodated. It is expected that such benefits will also be demonstrated through the planned operational trial of a Reduced Lateral Separation Minimum of 25 Nautical Miles (NM) (RLatSM).

3.6 The planned Aireon ADS-B implementation will provide near real-time position updates for each equipped aircraft. This will significantly improve situation awareness for air traffic controllers and provide for more timely conflict detection and resolution. The ability for air traffic controllers to provide advice and clearances during contingency and emergency situations will also improve. Additionally, ADS-B information will be available to better detect, report, and investigate aviation occurrences, improving Safety Management System processes.

3.7 Improved ATS in oceanic areas will allow for a more seamless transition to domestic areas. It is possible this new technology could support Air Traffic Flow Management (ATFM) sequencing much earlier in the flight, thereby allowing for increased efficiency and predictability. The availability of more timely and reliable information prior to arrival supports the evolving System Wide Information Management (SWIM) concept, allowing for information and effective collaborative decision making much earlier than in today's operational environment.

3.8 The LEOS benefits assessment included an assumption that RLongSM and RLatSM would have already been implemented, in accordance with the current plans endorsed by the North Atlantic Systems Planning Group (NAT SPG). The analysis estimated the effects if a 15 NM longitudinal separation minimum and a 30 NM lateral separation minimum could be applied between applicable aircraft, using ADS-B. Scenarios using the NAT OTS traffic from June 2012, with some adjustments to account for expected fleet changes, were run on NAV CANADA's Total Airspace and Airport Modeller (TAAM) fast time simulation tool in order to estimate possible fuel savings. Wind forecasts from the National Oceanic and Atmospheric Administration (NOAA) were used to provide the wind effects. The scenarios assumed that by 2018 all aircraft would be data link capable and that 90% of them would be equipped with ADS B. 600 flights were simulated.

3.9 A conservative estimated fuel savings per ADS-B equipped flight was 450 litres (855 pounds (imperial)). It should be noted this estimated savings was for the oceanic portion only, although it could be expected that some benefits would accrue outside this airspace. It was estimated that, over a year, at least 282,000 flights could benefit from LEOS ADS-B, with a potential fuel savings of 127 million litres (more than 240 million pounds).

3.10 A high level assessment was made of the potential benefits from implementing LEOS ADS-B in 8 oceanic areas; for comparison purposes, the Gander and Shanwick OCAs were included as one of the areas. This assessment estimated fuel savings accruing from up to 3 climbs per flight being accommodated. Such an operational improvement was viewed as achievable and also conservative. This assessment estimated total fuel savings in 2018 of approximately 439 million dollars (Canadian) and a concomitant savings of more than 1 million tonnes of CO₂ emissions.

3.11 ADS-B has been identified as a key component of a number of Aviation System Block Upgrades (ASBU) Modules related to improvements which could arise from enhanced ATS surveillance:

<i>B0-ASUR</i> (formerly B0-84)	Initial Capability for Ground Surveillance
<i>B0-SURF</i> (formerly B0-75)	Safety and Efficiency of Surface Operations (A-SMGCS Level 1-2)
<i>B0-FRTO</i> (formerly B0-10)	Improved Operations through Enhanced En-Route Trajectories

3.12 LEOS ADS-B is a game changer, providing for the possibility of global ADS-B coverage. The technology and the potential improvements fit with the planned evolution of the global air navigation system as foreseen in ICAO's updated Global Air Navigation Plan and the Next Generation Air Transportation System (NextGen) and Single European Sky ATM Research Programme (SESAR) initiatives. The possible Air Traffic Management (ATM) improvements could result in significant fuel saving leading to associated reductions in greenhouse gas emissions. LEOS ADS-B would provide for a cost effective alternative to replacing or expanding ground based ADS-B infrastructure. Expanded ATS surveillance coverage will support improved ATFM and better integration between oceanic and domestic traffic flows.