

To: The Honourable Marc Garneau, Minister of Transport, Canada

Re: ADS-B Standards for General Aviation Aircraft

I am writing on behalf of a large group of concerned pilots and engineers concerned with the current plans for the mandating of Nav Canada's version of ADS-B to General Aviation (GA) by 2023 in certain airspace classes. Although the satellite-based Aireon surveillance system has the potential to provide great world-wide coverage for commercial traffic, Aireon is NOT a complete and safe solution for Canada. It is also incompatible with much of the FAA system for GA as it potentially restricts a large body of FAA-approved 978 MHz UAT ADS-B aircraft from entering Canadian airspace.

Safety is the primary concern for pilots and Transport Canada alike, but as of this date, Transport Canada has not acted on the recommendations of the TSB from the 2017 and 2018 mid-air collisions near airports with surveillance radar. In particular, the St. Hubert, Quebec^[2] and Carp, Ontario^[3] incidents, each of which resulted in the death of a pilot. The presence of control zones and radar surveillance had little to no impact on the outcome of these events leading the TSB to recommend:

"The Board is concerned that, until technological solutions such as on-board collision-protection systems are mandated, a significant risk of collision between VFR aircraft will continue to exist in congested, high-density airspace areas in Canada."

"The Board notes that the risk of collision will increase as this traffic continues to grow, and see-and-avoid remains the primary means of defence."

"In addition, the Board recognizes that technological innovation is creating potential solutions that are both viable and economical."

"A meaningful improvement to the ability to see-and-avoid other VFR aircraft requires a practicable, affordable method of alerting pilots to the proximity of conflicting traffic."

"The Board appreciates that Transport Canada must examine all potential solutions before it can decide how to best recommend or mandate the adoption of one or more systems".

"On this basis, the Board requests that Transport Canada take a lead role, in cooperation with industry, in examining technological solutions, with the eventual aim of broad-scale adoption."

"As VFR traffic increases, additional lines of defence should be considered to reduce the risk of a mid-air collision. These lines of defence could include: changes in airspace classification, increased air traffic control (ATC) intervention, as well as ground-based and on-board technology."^[2]

But, the technology already exists to greatly reduce the number and severity of aviation accidents in the GA community. While ADS-B is at the core of this solution, a broader approach to the implementation and application of this technology needs to be considered against Nav Canada's narrow view of ADS-B. It is also not Nav Canada's responsibility to control safety enhancements beyond the Air Navigation Service (ANS).

ADS-B, in Nav Canada's narrow view is only an output signal from aircraft providing ATC with flight parameters for each aircraft they monitor. They only consider the ICAO-standard 1090ES ADS-B OUT requirement and leave the entire GA fleet without the added safety and enhancements the US enjoys. Over a decade ago, the FAA realized the limitations of legacy 1090 MHz systems bandwidth and implemented a new UAT system on 978 MHz to provide Flight Information Services Broadcast (FIS-B) and allow lower power, more economical solutions. As of December 1st, up to 79,214 ^[1] GA fixed wing ADS-B installations from the US would not be compatible with the proposed requirements here in Canada. The FAA ground-based system favours bottom-mounted antennas on aircraft, while Nav Canada's proposed requirement for antenna diversity is expensive and unnecessary for GA aircraft, especially given that the Aireon requirement only specifies top-mounted antennas. Why is Nav Canada requiring a top and bottom mount antenna?

Aireon requirement...<https://aireon.com/resources/technical-overview/>

"The Antenna

*In order to ensure reliable satellite reception, an A1 class transmitter and **top mount aircraft antenna** (commonly found on most commercial aircraft and private jets), is required due to the space-based nature of Aireon's receivers. Aircraft with a Traffic Alert and Collision Avoidance System (TCAS) to help prevent midair collisions are typically equipped with both top and bottom mount antennas."* (Note: A1 class transmitter is 125W at the antenna.)

Clearly, an ADS-B ground component is needed in the Nav Canada philosophy which could unlock the safety features of ADS-B for all of us. Further, contrary to the implication, 978UAT is as much an international standard under ICAO as is 1090ES. ^[7] Why are we not using the expanded capabilities of 978UAT in addition to 1090ES?

Ironically, simply moving the 1090ES transponder antenna to the top of the airframe from the bottom, can meet the technical requirement for signal levels into Aireon, but it can also work with ground ADS-B and radar services, as long as horizontal obstructions on the airframe are avoided. ^[6]

However, moving the antenna does not solve the problem of all of the FAA ADS-B qualified aircraft with bottom mount antennae and 978UAT. The current US GA ADS-B fleet is expected to grow to 132,000 as installs continue into 2020. Some 20%, or 26,400 of those aircraft are expected to have 978UAT along with an existing conventional transponder. There are also many Canadians with aircraft that are utilizing UAT, mostly for VFR looking for an economical safety solution. (This includes my own aircraft.) An accommodation is needed for these US and Canadian GA aircraft as they share the skies and the borders. We in Canada are in a unique position separating Alaska from the lower 48 States. There is potential for serious interactions with Canadian airspace. A harmonized approach is needed to work beyond the limitations of an Aireon-only system.

The FAA has a network of Ground-based Transceivers (GBT) to detect ADS-B targets on both frequencies for the ATC surveillance system. Traditional radars are also well integrated into the surveillance mix at strategic Class B & C terminal locations. The GBTs receive and retransmit targets to ensure that all traffic

are aware of one another in areas where these can mix. Radar tracked targets are also sent (TIS-B) to complete the surveillance picture for all aircraft with ADS-B IN, either 1090ES or 978UAT. **Aireon does not and cannot provide this level of traffic awareness for pilots.**

In April of 2019, the American Owners and Pilots Association (AOPA) published a summary of the accident rate reduction observed over the years from 2013 to 2017 for ADS-B equipped aircraft. ^[4]

*“A study that examined the effect of Automatic Dependent Surveillance-Broadcast (ADS-B) In on general aviation and air taxi accident rates found a significant reduction in the likelihood of an accident, which decreased by 53 percent, for aircraft equipped with ADS-B In. It also found that **the likelihood of a fatal accident decreased by 89 percent for aircraft using ADS-B In.**”^[5]*

These observations are significant and clearly show a substantial correlation with the investment that the FAA has made in ADS-B infrastructure. In contrast, Nav Canada has admitted that their ADS-B out solution (Aireon) alone will NOT have a significant impact on aviation safety because it is surveillance only. To compound matters, Nav Canada’s business approach has left GA under a veil of indifference. Business decisions have led to the reduction of ground based navigation aids not needed by the airlines and the removal of ground based radar not needed for their model of the ANS, further affecting GA safety negatively. The fees that we paid into Nav Canada were invested into a US corporation (at least \$150M ^[9]) rather than Canadian infrastructure. This path was probably not the intention of the Canadian Government in 1996 when Nav Canada was created.

In Canada, we have a network of Remote Communication Outlets (RCO) that cover strategic parts of the country for VHF communications, ATC clearances and Flight Service Stations for in-flight information. This is a legacy system handed over in 1996 by Transport Canada but logically must survive to provide ATC clearances either by VHF voice or data (CPDLC) in these remote locations. Why are these sites not being considered for providing electronic in-flight weather (FIS-B) services to Canadian pilots? The coverage would not be as extensive as in the USA but it would provide a significant safety improvement by enabling situational weather awareness. In conversations with Nav Canada we have been told that they have no such requirement to provide these services. ^[10] This narrow vision of purpose creates a real safety concern for Canadian pilots.

The current lack of standards for ADS-B safety growth in Canada has led to a few diversions. Like radar, Aireon is only a surveillance system, not providing the proven safety features of the FAA system. The lack of a compatible ADS-B regulation path in Canada has led to confusion of pilots/owners not knowing what equipment to install to get a higher level of safety. As a result, parallel standards and fleet tracking tools have popped up causing further confusion. For example, the use of FLARM and NemoScout has led to erosion of a standards-based solution. Range, capabilities, and compatibility suffer as a result. There are a lot of FLARM-equipped gliders in Southern Ontario but they cannot be seen directly on 1090ES ADS-B systems. NemoScout is another low power system meant for fleet tracking but it does not talk to either 1090ES or 978UAT systems. Low cost, reliable standardized technology is the key here and 978UAT may be the best answer to the problem when applied in conjunction with 1090ES ADS-B. The 978UAT and 1090ES frequencies are the only standards recognized by ICAO for civil aviation use.

Nav Canada and COPA (National) have been promoting Aireon to ultimately replace Emergency Locator Transmitters (ELT). But, Aireon satellite surveillance performs differently, it tracks aircraft in flight while the ELT is optimized to identify and locate a crash site. The ALERT service offered by Aireon will only track aircraft that have the compliant transponder and top mount antenna, to a possible crash site nearby. The ELT, required by ICAO, already in almost every Canadian aircraft, has the task of automatically or manually activating to SARTSAT and provide a VHF homing signal. The Aireon approach could work to speculate a crash situation, but it is expensive (at least \$8000) versus the existing ELT (new \$1500). The SARTSAT network already exists to support ELT operations. However, the ELT has one weak point in that the ELT system does not always work in a crash. The TSB has identified a recurring theme in their reports and actioned Transport a number of times to solve the problem. For example:

TSB Recommendation A16-05 *"The Department of Transport establish rigorous emergency locator transmitter (ELT) **system crash survivability** requirements that reduce the likelihood that **an ELT system will be rendered inoperative** as a result of impact forces sustained during an aviation occurrence."*

The older 121.5 MHz (only) ELTs were part of the problem. The newer, more robust 406 ELTs have a much better chance of surviving a crash, but the ELT transmitting antennae systems do often become disconnected. This would appear to be an installation problem and not an equipment issue. Guidance is needed by Transport to define crash resistant installation requirements and not to replace the ELT system. Regardless, avoiding the accident in the first place is the better idea. Situational awareness is the key to avoid terrain and in-flight services to avoid weather, and not simply ATC surveillance with Aireon.

The GNSS network (GPS) can easily be compromised as proven by the number of NOTAMs declaring outages. A large scale cyber-attack will break the integrity of ADS-B as each aircraft position is lost. This is where ground radar is needed for surveillance. Target positions are dependent upon well understood accuracies related to antenna resolution and aircraft barometric sensors, independent of GNSS. The update rate suffers, typically 5 seconds, but at least the data routing is direct as opposed to being bounced around a satellite and ground data network. With several Primary Service Radar (PSR) and Secondary Service Radar (SSR) sites being decommissioned, GA is losing another layer of safety.^[7] Unlike commercial airliners, most GA aircraft do not have on-board weather radar systems and require vectoring around weather by ATC. As an affordable option, ground-based ADS-B stations could provide this valuable FIS-B weather and NOTAMS. Ground radars, including PSRs must be brought up to date with weather capability and not turned off as proposed in the current Nav Canada proposals. Again, aviation safety should drive needed changes ahead of strictly the cost of business.

Believing that ADS-B is still the answer to aviation safety improvements, a number of us have been involved in the implementation of an ADS-B ground station at the Stratford airport (CYSA) in southern Ontario. The purpose is to transmit airport weather data and NOTAMs, while monitoring ADS-B traffic for the advisory Unicom. This is being done with the knowledge of Nav Canada who actually offered weather data for the trial. The project, based upon the station trials in the UK by avionics supplier uAvionix, is only partially completed due to a negative reaction of Transport Canada and COPA to using

978UAT. This reaction is discouraging and counterproductive. Regardless, we have integrated an ADS-B 1090ES/UAT978 receiver onto a radar-like display without help. We are also in the process of acquiring a weather station that produces METAR formatted data for transmission for in-flight weather. Also, negotiations have continued with Industry Canada to work with the FAA to determine a time slot and power level to reduce interference with the existing UAT/FIS-B US network. A 1 W transmitter could give up to a 25 nm range on 978UAT and avoid long range interference. We are calling this “xASOS” for inexpensive Airport Surface Observation System. There is also a low cost traffic ADS-B out component on 978UAT for traffic avoidance and fleet tracking that does not interfere with the installed transponders, keeping the cost and complexity down for the emerging aviation training sector.

The ADS-B display system was offered for trials at the Waterloo Tower (CYKF) but months later, Nav Canada management still has not responded to the proposal, in spite of the fact that it has the potential to enhance safety and situational awareness in the Waterloo Control Zone. Additionally, this could be a safe point of entry for US aircraft not equipped with Aireon-compatible ADS-B, providing at least a rudimentary level of harmonization with the US.

The current path Nav Canada is on will further erode safety for GA in Canada. Aireon is great for airliners and business GA aircraft, but most of the fleet is being negatively impacted by Nav Canada’s indifference towards GA. Given that GA is the breeding ground for tomorrow’s airline pilots and has been the primary source of commercial pilots for decades, it is hard to understand Nav Canada’s attitude toward the needs of GA.

Recommendations:

A multi-faceted approach is needed, consisting of local ground-based ADS-B using both 1090ES and 978UAT formats providing FIS-B in-flight data to meet the needs of GA pilots and provide much needed redundancy for ATC. As such, I make the following recommendations:

- 1) **Create a collaborative safety system with representation from the GA community to implement TSB recommendations in the GA community** studying;
 - a. ELT installation and technology issues that could lead to better crash integrity
 - b. ADS-B systems, including potential ground-based 1090ES and 978UAT equipment
 - c. Decommissioning of ground-based navigation aids and possible alternatives
 - d. Ways to improve situational awareness for pilots such as in-cockpit weather and traffic
 - e. Related issues like harmonization with US and possible impacts of GNSS cyber-attacks
- 2) **Transport Canada should look beyond Nav Canada’s narrow vision of ADS-B (ATC use only) to consider the true potential of ADS-B in making aviation safer through situational awareness** by;
 - a. Reviewing the benefits for ADS-B in aircraft, studying its true potential and considering the results of FAA studies on the effect of ADS-B in improving aviation safety
 - b. Considering ground-based ADS-B stations at Nav Canada’s FSS, RCO and present enroute navigation sites to provide in-flight weather and traffic on 978UAT. Aireon cannot do this! It has no downlink to aircraft
 - c. Implementing TIS-B in terminal areas

- d. Encouraging small airport operators to implement low-power ADS-B ground stations to provide weather and local advisories and monitor ADS-B traffic at their UNICOMs. Ground vehicles could also be equipped with low-cost UAT transponders to reduce runway incursions and conflicts with aircraft
- e. Providing incentives to pilots and owners to implement ADS-B (In and Out) systems in their GA aircraft including the provision of free FIS-B weather products in-flight
- f. Considering how a multi-faceted approach to ADS-B including both 1090ES through Aireon and 978UAT using ground stations to provide enhanced awareness of traffic and weather to the entire aviation community, redundancy to Aireon, an extra level of security and protection in the event of a cyber-attack, a way for GA operators to equip with less costly UAT-based ADS-B equipment, reduced maintenance costs for GA operators, and it would eliminate the need for very costly diversity equipment in aircraft below FL180

Summary:

Nav Canada intends to execute ADS-B regulations for General Aviation (GA) by 2023 in certain airspace classes. Although the satellite-based Aireon surveillance system has the potential to provide great world-wide coverage for commercial traffic, Aireon is NOT a complete and safe solution for Canada.

A complete solution would use a multi-faceted approach to ADS-B including both 1090ES through Aireon and 978UAT through ground stations to provide:

- **Enhanced Awareness** of traffic and weather to the entire aviation community while addressing the primary concerns of the TSB in several recent aviation accidents involving GA.
- **Harmonization with US** airspace and the safe transit of the significant amount of FAA qualified ADS-B aircraft.
- **Safety Infrastructure** to all parts of the country and all General Aviation as part of a national unity strategy.

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- Member of the RAA (8836), VP KW RAA,
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- Owner of an experimental aircraft (C-GJIB) with ADS-B IN and OUT(UAT).
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