

Inmarsat GADSS Solutions

Global Aeronautical Distress and Safety System

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1. Introduction to GADSS

ICAO's concept for the Global Aeronautical Distress and Safety System (GADSS) addresses the following three areas of technological requirements: Global Flight Tracking, Autonomous Distress Tracking, and Flight Data Recovery.



Global Flight Tracking



Autonomous Distress Tracking



Flight Data Recovery

1.1. Global Flight Tracking

According to Amendment 39 to ICAO Annex 6, Operation of Aircraft, as of November 2018, airlines are required to obtain a four dimensional position report at least every 15 minutes with an accuracy of 1 NM or greater depending on the aircraft's navigation capability, for all aeroplanes with a Maximum Certified Take-Off Mass (MCTOM) of 27,000 kilograms and a seating capacity greater than 19.

- > Aircraft equipped with Inmarsat's Classic Aero satellite communications system are meeting ICAO's 15-minute flight tracking requirement today.
- > More than 95% of the world's transoceanic commercial air transport fleet are equipped with Inmarsat's Classic Aero system today.
- > A vast majority of these Classic Aero-equipped oceanic aircraft are reporting their positions at 14-minute intervals or faster today.

1.2. Autonomous Distress Tracking and Flight Data Recovery

Amendment 40 to ICAO Annex 6 provides the following requirements for Autonomous Distress Tracking and Flight Data Recovery:

- > All aeroplanes of a MCTOM of over 27,000 kilograms, for which the individual certificate of airworthiness is first issued on or after 1 January 2021, shall autonomously transmit information from which a position can be determined by the operator at least once every minute, when in distress.
- > All aeroplanes of a MCTOM of over 27,000 kilograms, for which the individual certificate of airworthiness is first issued on or after 1 January 2021, shall be equipped with a Cockpit Voice Recorder (CVR) capable of retaining the information recorded during at least the last 25 hours of operation.
- > All aeroplanes of a MCTOM of over 27,000 kilograms and authorized to carry more than 19 passengers, for which the application for type certification is submitted to a Contracting State on or after 1 January 2021, shall be equipped with a means approved by the State of the Operator to recover flight recorder data and make it available in a timely manner.

Inmarsat's SwiftBroadband-Safety (SB-S) system with prioritised IP and a built-in tracking capability, is designed to securely and affordably support all GADSS requirements, while providing operators with the flexibility to meet the requirements according to their operational needs. SB-S has been flying

operationally since June 2015. It is available for initial retrofit installation on existing aircraft today and is scheduled to become a standard option on new aircraft deliveries from 2018.

2. Inmarsat Aviation

Inmarsat has been providing aeronautical operational satellite services for over 25 years through its Classic Aero network. Today 95% of the global oceanic wide-body commercial transport fleet and over 11,600 aircraft receive Classic Aero communications and surveillance services. Inmarsat is carrying its legacy of operational and safety-of-life services into the future with its SB-S network and by investing in a new I-6 satellite constellation.

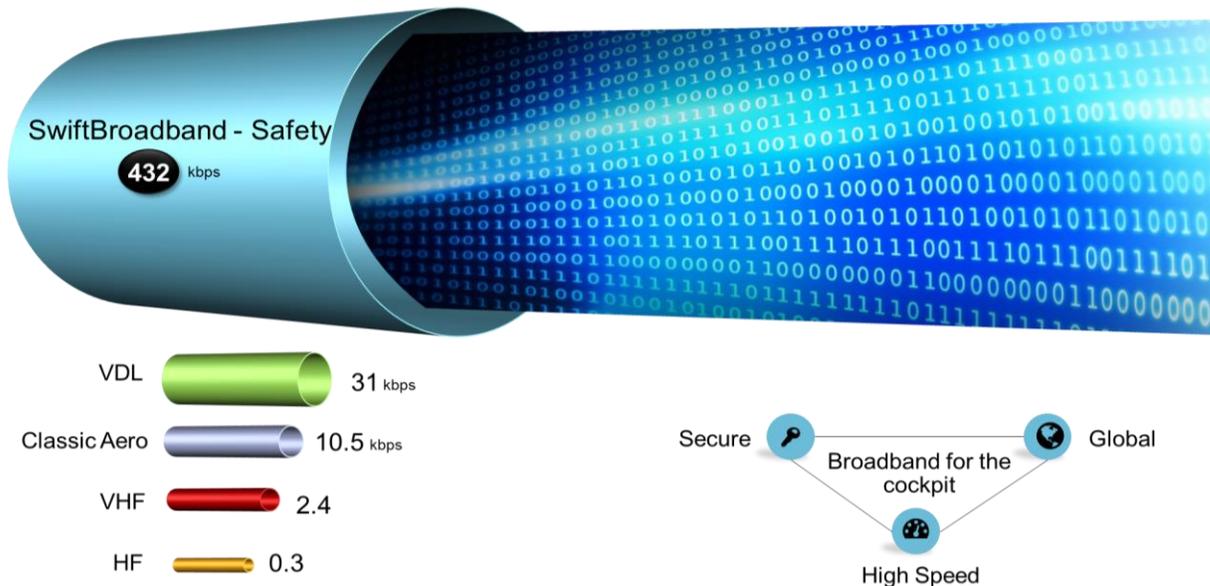
3. Inmarsat GADSS Solutions

3.1. Today – Flight Tracking with Classic Aero

Today, Inmarsat’s Classic Aero system provides the capability for 15-minute interval, 4D tracking. In fact, following completion of a successful Airservices Australia Enhanced Flight Tracking Evaluation, which demonstrated 14-minute interval flight tracking across two Flight Information Regions (FIR) using Classic Aero Automatic Dependent Surveillance (ADS-C) reports, the majority of Pacific Oceanic Air Navigation Service Providers (ANSP) adopted 14-minute ADS-C position reporting intervals, with some airlines and ANSPs routinely tracking at even faster intervals. Additionally, the Classic Aero system is able to support localised use of 64-second ADS-C position reporting intervals, initiated either manually by the pilot, by authorized ground personnel, or automatically in response to ACARS messages as specified by the operator.

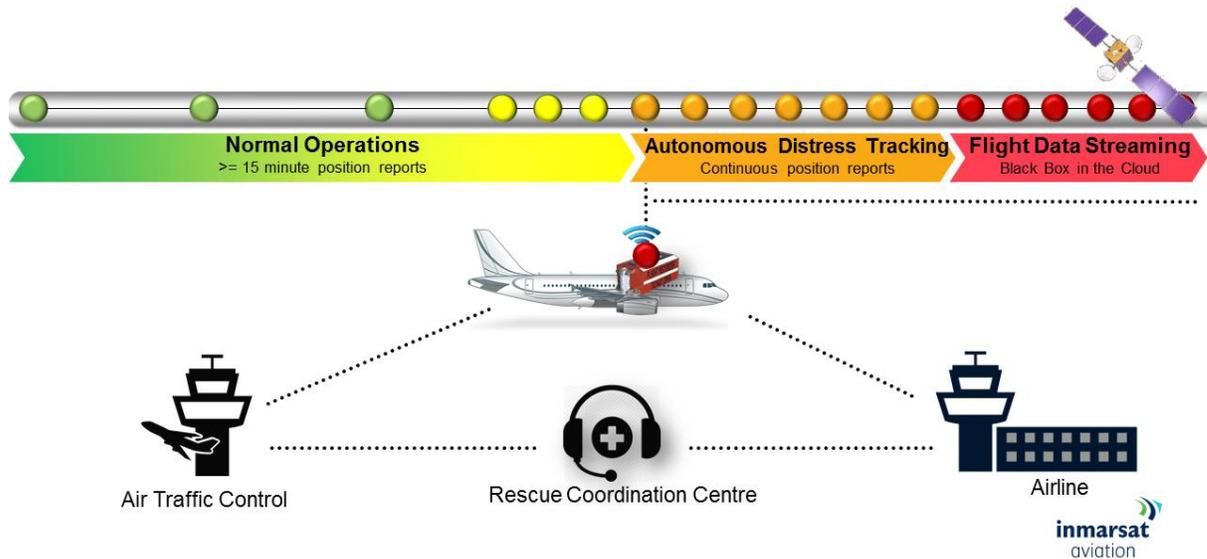
3.2. 2018 – Comprehensive GADSS Solutions with SwiftBroadband-Safety

Inmarsat is building upon the success of its Classic Aero system with its next generation satellite communications system: SwiftBroadband-Safety (SB-S). SB-S, with prioritised IP, provides a secure, flexible, high-capacity solution for future satellite communications applications.



3.3. Flight Tracking

SB-S provides a demonstrated capability for continuous, ADS-C 4D position reporting, at interval rates up to 10 seconds. Additionally, SB-S terminals include a built-in tracking function that may be used to meet GADSS flight tracking requirements outside of ACARS. The SB-S high-interval reporting capability will, ultimately, support reduced separation minima for oceanic areas.



SB-S is currently undergoing operational evaluation by the FAA Performance-based Rulemaking Committee (PARC) Communications Working Group (CWG) against ICAO GOLD required performance standards for surveillance (RSP180) and communication (RCP240).

3.4. GADSS Alternative Flight Data Recovery

The ICAO GADSS Concept of Operations provides a recommendation for Flight Data Recovery, including both cockpit voice recorder (CVR) and flight data recorder (FDR) information, which aims to assist accident investigators to obtain timely flight recorder information and help locate the aircraft wreckage.

While flight data recorders (Black Boxes) have proven reliable, there have been instances with flights lost over the ocean, where the search for recorders has been very long, flight data has never been recovered, or data was lost due to damage from exposure to severe fire or underwater conditions.

Flight data streaming, prior to an accident, will aid in recovering CVR and FDR data quickly, before a search has begun. Rapid access to flight data will assist investigators in locating physical wreckage, and it will enable near real-time trend analysis on the ground that could potentially allow early detection and mitigation of factors that might lead to an accident.

3.5. SB-S Flight Data Streaming

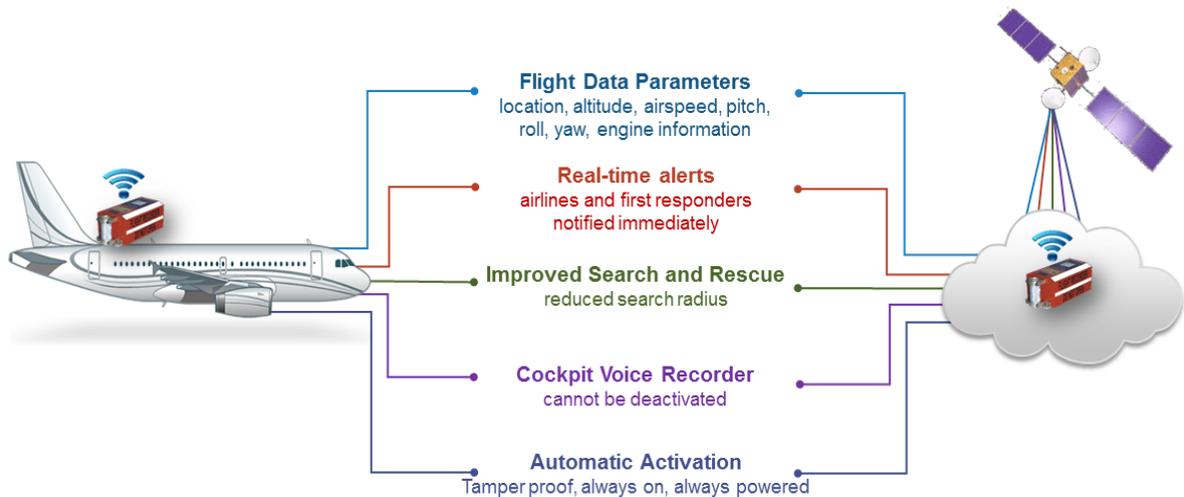
With a demonstrated capacity of up to 1.7 MB per second, SBS with a prioritised IP connection can stream vast quantities of data from complex modern aircraft, providing the high-speed, secure platform necessary to meet aviation flight data streaming needs.

Inmarsat will partner with an experienced application manufacturer to implement an interface device between the SB-S satellite data unit on the aircraft and the relevant digital and analogue aircraft data

sources and systems, as specified by airframe manufacturers, that formats the information, and provides it to sources such as flight data recorders.

The SB-S interface device will include applications with algorithms that analyse the data against specified parameters, identify distress conditions, and determine the data set transmitted from the aircraft. This can range from the streaming of distress tracking and flight data when distress conditions are met, to continuous streaming of all parameters allowing maximum analysis of aircraft telemetry.

Flight tracking tells **where** the flight is... ...Flight data streaming tells **what's** happening



When triggered by distress conditions, the system will include flight data from a specified period of time preceding the incident and continue to download CVR/FDR data throughout the flight to aid investigators in understanding both what was happening during the distress period as well as the circumstances that led to it.

The flight data will be transmitted to airline operations centres and to recipients authorized by the airline, such as air traffic service providers or rescue coordination centres, to aid in locating the aircraft and to begin real-time incident investigation.

The safety benefits of flight data streaming should not be underestimated; the availability of real-time flight data will allow operators to investigate incidents or operational deviations even before the airplane has landed.

The ability to obtain flight performance information in real-time enables an operator to more readily understand the health of its fleet, which will support earlier, more cost-efficient preventative maintenance. Access to flight data in real time also holds the promise of being able to respond to a developing safety or security situation in real time.

3.6. Autonomous Distress Tracking

Autonomous Distress Tracking (ADT) requirements are intended to narrow a potential search area to within 6 NM of the aircraft's position and to facilitate rapid initiation of search and rescue activities.

SB-S provides tracking, independent of the aircraft's primary systems, through its built-in tracking function. It provides the capability to trigger distress notifications and high-interval tracking, at up to

1-second intervals, based on manual inputs from the pilot or ground authority, specified ACARS messages, and flight parameter-based exceedance criteria. SB-S also meets requirements intended to prevent inappropriate de-activation.

In addition, SB-S provides flexibility for operators to meet ADT requirements according to their specific needs. For example, some operators may prefer to continuously track their aircraft at high-rate intervals and use distress triggers for notification. Operators may choose to authorize additional recipients of automatic distress notifications, such as air traffic service units or rescue coordination centres.

