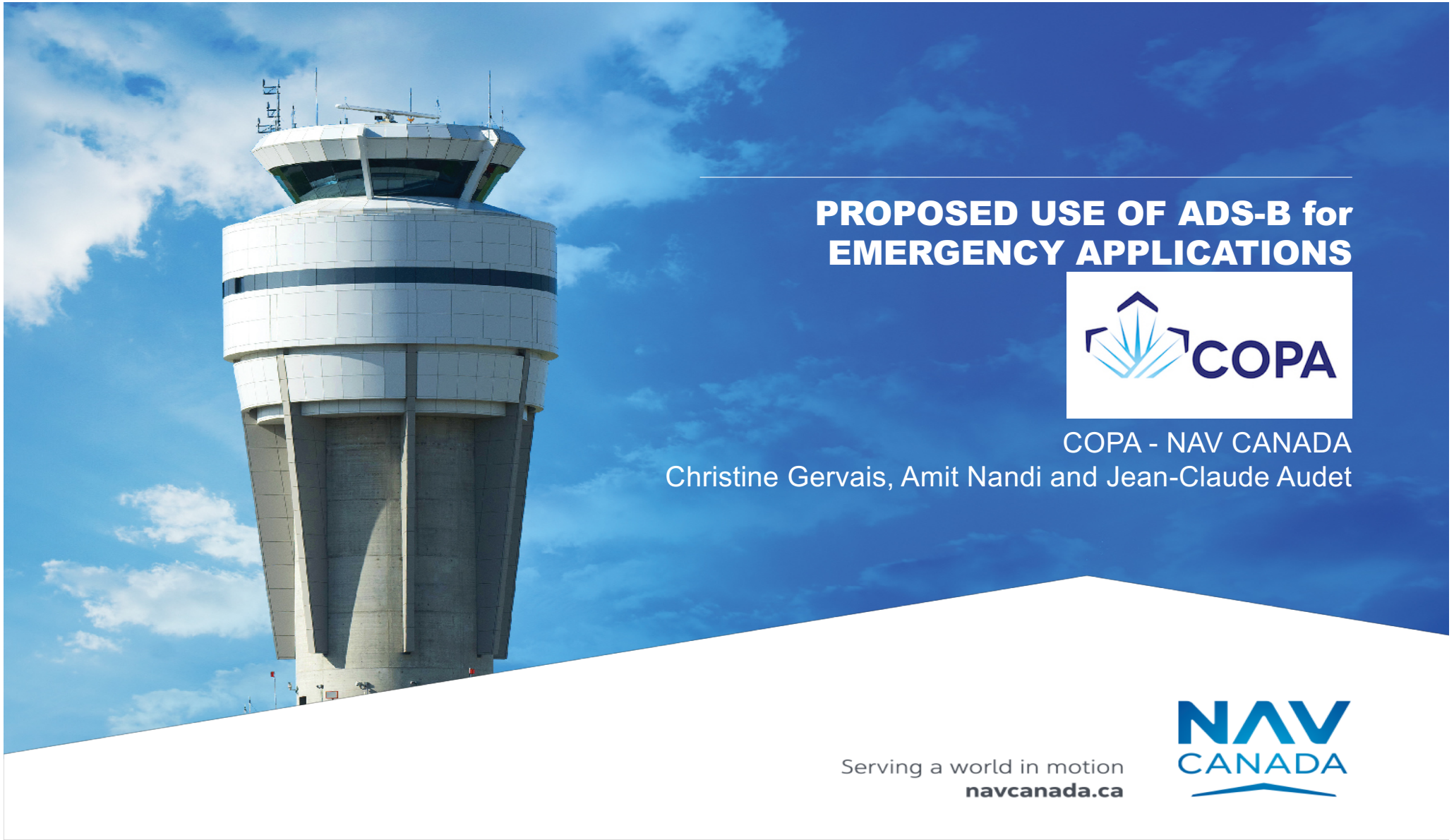

PROPOSED USE OF ADS-B for EMERGENCY APPLICATIONS

COPA - NAV CANADA
Christine Gervais, Amit Nandi and Jean-Claude Audet

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navcanada.ca

Helicopter pilot and passenger died after crash

CBC News · Posted: Dec 09, 2005 5:54 AM ET | Last Updated: December 9, 2005

The two men killed in Wednesday's crash of a Canadian Coast Guard helicopter off Newfoundland's Burin Peninsula died of drowning or hypothermia, said a coroner's report.

Pilot Gord Simmons, 65, and technician Carl Neal, 46, died after the aircraft crashed into the Atlantic Ocean near Marystown late Wednesday afternoon.

The office of Newfoundland and Labrador's chief medical examiner said Friday that autopsy examinations show "both individuals died as a result of post-impact events, either by drowning or hypothermia."

http://www.cbc.ca/news/canada/helicopter-pilot-and-passenger-died-after-crash-1.544515

CONTENTS

ICAO DEFINITION OF ELT

- Equipment which broadcasts distinctive signals on designated frequencies and, depending on application, may be automatically activated by impact or be manually activated. An ELT may take any of the following forms:
- **Automatic fixed ELT (ELT(AF))**. An automatically activated ELT which is permanently attached to an aircraft.
- **Automatic portable ELT (ELT(AP))**. An automatically activated ELT which is rigidly attached to an aircraft but readily removable from the aircraft.
- **Automatic deployable ELT (ELT(AD))**. An ELT which is rigidly attached to an aircraft and which is automatically deployed and activated by impact, and, in some cases, also by hydrostatic sensors. Manual deployment capability is also provided.
- **Survival ELT (ELT(S))**. An ELT which is removable from an aircraft, stowed so as to facilitate its ready use in an emergency, and manually activated by survivors.

ICAO SARPS

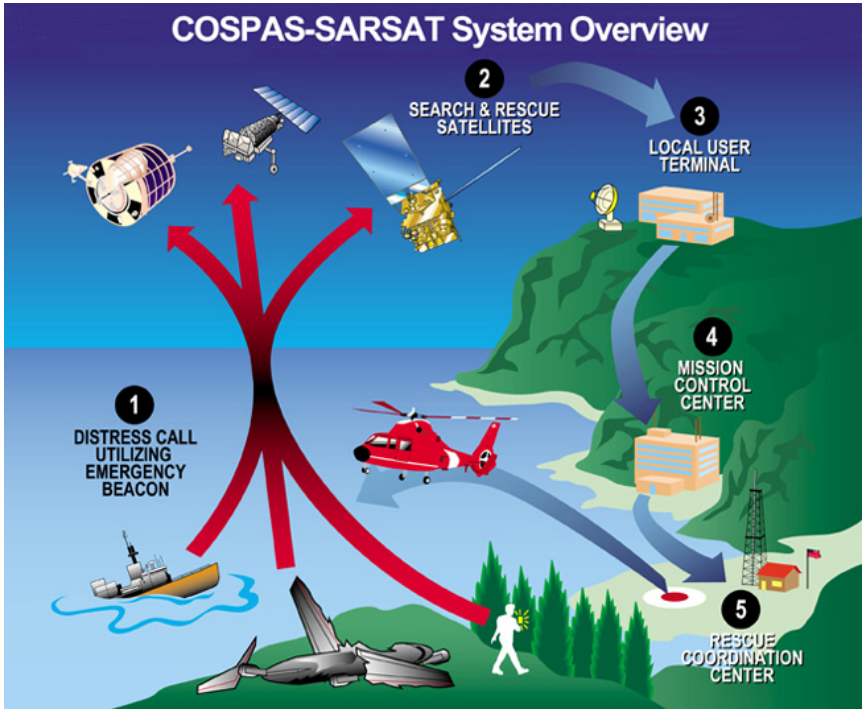
- ICAO Annex 10, Volume V requires that ELTs carried in compliance with the Standards of Annex 6, Parts I, II and III shall operate on both 406 MHz and 121.5 MHz. Although the SAR satellite systems are no longer able to use 121.5 MHz signals, this frequency is considered necessary to allow homing.
- All ELTs capable of transmitting on 406 MHz must be coded in accordance with ICAO Annex 10 and registered with the national agency responsible for initiating Search and Rescue or another nominated agency.
- In ICAO Annex 6, Part IIA, a Recommendation is made that all aeroplanes operated on extended flights over water and when operated on flights over designated land areas shall be equipped with an automatic ELT. There is an identical Recommendation in respect of certain Classes of helicopter when conducting overwater operations.

DESCRIPTION

A suitably configured ELT is an integral component of the international satellite system for search and rescue (SAR) see COSPAS-SARSAT. When activated manually - or automatically by immersion in water or as a result of high ‘g’ forces on impact - ELTs transmit a distress signal which can be detected by non-geostationary satellites and then located precisely by either or both of GPS trilateration and doppler triangulation.

COSPAS-SARSAT SYSTEM OVERVIEW

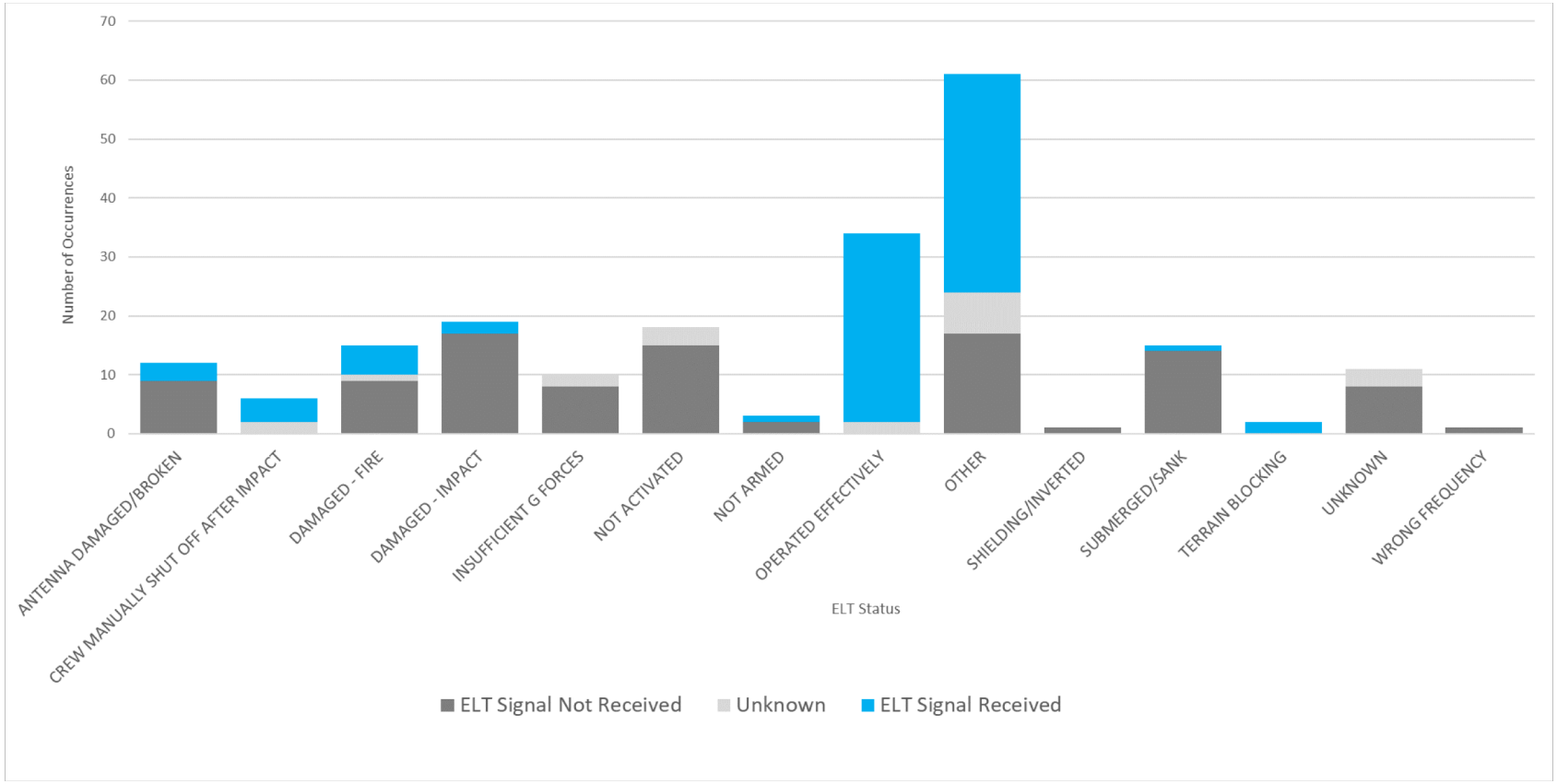
1. Emergency beacon activated
2. Alerts received by satellites are retransmitted to 38 automatic LUT worldwide
3. Alerts are routed to a mission control centre in the country that operates the LUTs
4. After validation processing alerts are relayed depending on beacon location or country of registration (406 beacons) to either another MCC or to the appropriate Rescue Coordination Centre (JRCC)



ELT LIMITATIONS

- A recent study conducted by the Canadian Mission Control Centre for SARSAT indicated that ELTs activate in only 62% of Canadian aircraft accidents where the aircraft sustained substantial damage.
- Studies conducted by other agencies, such as the Australian Transport Safety Bureau (ATSB) and the National Aeronautics and Space Administration (NASA) indicate **similar ELT failure rates**

CANADIAN TSB AVIATION SAFETY DATA 2008-17

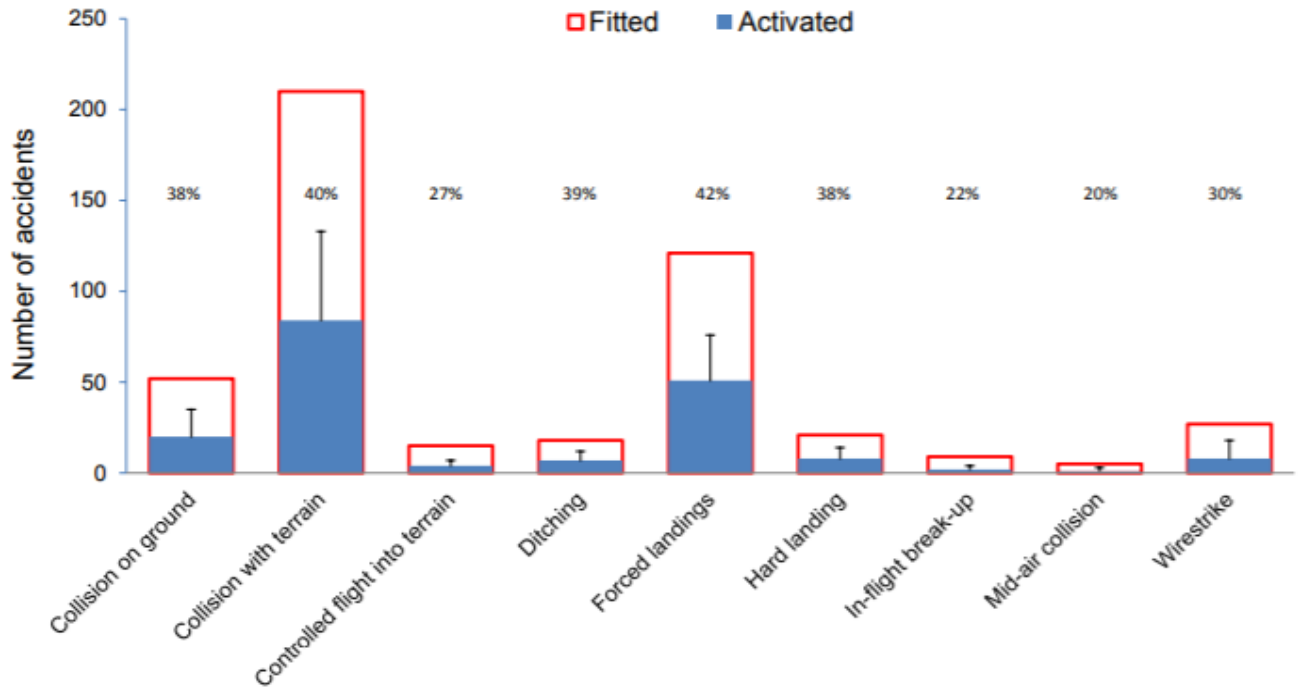


ELT SIGNAL NOT RECEIVED

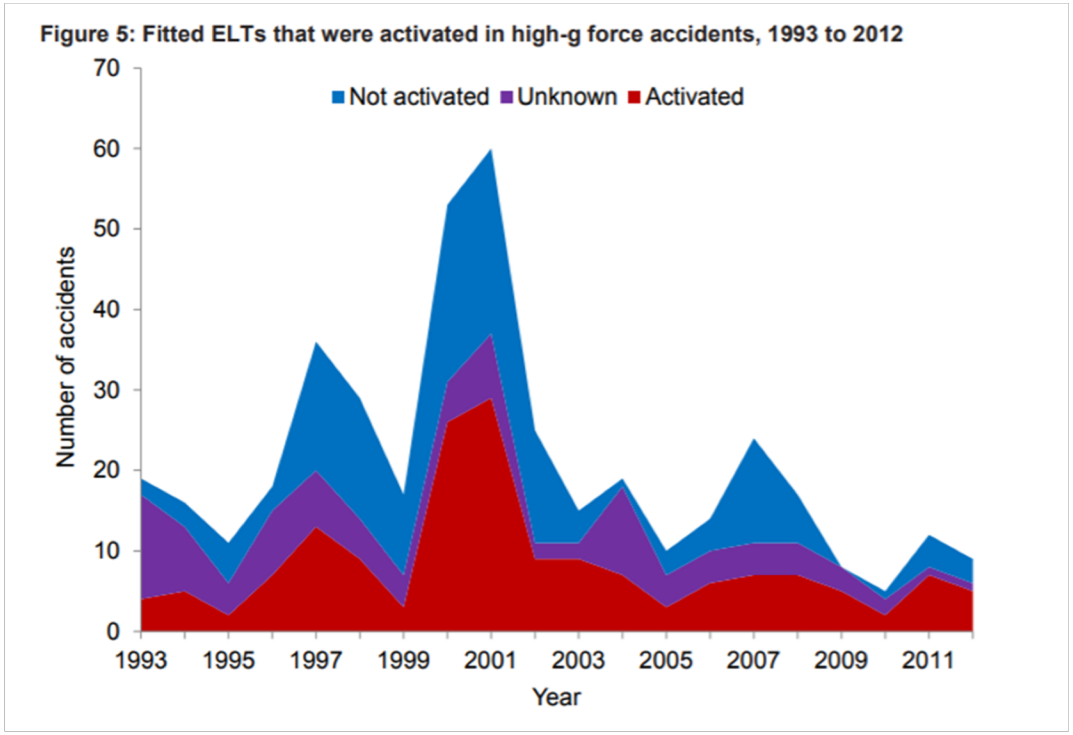
No ELT activation/signal	101
Fatal accidents	48
Total deaths	112
Accidents deemed survivable	16
Total deaths	47

AUSTRALIAN ELT REPORT

Figure 6: Number of fitted ELTs which activated for high g-force accidents by occurrence type, 1993 to 2012

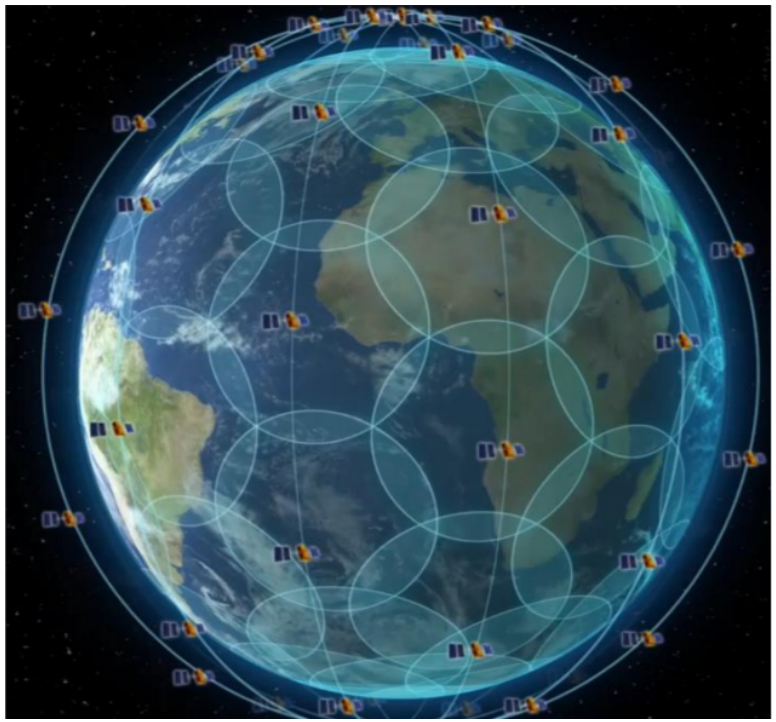


AUSTRALIA'S ELT ACTIVATIONS WITH HIGH G FORCE

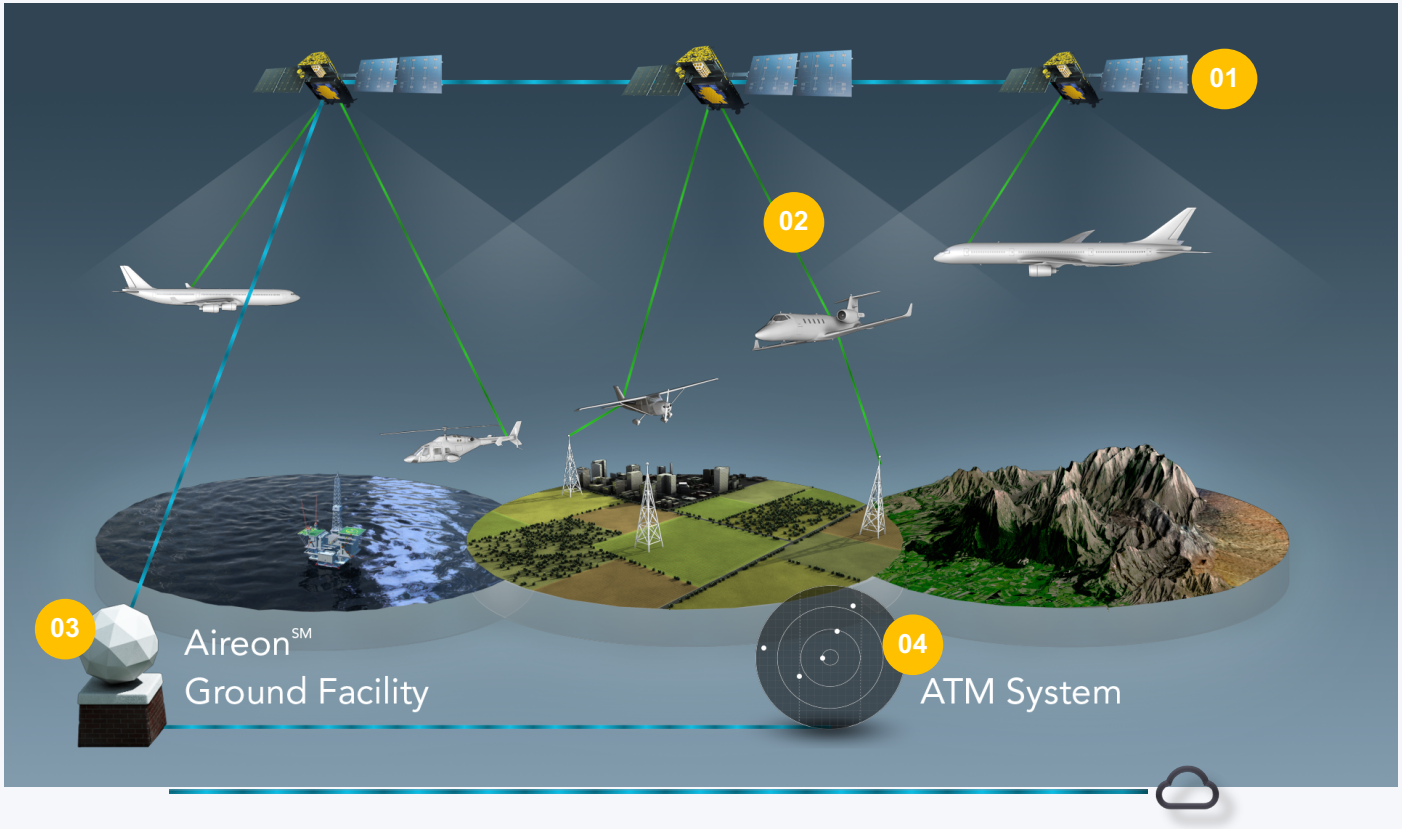


AIREON SYSTEM OVERVIEW

- Satellites in orbit: 66
  - 11 satellites per plane
  - Plus 9 in-orbit spare satellites and 6 ground spare satellites
- Orbital Planes: 6
- Operational altitude: 780 km
- **Availability: ≥ 0.999**
- Latency ≤ 2s\
- 8s Update Interval ≥ 96%



How does it work?



Aireon will place ADS-B receivers on the Iridium NEXT constellation, which consists of 66 Low Earth Orbit (LEO) satellites.

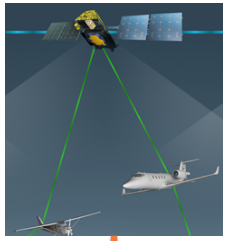
This space-based ADS-B receiver network will relay signals from all ADS-B equipped aircraft to controllers worldwide, allowing **100 percent global air traffic surveillance regardless of terrain, location or infrastructure.**

The surveillance data is relayed directly to the Air Navigation Service Provider (ANSP) in order to manage the air traffic.

The surveillance data is also being sent to Cloud computing resources for creating flights for the purposes of billing analysis.

Source: https://aireon.com/services/global-air-traffic-surveillance/

HOW THE SYSTEM WOULD WORK

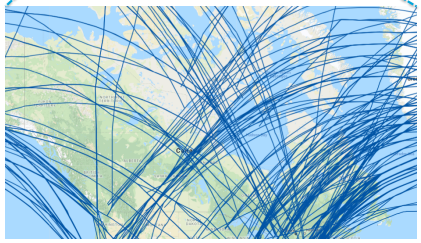


ADS-B traffic picked up by LEO satellites from aircraft

Aireon Processing and Distribution System

Data feed of ADS-B Traffic in Canada

Real-time analysis of traffic



Anomalous flight detected Canadian Mission Control Centre

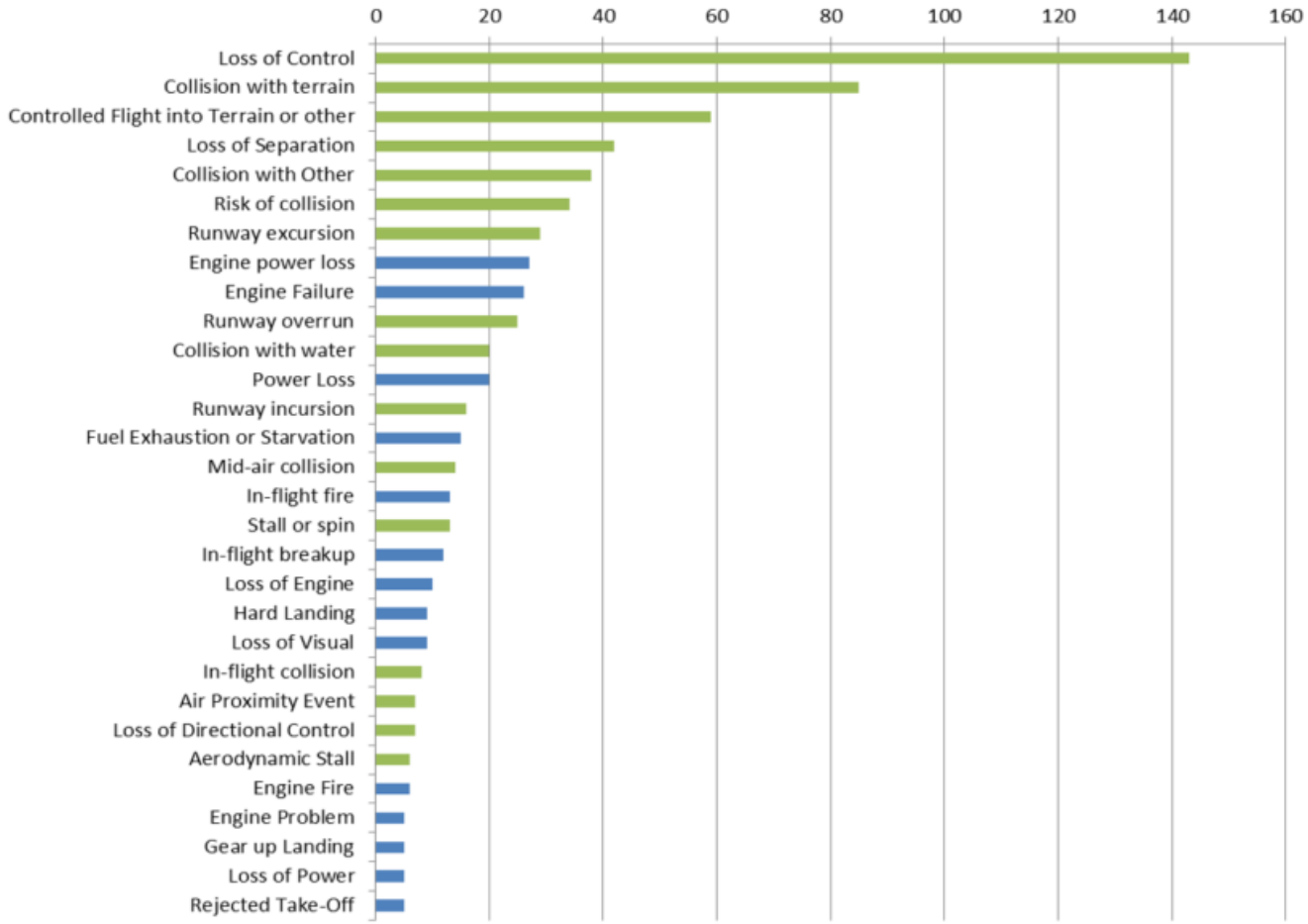
Mission Control Centre

NAV CANADA ATC

Regional Control Centre

Situation analyzed and SAR dispatched

TYPES OF INCIDENTS AND POTENTIAL APPLICABILITY



Incidents where ADS-B telemetry has the potential to detect the event

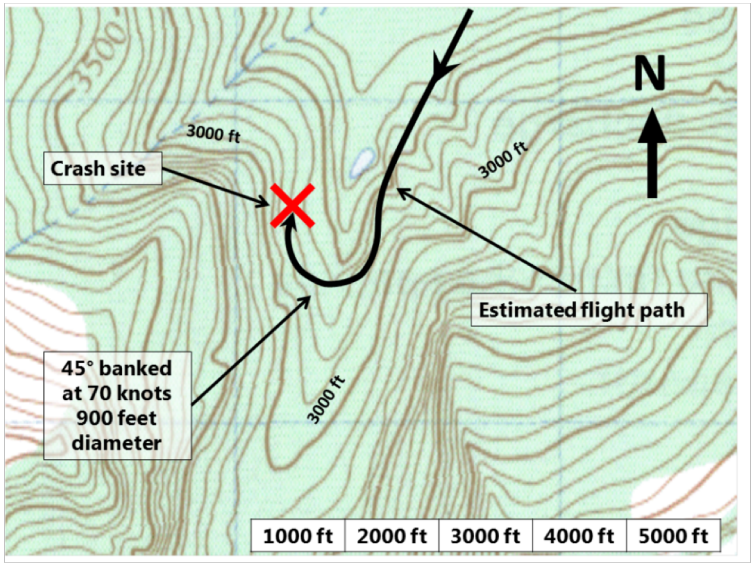
Incident categories that do not involve ELT activation

TYPES OF INCIDENTS AND DATA AVAILABLE AS INPUT

Type of Incident	Factors or Reference Data that can be input to automatically detect potential problems with flight
Loss of Control	• Sudden, unexpected, erratic manoeuvres
Collision with Terrain	• Last point far away from destination • High vertical speed prior to end of flight
Collision with water	• High vertical speed prior to end of flight • Last point is on water (not suitable for type)
All	• Aircraft type lookup based on ICAO code • Aerodrome locations

EXAMPLE 1: PILOT TRAINING FLIGHT

- Aircraft on flight itinerary from small aerodrome to training area
- Spins and stalls show anomalous flight behaviour within a designated training area



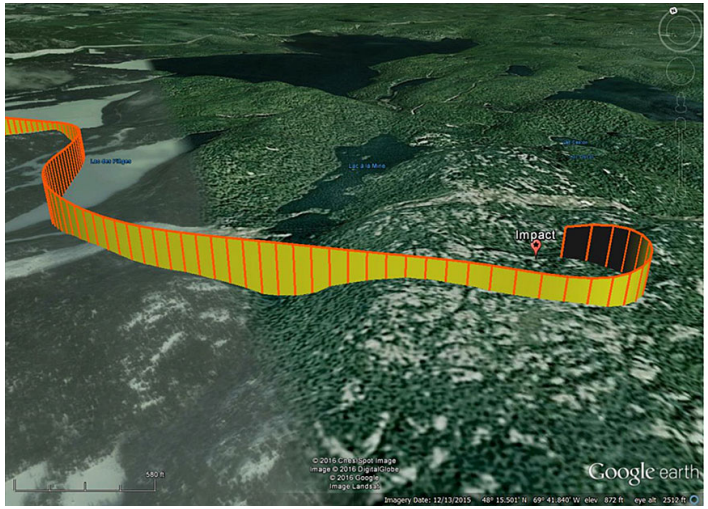
System operation:

- *A-LIVE system detects flight track ends considerable distance away from aerodrome of departure*
- *High vertical speed calculated near ground*
- *Airspeed was close to aerodynamic stall speed of aircraft*
- *Low/no airspeed and anomalous flight behavior prior to end of flight*
- *Sends alert continuously to CMCC*

Similar to: http://www.bst-tsb.gc.ca/eng/rapports-reports/aviation/2011/a11p0106/a11p0106.asp

EXAMPLE 2: SKI PLANE LANDING ON RIVER

- Ski plane attempts to land on icy river but could not stop its run.
- Pilot tried to avoid collision with camp, pulled up, ice gave way and aircraft sank.
- 3 occupants exited aircraft but since it was sinking, decided to swim to shore.
- One of the occupants went missing in the current. The pilot and the second passenger suffered hypothermia.
- The accident was reported by TC.
- No ELT activated, no flight plan.



System operation:

- *A-LIVE system detects abnormal manoeuvres just prior to end of flight.*
- *System detects abrupt decrease of airspeed for type of aircraft.*
- *System send alert continuously to CMCC.*

Similar to Cadors report 2016Q0718

EXAMPLE 3: HELICOPTER COLLISION WITH WATER

- Heavy snow showers.
- Helicopter crashed when the tail broke off after contacting the water during a rapid flare.
- Pilot and Passenger survived the water impact and escaped.
- The ELT on board sank and was not able to signal search and rescue (SAR).
- SAR efforts did not begin until one hour after the flight's planned ETA.
- The pilot perished from hypothermia, and the passenger drowned.

System operation:

- *LIVE system detects landing on water for type of aircraft not equipped to make water landings*
- *System sends alert continuously to CMCC*

TSB Final Report A05A0155-Collision with Water

Other Accidents and Incidents

- S76, vicinity Moosonee ON Canada, 2013 - The wreckage, which was near to the departure airport, was not located for over 5 hours after the ELT failed to function. The ELT failure was attributed to the tailboom-sited external antenna being severed.
- E190, en route, Bwabwata National Park Namibia, 2013 - No distress calls were made and no signal was transmitted from the ELT after the crash. This was found to be due to a break in the co-axial cable which linked the unit to the external antenna.
- B744, en-route, East China Sea, 2011 - The ELT was activated but its signal was not received and it was found that was of a type which was inoperative in water.
- B190, Blue River BC Canada, 2012 - The impact forces had not been enough for the ELT to be activated.
- MD83, en route, near Gossi Mali, 2014 - No signal was received from the ELT and it was found damaged at the crash site.
- C30J, en-route, northern Sweden 2012 - The ELT did not transmit and was found to have sustained major damage at impact.
- B788, London Heathrow UK, 2013 - The fire had been initiated by an uncontrolled and rapid discharge of stored energy from the 5-cell lithium-metal battery which powered the ELT.

CONCLUSION

- Space based ADS-B technology can deliver improved alerting services to Canadian general aviation community
- The new system could offer improved reliability in alerting SAR of accidents
- ADS-B technology has the potential to meet the intent of the ICAO ELT compliance mandate

RECOMMENDATION

- Support the establishment of a study group comprised of NAV CANADA, Transport Canada, DND and representatives from the GA community, such as COPA, with a mandate to further investigate the development of this concept and to present recommendations of the next steps by CPAAT 13