Practical Guide to GADSS Autonomous Distress Tracking Implementation

November 2018

Contents

Introduction

Following several accidents where downed aircraft could not be located at all, or only after long and expensive search efforts, the Global Aeronautical Distress and Safety System (GADSS) recommendations were adopted by the International Civil Aviation Organization (ICAO) in March 2016. These recommendations, Standards And Recommended Practices (SARPS), support the goal of improving aircraft tracking and identifying distress situations during the flight, when it is still possible to track the aircraft and initiate a timely rescue operation.

For the benefit of GADSS stakeholders (in particular Aircraft Operators, Rescue Coordination Centers and Air Traffic Service Units), this white paper provides GADSS implementation considerations, based on the latest progress in terms of standardization and industry solutions. It also describes Orolia's end-to-end approach to meeting GADSS requirements.

ICAO GADSS in Summary

GADSS is designed to support each flight phase, including normal flight, in-flight distress situations, and post-flight. Amendment 40A to Annex 6, Part 1 of the ICAO convention is a recommendation especially aimed at maximizing, in case of an accident above ocean or land areas, the probability of:

- Locating the aircraft and flight recorders in a timely manner for rapid accident analysis and determination of safety improvement measures
- Rescuing survivors

GADSS Components

The figure below provides a graphic summary of GADSS components and stakeholders.

Figure 1 : Graphical GADSS Summary

Aircraft Tracking

Aircraft Tracking (AT), also referred to as Normal Tracking, is related to normal flight conditions (until a distress situation is encountered).

Key requirements include tracking the aircraft at a maximum of 15-minute intervals worldwide, and aircraft operators are required to set up appropriate procedures to ensure the management of this tracking data.

This tracking capability must be implemented on all aircraft with a Maximum Take Off Weight (MTOW) higher than 45.5 tons, or with MTOW higher than 27 tons and carrying more than 19 passengers, starting in November 2018.

Aircraft Tracking is generally considered as a rather straightforward implementation. Satellite communications (satcom) transmissions such as Inmarsat and Iridium, and space-based Automatic Dependent Surveillance Broadcast (ADS-B) are seen as the enabling technologies to ensure tracking continuity, even above oceanic areas.

Autonomous Distress Tracking

Autonomous Distress Tracking (ADT) is related to the flight phase which starts when a distress situation is detected and stops when the aircraft ceases to fly or comes back to a normal flight situation. An aircraft is in distress when it is in a state that, if aircraft behavior is left uncorrected, may result in an accident. EUROCAE ED-237 provides guidance on determining a distress situation.

Key requirements to enable the location of an accident site within a six nautical mile (NM) radius include:

- A maximum one-minute interval location transmission of 4D (time, horizontal location in LAT/LON, altitude) data. Note that altitude is desirable and not mandatory, but it is important in order to extrapolate the aircraft trajectory.
- ADT transmissions must be resilient to aircraft electrical power failure, aircraft navigation and communication systems failure, as well as human factors. In particular, in case of electrical power loss, transmission will continue for the expected duration of the remaining flight.
- The aircraft operator will be notified when one of their aircraft is in a distress condition, without the need for flight crew intervention; however, the flight crew must also be able to trigger the distress transmission.
- Distress tracking data will be delivered also to Search and Rescue (SAR) stakeholders as well as Air Traffic Service Units (ATSU).
- False alerts will be minimized, with the probability of erroneous distress notifications being lower than 1.10^{-5} per flight hour.

Autonomous Distress Tracking capability must be implemented on all **new-built** aircraft with MTOW above 27 tons (no passenger number criteria) first delivered after January 1, 2021.

End-to-end ADT requirements are not only more difficult to meet from a technical perspective (compared to aircraft tracking), but it is also difficult for aircraft operators to distinguish which candidate solution really meets the requirements, since guidance and means of compliance material are still being developed.

It is therefore important to consider ADT not as a simple extension of AT, and instead address its implementation as a specific project, requiring its own dedicated solution.

Post Flight Localization and Recovery

Post Flight Localization and Recovery (PFLR) is required at the end of the flight, following a distress situation.

Key requirements include:

- Locating the accident site (immediately after crash) with better than 1 NM accuracy.
- Improving the ability to retrieve the aircraft above or under water, by means of:
    - Emergency Locator Transmitter (ELT)
    - ULB emitting at 8.8 kHz and attached to the flight recorder
- Communicating the accident location to SAR stakeholders, as well as ATSU and relevant authorities.

Post Flight Localization and Recovery capability must be implemented for all **new- type certification** with MTOW above 27 tons and more than 19 passengers, after January 1, 2021.

ICAO GADSS stakeholders

While aircraft operators have the primary responsibility for ensuring compliance with Aircraft Tracking, Autonomous Distress Tracking and Post Flight Localization and Recovery, distress tracking data (including end of flight location) must be made available to two other key stakeholders:

- Rescue Coordination Centers (RCC)
- Air Traffic Service Units (ATSU)

Relevant national authorities and accident investigation agencies are also important stakeholders.

European Union / EASA Implementation

Regulations

The European Union adopted GADSS recommendations through Commission Regulation (EU) 2015/2338 – December 2015, which amends regulation (EU) 965/2012. EU 2015/2338 introduces CAT.GEN.MPA 205 related to aircraft tracking systems (applicable from December 16, 2018) and CAT.GEN.MPA 210 related to Location of an Aircraft in Distress (applicable from January 1, 2021).

As an incentive to implement an ADT system on new-built large aircraft after January 1, 2021, this EU regulation notably allows the use of an ADT system instead of the currently mandatory automatic ELT. In order to encourage the retrofit of older aircraft, the regulation also allows for the replacement of existing automatic ELTs with an ADT system, rather than requiring both.

Aircraft Tracking has already been adopted by many civil aviation authorities (China, Australia, Malaysia, Singapore, etc.), while autonomous distress tracking adoption is still under consideration.

EASA: A Different Approach than ICAO for ADT

EASA implementation of GADSS differs from ICAO as follows:

- EASA focuses on rescuing survivors (in the case of a survivable crash), whereas ICAO focuses on retrieving the aircraft.
- EASA focuses on locating the end of flight, whatever the method, whereas ICAO prescribes Autonomous Distress Tracking as the required method to locate the end of flight.
- EASA wants SAR and ATSU as the prime interface for retrieving end of flight location, while ICAO wants the aircraft operators to be responsible for distress tracking data reception.

The EASA approach results in means of acceptance that significantly differ from ICAO, notably introducing the following requirements (non-exhaustive list):

- There is a requirement for a 121.5 MHz homing transmitter, which must survive a survivable crash.
- In case of a survivable crash, the end of flight location must be transmitted, at the latest, 15 minutes after the end of flight, with a 200-meter accuracy.
- The required power autonomy relates to the duration of the flight without engines (typically 30 minutes), plus 15 minutes following the end of flight. Getting power from the emergency bus is acceptable, as long as the emergency bus remains available after the end of flight.
- There should be no way to disengage the system in flight (apart from circuit breaker).

A crash survivable ELT(DT), as defined by ED-62B, meets EASA Common Performance Objectives.

GADSS References

In addition to mitigating danger from DDoS attacks, time servers such as those from Orolia offer several other advantages, including:

Standardization / Recommendation Documents

ICAO

GADSS recommendations are primarily expressed in Amendment 40A to Annex 6 of the ICAO convention, Part 1, 10th edition (2016).

Additional documentation has been produced by ICAO to provide guidance on the understanding and implementation of GADSS by ICAO, including:

- GADSS Concept of Operations (CONOPS) - last release v6, June 2017
- Doc 100154 - Manual on Location of Aircraft in Distress and Flight Recorder Data Recovery – expected second half of 2018
- White paper related to Distress Tracking Data Repository, June 2018
- Circular 347, aircraft tracking implementation guidelines for aircraft operators and civil aviation authorities, January 2017

EASA

- Common Performance Objectives (CPOs) for CAT.GEN.MPA.210 -expected end 2018

EUROCAE / RTCA

- EUROCAE ED237: Minimum Aircraft System Performance Specifications (MASPS) for criteria to detect in-flight aircraft distress events to trigger transmission of flight information, February 2016
- EUROCAE ED62B / RTCA DO-204B: Minimum Operational Performance Specifications (MOPS) for Aircraft Emergency Locator Transmitter, expected December 2018

ED62B / DO204B includes, amongst others, the MOPS for a new type of ELT, the "distress tracking" ELT or ELT(DT), meeting ICAO recommendations.

AEEC / SAE: The industry standardization Group AEEC/SAE ARINC has set up two groups to develop architectures and detailed requirements:

- APIM 17-004 on ADT, with work completion expected by early 2019 (paper 680)
- APIM 17-005 on PFLR with work completion expected by September 2020

Key Aspects of GADSS Implementation

Two aspects of GADSS recommendations are of particular importance, as follows:

Performance Based System

ICAO GADSS recommendations are expressed as "performance based", in a non-prescriptive way. This approach aims to allow the emergence of the most economically efficient and robust solutions or technologies. However, it leaves to national civil aviation authorities the duty to establish prescriptive means of compliance. It also presents aircraft operators the burden of choosing between different concepts and solutions which are very different in their nature, as well as identifying appropriate means of compliance.

Performance, robustness and reliability, and cost of ownership will need to be assessed by aircraft operators as they consider the end-to-end implementation of the GADSS system.

End-to-End System Performance

ICAO GADSS recommendations emphasize the need to assess performance and robustness from an end-to-end perspective, e.g. from Aircraft to Airline Operations Center (AOC) and other stakeholders.

Doc 10054 defines the generic architecture of a GADSS ADT system as below:

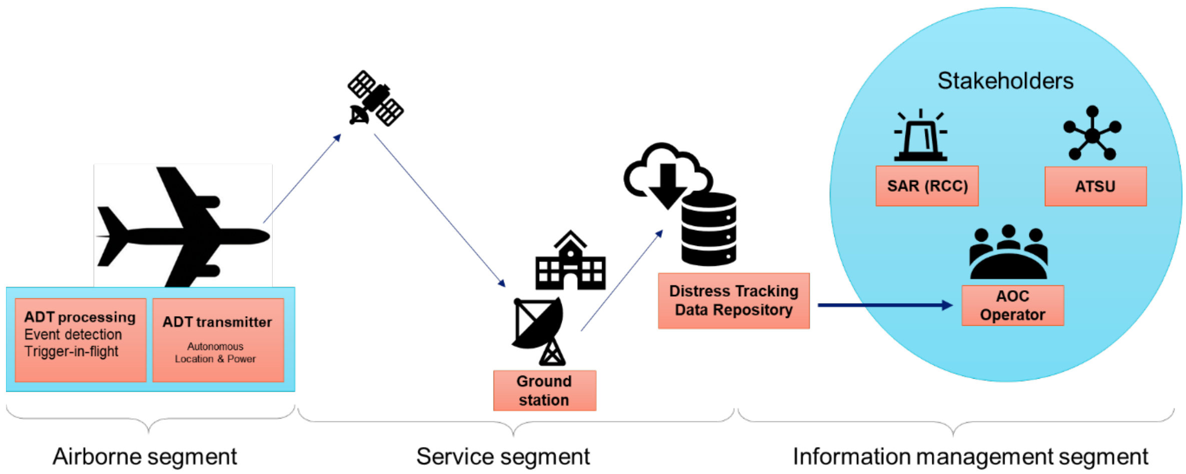

Figure 2 : GADSS System Segmentation

Autonomous Distress Tracking - CAT.GEN.MPA 210 Implementation

Main Categories of Solutions

The main categories of solutions include (space-based) ADS-B, satcom trackers, and ELT(DT). Autonomous Flight Data Recorders (AFDR) can be also considered here, when combined with an ELT(DT).

The AEEC ARINC project 17-004 on Autonomous Distress Tracking has been reviewing system architectures and detailed requirements related to these three candidate solutions (ADS-B, satcom, and ELT(DT)) with the goal to complete its report by January 2019. This industry standardization working group also analyzes “dissimilar complementary architectures”, based on a combination of two types of architecture, and aiming at improving the robustness of the overall solution.

Space-based ADS-B

Space-based ADS-B leverages the existence of ADS-B Out equipment onboard aircraft, which broadcasts the aircraft location and other information; this tracking data is received through a ground network of ADS-B receivers, but also through a dedicated payload onboard Iridium satellites, operated by AIREON, allowing the reception of ADS-B Out even in oceanic areas.

ADS-B equipment is currently mandated on new-built aircraft and Means of Compliance are standardized through DO-260B / ED-102A.

This solution, providing global coverage, is a good fit for aircraft tracking.

However, currently available ADS-B equipment does not provide the feature set required to meet the GADSS ADT requirements (in particular, resiliency to aircraft power or location failure). In addition, ADS-B Out can be manually selected to standby mode, which is a violation of GADSS requirements.

Adding the missing ADT features to ADS-B equipment may significantly increase its price, thus defeating the initial factor in favor of this approach.

Satcom Trackers

There are multiple satcom tracker solutions available today, based on Inmarsat, Iridium, Globalstar and other constellations. Only Iridium provides truly global coverage today. No mandate currently requires this type of equipment onboard aircraft.

Like space-based ADS-B solutions, satcom trackers are well suited for aircraft tracking; however, they also do not meet GADSS ADT requirements regarding resiliency to aircraft power failure.

The tracking data are distributed through each satcom operator cloud, which is efficient to distribute data to the aircraft operators for normal operations but is more problematic when appropriate RCCs and ATSU need to be contacted and provided with distress tracking data.

Using a satcom tracker for ADT makes sense only if it is already used for Aircraft Tracking. Adding a satcom tracker specifically for ADT or modifying a satcom tracker installation in order to meet ADT requirements would result in a significant additional cost (installation, operation).

ELT(DT)

ELTs have been mandated and installed onboard aircraft for many years. An ELT is an emergency dedicated and optimized transmitter, where the transmission is triggered by an event (crash, immersion, etc.), or manually. The transmitted signal provides notification of the emergency event and allows localization of the origin of the signal.

Standards for a new type of ELT have been developed in order to support in-flight triggering and tracking, which is the Distress Tracking ELT or ELT(DT). A new release of the ELT standard (ED-62B / DO-204B) will include MOPS for the ELT(DT), meeting ICAO recommendations. This release, expected by the end of 2018, will provide appropriate Means of Compliance for GADSS ADT implementation. The TSO / ETSO C126 will be updated shortly afterward, to reflect the new ED-62B / DO-204B release.

The ELT(DT), as the airborne segment, is closely linked and interfaced with the international COSPAS-SARSAT system and infrastructure, which acts as the service segment.

The 406 MHz emergency signal is transmitted to Rescue Coordination Centers (RCC) through the COSPAS-SARSAT infrastructure, which includes Low Earth Orbit and Geostationary Search and

Rescue satellites (LEOSAR / GEOSAR), as well as Medium Earth Orbit Search and Rescue (MEOSAR) payloads on recent GPS, Galileo and Glonass positioning satellites. Dedicated ground infrastructure processes the received signal, primarily to determine the signal origin, and distributes it through Mission Control Centers (MCC) to the appropriate RCC. Distress Tracking data are also transmitted to aircraft operators and ATSU through System Wide Information Management (SWIM) compatible distribution services.

A crash-survivable ELT(DT) also contributes to meeting GADSS Post Flight Localization and Recovery requirements, as it continues transmitting its location and a homing signal for SAR responders for 48 hours following a land crash.

It is important to note that there is no subscription fee for the COSPAS-SARSAT service, though its quality of service is guaranteed by the COSPAS-SARSAT organization. Due to its optimized size and weight, an ELT is a cost-efficient solution to integrate onboard aircraft.

Automatic Deployable Flight Recorder (ADFR)

Mostly designed to cover PFLR requirements, the ADFR is a flight recorder within a floating capsule, which is ejected from the aircraft an instant before a crash (when the aircraft structure starts to deform). The activation of an embedded ELT can be triggered at the time of ejection, in order to locate the Flight Recorder Capsule and provide a homing signal to recover it in a timely manner.

Note: unless the associated ELT is a Distress Tracking type (ELT(DT)), an ADFR cannot be considered as a GADSS ADT compliant solution in itself.

Dissimilar Complementary Technologies

Improving system robustness generally requires combining solutions which have different failure modes. The “dissimilar complementary technology” investigation from the AEEC ARINC working group is related to a number of combinations between ADS-B, satcom and ELTs.

From the Orolia perspective, it appears that the **ADS-B + ELT(DT)** combination brings the most value to aircraft operators, since these two architectures have strongly complementary operations and failure modes.

In addition, MOPS for each are well-defined through RTCA/EUROCAE standards, and there is significant and substantial accumulated experience in the installation, operation and maintenance of the two solutions.

Pros & Cons Associated with Various Solutions

Figure 3 provides a comparison table showing the compliance of the main candidate solutions with the main requirements of each GADSS component.

- + (green) shows compliance / good fit
- - (red) shows non-compliance / little fit
- Yellow shows partial compliance / partial fit

GADSS component / requirement Transmission type	Space based ADS-B continuous	Satcom Trackers continuous	ELT(DT) triggered	ADFR + ELT triggered	ADFR + ELT(DT) triggered
Aircraft Tracking					
Global coverage	+	+ (Iridium only)	-	-	-
< 15 min tracking interval continuous tracking	+	+	-	-	-
Autonomous Distress Tracking					
In flight detection of distress condition	ASD-B equipment will need interface update	satcom equipment will need interface update	+	-	+
4D Distress tracking data transmission at < 1 min interval	+	+	+	-	+
Automatic distress condition activation and cancellation	No cancellation message, needs interface update	No cancellation message	+	-	+
Manual distress condition activation and cancellation			+	-	+
Robust to aircraft electrical power loss for remaining duration of flight	-	-	+	-	+
Robust to aircraft location loss	Some solutions include their own internal location receiver	Some solutions include their own internal location receiver	+	-	+
Delivery of distress data to operator	+	+	+ (with dedicated application at AOC)	+ (with dedicated application at AOC)	+ (with dedicated application at AOC)
Delivery of distress data to SAR	-	-	+	+	+
Delivery of distress data to ATSU	+	-	+	+	+
Subscription / recurring cost	Space-based ADS-B subscription	satcom subscription	Free	Free	Free

GADSS component / requirement Transmission type	Space based ADS-B continuous	Satcom Trackers continuous	ELT(DT) triggered	ADFR + ELT triggered	ADFR + ELT(DT) triggered
Aircraft Tracking					
Deployment cost	$ - if ADS-B equipment already GADSS compliant, $$$ - if an updated ADS-B equipment is required	$ - if satcom equipment already GADSS compliant, $$$ - if an updated satcom system is required	$	$$$	$$$
Post Flight Location & Recovery					
Post -crash survivability, 48 hours	-	-	+	+	+
Post-crash location transmission	-	-	+	+	+
Post-crash homing signal	-	-	+	+	+

Figure 3: GADSS Candidate Concepts Comparison

Onboard ADT Architecture

Onboard installation includes the following sub-systems:

- ADT processing unit
- ADT transmitter

The ADT processing unit gathers data from the avionics (navigation, engines, Ground Proximity Warning System (GPWS), etc.) and stimulates a distress trigger (Trigger in Flight), based upon the exceedance of defined aircraft flight parameters (maximum roll/pitch, min/max airspeed, etc.). The trigger message (ARINC Label 202, in the current standardization process) includes the trigger status and an aircraft in-flight / not in-flight flag, along with additional information. The aircraft manufacturer is generally best positioned to define the trigger threshold for the parameters used in trigger processing.

This trigger in-flight message is sent to the ADT transmitter through the aircraft ARINC429 bus, several times per second.

If the aircraft is in-flight and receives the Label 202 message with "activated" trigger, the ADT transmitter starts transmitting distress tracking data at the proper rate, along with aircraft identification and distress condition notifications. The ADT transmitter also transmits a distress cancellation signal if the aircraft recovers. An ADT transmitter generally includes a main unit, and a fuselage antenna.

In the case of ELT(DT), onboard integration includes the connection of ELT(DT) with the following onboard systems:

- Aircraft power (28 VDC)
- Aircraft navigation (ARINC 429)
- Trigger-in-Flight / ADT processing (ARINC 429)
- Cockpit control panel

The integration of an ELT(DT) is very similar to the integration of a legacy automatic ELT; the primary difference is the addition of the Trigger-in-Flight ARINC interface.

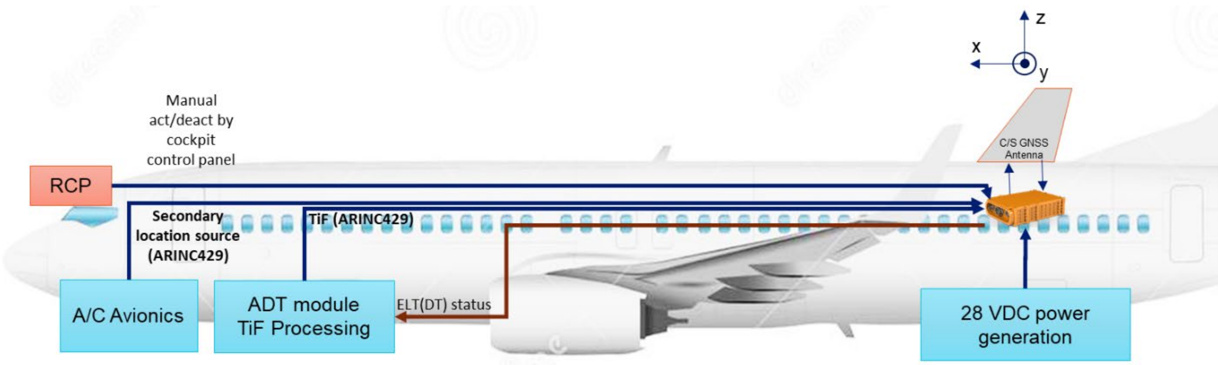

Figure 4 : ELT(DT) Aircraft Integration

OROLIA End-to-End Proposed Solution for GADSS

System Architecture

Orolia provides a complete GADSS end-to-end solution, based on its Kannad Ultima-DT for the airborne segment, using Cospas-Sarsat MEOSAR infrastructure for the service segment, and including Orolia's PRISMA Aircraft Distress Tracker (ADT) , as the front end to enable AOCs to retrieve and manage distress tracking data.

This end-to-end solution is based on Orolia's world-leading position and long track record of supporting the entire COSPAS SARSAT eco-system, including ELTs, as well as MCC turnkey systems and RCC software applications.

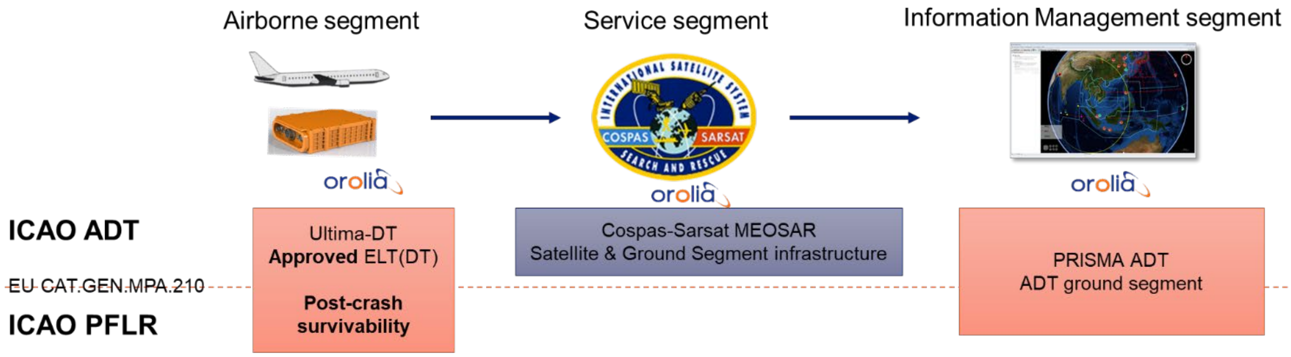

Figure 5 : Orolia's End-to End Concept to Meet GADSS Requirements

Airborne Segment: Kannad ULTIMA-DT as an ELT(DT)

Orolia's Kannad ULTIMA-DT is a crash-survivable ELT(DT), addressing both ADT and PFLR requirements for crash site location through a single unit.

Presentation / Features

Figure 6 : Kannad ULTIMA-DT

The Kannad ULTIMA-DT crash-survivable ELT(DT) has the following key features:

- Activation / cancellation:
    - Manual (via cockpit control panel)
    - Automatic activation in-flight upon ADT trigger (Trigger in Flight), only if aircraft is in flight

- Optionally, and if aircraft is in flight: upon loss of ARINC bus, loss of power, ground activation through GALILEO RLS command service, crash detection (software based – no G-switch)

- Location:
    - Primary source: internal GNSS receiver, with antenna integrated in external fuselage antenna
    - Secondary source: aircraft avionics originated position
- Power:
    - Internal battery and aircraft 28 VDC
- Battery:
    - Lithium: 24 hours operating life (406 MHz signal), and 48 hours on 121.5 MHz
    - Compliant with FAA/EASA Special Conditions on non-rechargeable lithium batteries (DO-227A, TSO-C142b)
- ARINC interfaces (IN, OUT) for connection to avionics (Trigger-in-Flight, location, status)
- Aircraft Identification Module support, for self-programming with aircraft ID
- RS422 maintenance interface allowing onboard, real-time, graphical access to main beacon status and event log
- High level of self-testability
- Single external fuselage antenna, including 406 MHz and 121.5 MHz transmission antenna and GNSS reception antenna
- Internal backup antenna for 406 MHz (if external antenna is broken or disconnected)
- Rugged design to meet crash environmental conditions, as per ED-62B / DO-204B
- Convenient form factor for integration in the rear aft (before the tail), with no orientation constraints

Main Benefits

The Kannad ULTIMA-DT design simplifies onboard implementation and operations, minimizing the required investment while meeting all GADSS ADT requirements.

- Same unit addresses ADT and PFLR requirements for accident site location
- Transmission system dedicated and optimized for distress situations (device robustness)
- Crash survivability, maximizing the probability of locating survivors
- Ensures continuity with ELT from an installation, operation (procedure) and maintenance perspective
- Small Size, Weight and Power (SWaP) – size, weight and power consumption minimized
- Simple integration and installation, with single external antenna to reduce implementation time and cost
- High onboard testability (interfaces, health, history) minimizes in service maintenance requirements
- Leverages the existing, worldwide, Cospas-Sarsat MEOSAR satellite and ground infrastructure
- Subscription free – no ongoing service costs

Service Segment: Cospas-Sarsat MEOSAR

The international Cospas-Sarsat system provides accurate, timely and reliable distress alert and location data to help search and rescue authorities assist persons in distress.

To achieve this mission, Cospas-Sarsat participants implement, maintain, coordinate and operate a satellite system capable of detecting distress alert transmissions from radio beacons that comply with Cospas-Sarsat specifications and performance standards, and capable of determining their position anywhere on the globe. The distress alert and location data is provided by Cospas-Sarsat participants to the responsible SAR services worldwide, including oceanic coverage.

Cospas-Sarsat cooperates with the International Civil Aviation Organization, the International Maritime Organization, the International Telecommunication Union and other international organizations to ensure the compatibility of the Cospas-Sarsat distress alerting services with the needs, standards and applicable recommendations of the international SAR community.

More information on the Cospas-Sarsat organization can be found at [https://www.cospas-sarsat.int.](https://www.cospas-sarsat.int)

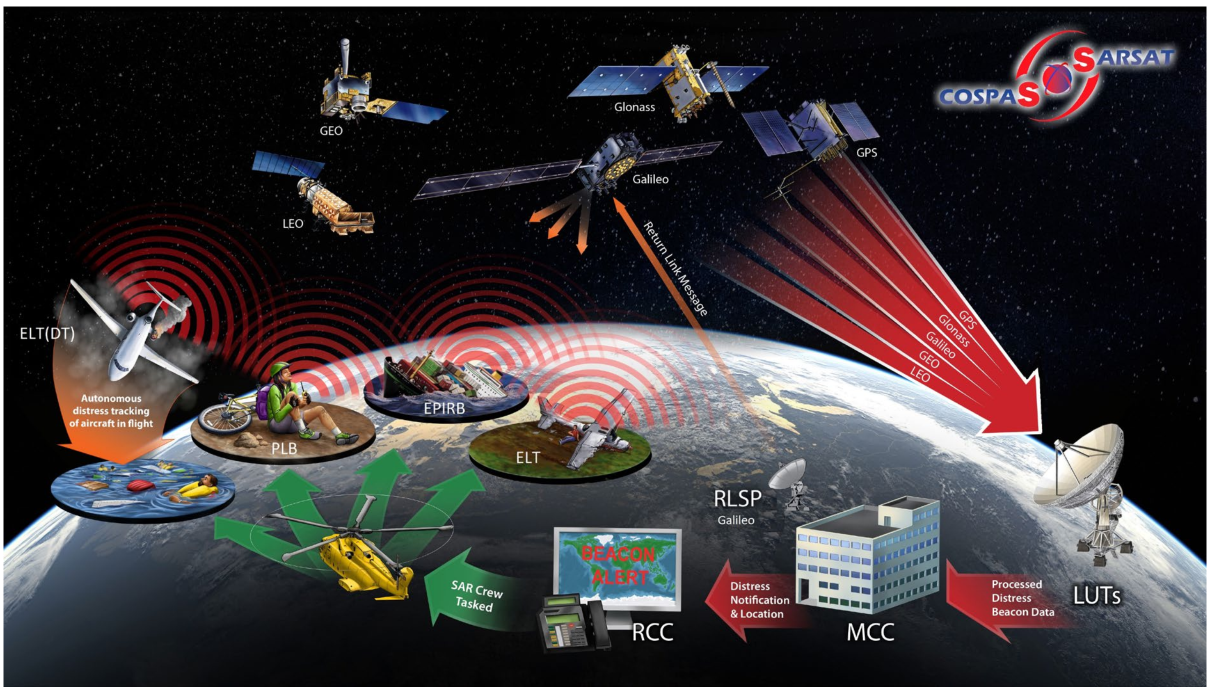

Figure 7 : Cospas-Sarsat System View

The new MEOSAR satellite infrastructure currently being deployed by Cospas-Sarsat will significantly increase system performance and robustness, including:

- Global coverage with near instantaneous detection through more than 70 satellites in the GPS, GALILEO and GLONASS constellations (plus legacy LEO and GEO satellites)
- From beacon activation to MCC: typical 5-minute latency

- Increased robustness against beacon-to-satellite obstruction (typically more than 20 satellites in visibility at any given time)
- Specific enhanced signal for ELT(DT) supports GNSS encoded position in the message
- Independent location capability of high speed / in-flight objects (if the message contains no encoded position)
- Cancellation capability

The new MEOSAR infrastructure is planned to support ELT(DT) protocol by Q1 2019.

Distribution Segment: Orolia's PRISMA Suite

Orolia supports the distribution of distress tracking data with the following suite of applications:

- PRISMA ADT, at operation / AOC level
- PRISMA RCC, at RCC level

PRISMA ADT is a front-end application which:

- Receives and processes distress notifications and distress tracking data from Distress Tracking Data (DTD) repository, MCC or other cloud sources (Iridium, Inmarsat)
- Provides a timely and clear situation display using maps and symbols, enabling AOCs to quickly assess and respond to a distress situation
- Manages data transfer, contacts and coordination with stakeholders (RCC, ATSU, authorities, etc.) via e-mail and calls
- Provides automated situation reports and updates
- Generates a record trail to support regulatory and legal requirements (e.g. crash investigations)
- Enables SWIM integration

PRISMA ADT is a standalone, Software as a Service (SaaS) solution, simplifying system deployment and ongoing upkeep.

Prisma RCC adds SAR asset management capability to PRISMA ADT.

Figure 8 : Orolia PRISMA RCC

Schedule Considerations

The end of 2018 will see the completion of GADSS Aircraft Tracking (AT) implementation. This is the right time for aircraft operators to begin considering Autonomous Distress Tracking (ADT) and Post Flight Localization and Recovery (PFLR) implementation.

Aircraft delivered after January 1, 2021 will have to implement, at a minimum, an ADT system. Taking into account airframer delivery backlogs, there are already many aircraft on order and planned to roll out after this date.

Stakeholders should be planning now for aircraft due to be delivered by early 2021, as follows:

- Aircraft operators need to select which ADT system they will have onboard before mid-2020
- Airframers need to be able to offer ADT systems to operators before early 2020
- ADT infrastructure (service and information management segments) needs to be ready by early 2020
- Airframers need to start qualifying ADT systems for integration by mid-2019

ADT suppliers need to submit their solution to airframers by early 2019

Conclusion and Takeaways

ICAO GADSS recommendations are close to enforcement, with the first milestone in November 2018. Industry has been working hard to propose concepts and design solutions that meet these requirements.

The first step for GADSS, Aircraft Tracking implementation, is relatively straightforward, and deployment among aircraft operators is happening now.

The following steps for GADSS, in particular the Autonomous Distress Tracking, are more challenging. The required end-to-end implementation must address the complete range of requirements, with no "cherry-picking". In order to address ICAO's performance-based approach, and the January 2021 in-service deadline, aircraft operators who expect aircraft deliveries in 2021 and beyond should work on a solution assessment in 2019 at the latest.

The ELT(DT) is a cost-effective solution that is SWaP optimized for emergency transmission and provides continuity with existing ELTs, while leveraging the proven international Cospas-Sarsat infrastructure. **The ELT(DT) meets all GADSS ADT requirements.**

Orolia's Kannad Ultima-DT crash-survivable ELT(DT) minimizes aircraft operator investment as it also addresses the PFLR requirement, mandatory on all new aircraft type certifications starting in January 2021, and maximizes the opportunity to quickly locate survivors – a key element in how operators communicate to their customers that they are proactively driving safety improvements.

The combination of the ELT(DT) and ADS-B, as dissimilar complementary architectures, provides a technically mature and affordable means to improve the robustness and performance of the overall ADT implementation, with a well-defined means of compliance through ETSO/TSOs.

ADT ground segment requirements are addressed through Orolia's PRISMA ADT and PRISMA RCC systems, building on extensive experience and world-leading expertise to focus on the timely collection, analysis and distribution of safety critical distress tracking data to stakeholders, and resulting in reduced loss of life in survivable accidents.

With this system approach, Orolia offers a Cospas-Sarsat based comprehensive, end-to-end, cost effective solution available in a timely manner to meet GADSS ADT requirements by January 1, 2021.

Glossary

ADFR	Automatic Deployable Flight Recorder
ADS-B	Automatic Dependent Surveillance - Broadcast
ADFR	Automatic Deployable Flight Recorder
ADT	Autonomous Distress Tracking
AFDR	Autonomous Flight Data Recorders
ANSP	Air Navigation Service Provider
AOC	Airline Operations Center
APIM	ARINC Project Initiation / Modification
ARINC	Aeronautical Radio, Incorporated
AT	Aircraft Tracking
ATSU	Air Traffic Service Units
DT	Distress Tracking
ELT	Emergency Locator Transmitter
ELT(DT)	Emergency Locator Transmitter – Distress Tracking type
ETSO	European Technical Service Order
EASA	European Aviation Safety Agency
FAA	Federal Aviation Administration
GADSS	Global Aeronautical Distress Safety System
GNSS	Global Navigation Satellite System
GPWS	Ground Proximity Warning System
ICAO	International Civil Aviation Organization
MASPS	Minimum Aircraft System Performance Specification
MCC	Mission Coordination Center
MEOSAR	Medium Earth Orbiting Search & Rescue
MOPS	Minimum Operational Performance Specification
MTOW	Maximum Take Off Weight
NM	Nautical Mile
PFLR	Post Flight Localization & Recovery
RCC	Rescue Coordination Center
RTCA	Radio Technical Commission for Aeronautics
SATCOM	Satellite Communication
SAR	Search and Rescue
SARPs	Standards And Recommended Practices
SWIM	System Wide Information Management
TSO	Technical Standard Order

USA

Orolia USA Inc.

1565 Jefferson Road

Suite 460

Rochester, NY 14623

Phone: +1.585.321.5800

France

Orolia France

Parc Technopolis, Bât. Sigma

3 Avenue du Canada

91974 Les Ulis Cedex France

Phone: +33 (0)1.64.53.39.80

Singapore

Orolia Asia Pacific Office

1 Changi Business Park Crescent

Changi Business Park

Singapore 486025

Phone +65 8725 5543

www.orolia.com

www.spectracom.com

November, 2018 - Rev O