

GRICAS OPERATIONAL GROUND SEGMENT WORKSHOP
Barcelona, 12-13 July 2016
Executive Summary



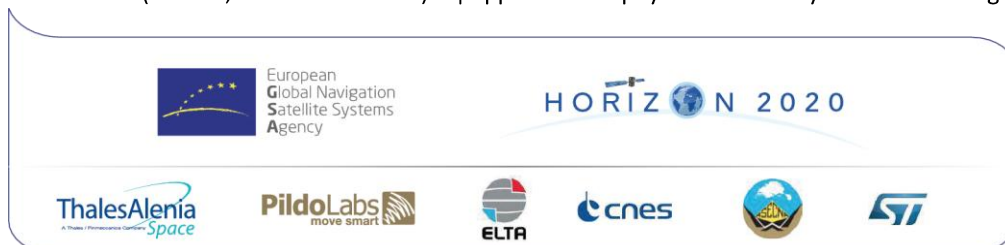
GRICAS: Why and how answering to new ICAO requirements for in-flight distress tracking with Cospas-Sarsat system?

1 Cospas/Sarsat system and operators: 40 years of heritage in SAR

Cospas/Sarsat is a public international satellite-based SAR, distress alert detection and information distribution system born from the fusion of the soviet COSPAS system and the French/American SARSAT system. It was established in 1979 by Canada, France, the USA and the former USSR, and has been joined by 42 other countries and organization over the years. It is today the most important worldwide rescues system, having been used since 1982 to save 39 000 human lives in about 11 000 distress events: around 1200 people are saved every year among which around 200 (17%) in aeronautical distress situation. Indeed, from the beginning, C/S has been integrated to aircraft safety and security systems with 2 types of beacons: ELT (Emergency Located Transmitter), attached to the aircraft and mandatory in most of them; and PLB (Personal Located Beacons), attached to the pilot, widely spread in general aviation. Aviation domain represents today 20% of the 1.6M deployed beacons. In 2014, C/S has answered to 107 distresses in aviation domain, saving 226 lives. Thanks to the efficient communication linked between the MCCs and the RCCs and the experience sharing, the ground operational segment of Cospas/Sarsat in general and the aeronautical one in particular has reached the rank of most performing SAR system, being the only one having detected and correctly processed the distress in nearly half of the event for the year 2014. Over the last 34 years, with 42 members, 32 operational MCC deployed in 30 countries all around the world, and more than 100 RCC/SPOC, Cospas/Sarsat consolidated its international SAR network and earned a rich experience in coordination of information and rescue means in all the events it treated.

2 Cospas/Sarsat is being modernized and will be ready to provide the services

For the past few years, C/S has been moving forward to offer a more performing SAR solution with the migration to the MEOSAR **placing us at the edge of a revolution in C/S system**. The evolution towards MEO orbits is supported by GNSS constellations (Galileo, GPS and Glonass) equipped with a payload that relays the distress signals towards



ground stations (MEOLUT). This transition will increase the quality of service of this global rescue service, with several key added values compared to LEOSAR and GEOSAR system:

- Worldwide real time detection
- Instantaneous independent localization with accuracy < 100m
- Capacity to localize high dynamic holders
- Return link service
- Opportunity for implementation of a Second Generation Beacon (SGB) with modernized signal characteristics for better detection and location accuracy

The SGB implement a new modulation improving the measure of Time Of Arrival (TOA) and thus offering better localization performances which is of great interest for ELT(DT) triggerable in-flight (Frequency Of Arrival (FOA) is less useful for moving beacons due to its contribution to the total Doppler).

The MEOSAR system offers many new solutions for aviation safety and security:

- The beacon may be **activated and independently localized in-flight**. The new generation beacon is particularly adapted to in-flight accurate independent localization.
- The beacon is **continuously tracked after activation**, during the whole descent phase
- The MEOLUT (ground station for MEOSAR system) detects beacons after crash and then improves the **availability of position after landing**
- The **Return-Link** service of Galileo offers 3 new features:
 - An **exchange of information** between the ground systems and the beacon
 - The possibility to **remotely activate the beacon from ground**
 - The possibility to remotely **optimize the beacon transmission** (burst period towards battery).

With this new high performing system, Cospas-Sarsat appears as the most relevant SAR system to answer to the new ICAO recommendation. ELT remotely activated allows also answering to many distress situations where the crew has no control (for instance, terrorist attacks...), with the specific possibility to remotely trigger the ELT(DT) of a non-cooperative aircraft from ground in a complete independent way.

Finally, to comply with existing environmental and test conditions (lightning, radiofrequency, altitude, pressure, shocks, vibration, fire, transmission duration) and C/S requirements, ELT has now to comply with recent aeronautical standards (DO 160, ED 162) and quality standards: REACH, ROHS, EMC and ESD including documentation, being understood that those requirements have to be fulfilled without any compromise on product availability and reliability, offering ELT with higher performance requirements.

3 GRICAS design answers to all distress situations with high care to human factors

GRICAS operational concept is based on three main distress scenarios: the automatic activation by avionics, the manual activation by cockpit crew and the manual remote activation from ground through the Return-Link Service. Based on those scenarios, the solution design requires an ELT continuously armed and tracking GNSS with its own internal GNSS receiver (GPS + Galileo). Thus the ELT is always ready to be triggered to transmit a SAR alert as well as the needed localization data. Moreover, the designed solution offers a strong robustness to terrorist attacks with the acknowledgment from the ground under the responsibility of RCC to the transmission cancel of a manually triggered ELT, to avoid ill-intentioned cancellation. Moreover, human factors have taken more and more importance in the latest year to design aeronautical systems, GRICAS solution design takes this studies into account and recommend a manual acknowledgment from the cockpit crew to be requested in case of automatic activation by avionics, before the avionics send the cancellation command to the beacon. Thus, the pilots confirm they are back in control of the flight in addition of the flight dynamics criteria characterizing a normal flight situation.



Thanks to the MEOSAR mission segment of Cospas-Sarsat and using Return-Link acknowledgment function, the probability for the ground segment to receive a distress alert reaches the 100% even for distress event resulting in a back to normal situation. Therefore all distress events are received, treated and archived.

4 GRICAS solution promotes integration of SWIM in information management during distress alerts

GRICAS will be supporting the connection of all the actors of the Cospas-Sarsat operational ground segment to the aviation information management system SWIM to ensure a complete, better and faster sharing of the information between the involved stakeholders of a distress event. SWIM is a System Wide Information Management consisting of standards, infrastructures and governance enabling the management of ATM related information and its exchange between qualified parties via interoperable services is under development as interconnected regional solutions. In emergency situations the involved stakeholders of the C/S SAR chain should be connected to the SWIM to receive and exchange essential tracking information and miscellaneous data (weather information, maintenance history, surrounding aircrafts ...) in an efficient way. In particular, the connection of RCCs and nodal MCCs should be of great interest to improve the response time of the ground operational SAR segment.

In GRICAS system, the remote activation should be proposed as a service of the SAR system, accessible through SWIM, and provided to the actors which may require an in-flight activation in case of aircraft loss (MH370), in particular the airlines. Its use will immediately triggers the ELT in the aircraft, start its transmission, and open the search and rescue in the RCC in charge of the area where the aircraft is flying, exactly as any other alert.

5 GRICAS provides a fully independent solution for distress delivery in all situations

The operational concept and the solution design associated proposed by GRICAS ensure the ELT(DT) mission not to be affected by a communication link inhibition with the avionics or even a loss of communication with the aircraft's GNSS receiver. The ELT(DT) operates in reception only towards the avionics (receiving GPS localization and triggers), guaranteeing thus a risk-zero in terms of hacking of the avionics through the ELT, nor data interference.

In addition, the independent localization of the distress alert provided by the MCC eliminates the risks linked to GNSS to dispose at any time of an available localization's estimation.

Finally, the ELT(DT) can be triggered in a completely independent process without any inhibition risk thanks to the manual remote activation from ground by Return-Link Message. This service will be provided to airlines, which will be able to request a remote activation (and deactivation) to the Return-Link Service Provider, knowing that the activation of the ELT(DT) will set off a SAR event by the RCC in charge. The request for the activation (and deactivation) can be made through a SWIM interface.

The problem of the ELT maintenance and its independence towards the avionic system has been raised. A maintenance procedure based on the use of self-test messages at the take-off would allow testing the complete chain: ELT, communication links, SAR antenna and beacon's GNSS receiver. The results of the self-tests can be shared on SWIM optimizing the control of the beacon's availability and performance without making it a dependent element of any avionics' device.

Main Conclusions

The participants to the workshop agreed on the following conclusions:

- The GRICAS operational concept and solution design represent a **relevant solution to ICAO recommendations**.
- The **RCC's role shall be reinforced** in the future operational ground segment for ELT(DT) to improve its efficiency: it shall be in charge of requesting the manual acknowledgment of end of distress in case of a manual activation and cancellation by the cockpit crew and it shall be connected to SWIM to share and receive relevant information in an efficient way during distress event
- At least RCC's investigation's functions, maintenance monitoring using self-tests and remote activation from ground through RLM capability shall be **integrated to SWIM**. The relevant SWIM's services to answer to this requirement need to be defined.
- The GRICAS solution based on C/S system is a completely independent solution from avionics, cockpit crew and GNSS availability for trigger, localization and cancellation of a distress. In accordance, the detailed enforcement of **independent maintenance process** is to be consolidated with airlines and aircraft manufacturers.
- The airlines can request a manual remote activation of the ELT of one of its aircraft. The request is made through SWIM directly to the RLSP.

Thales Alenia Space and PildoLabs would like to warmly thank all the participants to the workshop: ASECNA, Air Europa, French aeronautical RCC, ELTA, CNES, GSA and Brazilian Air Force.



And special thanks go to all the members of the consortium and outside the consortium who helped setting up this workshop: CNES, BEA, Cospas/Sarsat Secretary and Airbus.

GRICAS project will be presented in September at the SC229 in Lorient, France and at the C/S JC in Montreal, Canada.

