Galileo: A Technological Revolution in the World of Search and Rescue

Four new satellites are scheduled to be launched aboard a single Ariane rocket on Nov. 17, 2016 leading to increased global coverage and next-generation Search and Rescue services will be operational by the early next year.
SUMMARY

Four new satellites are scheduled to be launched aboard a single Ariane rocket on Nov. 17, 2016. This launch will bring the number of satellites in space up to 18, considerable increasing the global coverage of the Galileo constellation. While most people are aware that Galileo provides a new global positioning system, it also offers breakthrough Search and Rescue (SAR) capability. The European Union’s Galileo satellite constellation uses the group’s atomic clocks. Now, with the world’s most advanced McMurdo’s SAR ground segment and the beginning of the early services, this will dramatically improve the speed and delivery of Search and Rescue services around the world, resulting in a safer environment for us all.

The McMurdo Group Press Team

1. GALILEO IS NOW A REALITY
The early services, with a breakthrough Search and Rescue capability

2. SEARCH AND RESCUE (SAR) ECOSYSTEM:
COSPAS-SARSAT, the free International Search and Rescue system

3. MEOSAR: The future SAR satellite system
A technological revolution for Search and Rescue

4. MCMURDO GROUP
The global leader in end-to-end COSPAS-SARSAT Search and Rescue solutions

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1. GALILEO IS NOW A REALITY
The early services, with a breakthrough SAR capability

Galileo European Program: the most accurate GNSS System

Galileo is a global navigation satellite system (GNSS) currently being built by the European Union (EU) and European Space Agency (ESA). Whereas GPS was initiated by the US military, Galileo was always intended to be a civilian system.

Compared to the US GPS (Global Positioning System), with accuracy up to a few meters, Galileo will offer sub-meter accuracy. One of the key factors is the higher-precision & stability of atomic clocks.

Galileo is much more than a new navigation system

But in addition to greater accuracy of the new GNSS systems: Galileo, Russia’s GLONASS equivalent and the US military’s next-generation GPS constellations will take another step forward, and start offering early MEOSAR operational services by the end of this year or early 2017.

Galileo’s contribution to the MEOSAR system

With Europe’s in-orbit Galileo, every satellite has an on-board SAR payload. All scheduled Galileo satellites (30 in all in the coming years) will carry SAR transponders that relay signals from SAR distress beacons, carried by individuals or ships or planes and forward them to SAR authorities and first responders.

As of November 2016, with 14 satellites in orbit and four on the launchpad, the availability and satellite coverage for relay of signal will gradually improve, enabling early Galileo positioning and SAR services to be available in early 2017.

McMurdo’s contribution to the MEOSAR system

In addition to the precise atomic clocks on Galileo, McMurdo, is the world’s first provider of end-to-end products and services in the COSPAS-SARSAT ecosystem - providing ground receiving stations called MEO Local User Terminals (MEOLUTs) to help with beacon identification and decode location information. Furthermore, the European Commission (EC) has selected McMurdo to lead the development of next-generation search and rescue distress beacons.
Search and Rescue Payload: SAR radio transponders will be carried as part of the payload of next-generation navigation satellites of the European Union's Galileo constellation.

Global Navigation Payload: Satellites will provide global navigation based Public Regulated Services (PRS) and Open Services (OS).

**Each satellite in Europe’s in-orbit Galileo constellation has an on-board SAR payload.**

**Galileo will take another step forward by offering early services such as:**

### SEARCH AND RESCUE

**Search and Rescue (SAR):** The Galileo system is critical to the upgrade of the COSPAS-SARSAT international search and rescue program which has saved over 39,000 lives since its inception in 1982.

**How will Galileo dramatically improve Search and Rescue?**

Galileo will include a number of breakthrough innovations such as:

- **SAR Payload:** Next-gen SAR technology on board Galileo satellites will reduce the detection times of COSPAS-SARSAT distress beacons from hours or minutes to seconds, thereby expediting recovery and saving more lives.

- **Return Link Service:** A new feature of the Galileo SAR system is its ability to send messages back to the beacons’ users, confirming that their distress signal has been received (fact sheet N° 3).

### GLOBAL NAVIGATION

**Open Service (OS):** Galileo's freely accessible service for positioning, navigation and timing will be fully interoperable with GPS & GLONASS systems and can be used for many mass-market applications such as in-car navigation and location-based mobile services.

**Early Public Regulated Service (PRS):**

The PRS will be an encrypted service limited to government-authorized users. It is designed for greater robustness and increased availability. The signal will be resistant to unintentional interference, malicious jamming, spoofing and false interception/re-broadcast.

Galileo is more than just a GPS system!
2. COSPAS-SARSAT: International Satellite Aided Search & Rescue system

The original search & rescue ecosystem initiated by 4 countries

Photograph courtesy of U.S. Air Force and U.S. Coast Guard

Provides distress alert and location data to help search and rescue authorities assist persons in distress

Wherever an accident takes place, on a boat, in a plane or in the mountains, rescue teams are always confronted by the same problem: how to locate potential victims quickly and accurately.

COSPAS–SARSAT help locate distress victims and thus save lives.

During the 1970s, the US, Canada, the USSR and France decided to set-up a global system for the gathering of information and the positioning of emergency operational situations. Called COSPAS-SARSAT, this international global satellite system provides, free-of-charge, distress alert and location information to search and rescue authorities anywhere in the world for maritime, aviation and land users in distress. Where other technologies (satellites phones, AIS..) are out of range, COSPAS-SARSAT can locate people in danger.

How it works? Easy, free & simple:

Relayed by satellites, analyzed by control centers on the ground, the COSPAS-SARSAT system distress signals allow for the detection and accurate location of the beacon’s position and for the appropriate rescue authorities to be alerted quickly. A 406 MHz beacon certified by the COSPAS-SARSAT organization does not require any subscription fee.

By sending an automatic or manual signal to search and rescue teams via the COSPAS-SARSAT system, distress beacons streamline the rescue chain and increase the victims’ chances of survival. To date, over 39,000 lives have been saved due to the distress beacons operating with the COSPAS-SARSAT satellite-aided Search and Rescue system.

On average over the last four years, assisted rescues accounted for

6 rescues per day
3. MEOSAR : the next-gen of COSPAS-SARSAT

A technological revolution for Search and Rescue with up to 72 satellites, an European world premiere

In the domain of Search & Rescue, the MEOSAR system represents a technological revolution similar to the impact of GPS in the world of radio-navigation in 1995. MEOSAR brings several improvements to COSPAS-SARSAT including:

- A constellation of approximately 72 MEOSAR satellites (vs. 6 GEOSAR and 6 LEOSAR satellites with COSPAS-SARSAT today). This will provide persistent worldwide coverage.

- When a distress radio beacon transmits its first signal, the signal that is received by at least three MEOSAR satellites can be located within a few seconds; This could take up to 45 minutes or more with original Cospas-Sarsat system).

- The signal is relayed to satellite ground stations or Local User Terminals (LUTs) on Earth where time-difference-of-arrival and frequency-difference-of-arrival positioning techniques are used to calculate beacon locations.

- The MEOSAR system’s objective is to enable single burst locations, locate beacons within 100 metres, 95% of the time, and within the first five minutes, even if beacons are not equipped with a GPS receiver.

- The MEOSAR system will have a Return Link Service enabled by Galileo satellites allowing rescue forces to send acknowledgment and feedback to the beacon user indicating that help is on the way.

How will MEOSAR revolutionize the SAR world ?

Real-time worldwide coverage

It takes only a few seconds to track air, land or sea emergency beacons

Return Link Service via the Galileo satellite/system
4. MCMURDO GROUP:
The Global Leader in End-to-End COSPAS-SARSAT Search and Rescue Solutions

McMurdo Group is the world’s first provider of a end-to-end solutions for COSPAS-SARSAT ecosystem - from distress beacons to satellite ground station infrastructure including mission control and rescue coordination center software. McMurdo Group brings together 140 years of combined experience by consolidating proven search and rescue brands. Nearly 25 percent of the world’s emergency distress beacons and approximately 50 percent of the Cospas-Sarsat search and rescue infrastructure globally are manufactured by McMurdo.

Single vendor, end-to-end COSPAS-SARSAT ecosystem
In an industry known for its diverse players (beacon manufacturers, satellite ground station developers, control center operators, rescue equipment providers, rescue teams, regulators and others), McMurdo Group brings leadership, expertise and stability to this fragmented industry. With the acquisition of a leading ground segment provider in 2014, the McMurdo Group became the unique player worldwide with the capability of mastering the whole range of technologies in the COSPAS-SARSAT system, from the distress beacons through to the control centers equipped with operational search and rescue software.

A world trendsetter in the SAR world
With a unique, comprehensive view of the SAR industry and by understanding and owning the various elements of the SAR ecosystem, McMurdo Group speeds the introduction of innovative SAR solutions, drives knowledge delivery and standardization industry-wide. McMurdo can create entirely new solutions that leverage joint partner development efforts. As a result, McMurdo has become the most trusted name in emergency readiness and response and has been recently awarded several contracts:

- In October 2016, McMurdo was awarded a contract by the U.S. Army to provide working prototypes of a custom personnel recovery device (PRD). As a militarized personal locator beacon (PLB), the PRD will be a component of the Army’s Personnel Recovery Support System (PRSS), to alert and notify if a soldier has become isolated, missing, detained or captured.

- In August 2016, it was awarded a US$3 million contract with the United States Coast Guard (USCG). McMurdo for the supply up of to 16,000 FastFind® 220 personal locator beacons (PLBs) over the next five years to enhance crew safety in the event of emergencies.


Key provider of MEOSAR infrastructure
Providing the most prestigious authorities & Government Agencies through the world (NOAA, Australian Maritime Safety Authority known as AMSA & Maritime New Zealand called MNZ, ...), MEOSAR infrastructure is expected to revolutionize the SAR industry. McMurdo Group is poised to help save even more lives and to be a leading voice in the SAR community today and in the future.

40,000 lives since 1982
McMurdo in numbers

25%
Percentage of world’s 406MHz beacons manufactured by McMurdo

2
Top 2 SAR regions of the world (USA, Australia/NZ) use McMurdo SARSAT infrastructure solutions

3,000
In kilometers, world’s longest contiguous coastal surveillance solution by McMurdo

20M
Number of transactions processed annually for McMurdo workboat and fishing customers

60%
Estimated market share percentages for McMurdo in military\(^1\) and commercial beacon markets

40K
Number of lives saved using satellite-based SAR solutions since 1982

\(^1\)Military beacons outside of US

\(^2\)Source: COSPAS-SARSAT Bulletin, Sep 2012

McMurdo SAR infrastructure in the world

As of Oct. 2016

Government Agencies and Authorities around the World rely on McMurdo ground segment

To provide beacon identification and location information, the satellite downlinks are processed by ground receiving stations called MEO Local User Terminals (MEOLUT). The distress alert information computed by MEOLUTs is forwarded to COSPAS-SARSAT Mission Control Centres (MCCs) for distribution to SAR services.
In this second part of the Press Kit, you will find several Fact Sheets which outline information on Galileo or COSPAS-SARSAT subjects that you might find useful.

5. ANNEXES:

- Fact sheet 1: Satellite Navigation Systems (Sat-Nav)
- Fact sheet 2: 4 Things to Know to Maximize Your Chance of Rescue Using Emergency Beacons
- Fact Sheet 3: Return Link Service on Next-Generation COSPAS-SARSAT Beacons
- Fact sheet 4: A revolution in Search & Rescue
- Fact sheet 5: McMurdo selected by the European Commission (EC) to lead the development of next-generation search and rescue distress beacons

6. ACRONYMS, ABBREVIATIONS, PRESS CONTACT

7. PHOTO GALLERY
Fact Sheet 1 - Satellite Navigation Systems

How do Satellite Navigation Systems work?

The principle of navigation by satellite is based on the transmission of signals from at least four satellites to the user. To reach a positioning accuracy in meters, these signals must be synchronised to a billionth of a second. The ultra precise time control on board each satellite, using space atomic clocks, is therefore key for the performance of the navigation system. This is why each satellite has up to four on-board atomic clocks.

The on-board clocks in navigation satellites are 10 millions times more stable than a quartz watch so as not to deviate by more than a billionth of a second per day.

Orolia (the McMurdo Group Parent Company) is a provider of a key component in the largest satellite navigation systems. Orolia provides atomic clocks to the Galileo system, through its Swiss subsidiary SpectraTime. The group is the only European source of atomic clocks.

Its technological know-how in this field has been already established by the In-Orbit Validation satellites of the Galileo European Programme, with, as of today, the most accurate atomic clock ever placed in orbit. Its technological expertise has also allowed the Group to be awarded contracts to provide atomic clocks for the IRNSS Project (Indian ‘GPS’) and to participate in the Beidou program (Chinese ‘GPS’).

Where does the European program name Galileo come from?

From the astronomer Galileo Galilei (1564-1642), an Italian physicist, mathematician, engineer, astronomer, and philosopher who played a major role in the scientific revolution. Known as the "father of modern observational astronomy" for his main achievements, he was also condemned by the Church for having claimed that the Earth orbited around the Sun.
Fact Sheet 2 – Four Ways to Maximize Your Chance of Rescue Using Emergency Beacons

1. Choose the appropriate beacon so the COSPAS SARSAT ecosystem can work for you. You should choose a 406 MHz beacon – which is required for many types of ships and aircraft but usually not mandated for leisure activity. There are 3 types of beacons:

   - **PLB (Personal Locator Beacon)** (an outdoor beacon).
   - **EPIRB (Emergency Position-Indicating Radio Beacon)** (a maritime beacon).
   - **ELT (Emergency Location Transmitter)** (an aircraft beacon).

2. It is critical to register your beacon. Each beacon has a unique ID number which provides rescue authorities key personal information to accelerate the rescue process. Register online at www.406registration.com.

3. It’s also important to self-test your beacon. It is always better to self test in the first 5 minutes of the hour in order to reduce impact on real alerts. Manufacturer’s instructions will vary by beacon, but the message here is to make sure your beacon is operational before you depart so that it is functional in the event of a distress situation.

4. Ready to go? Keep the Beacon Within Reach or Set to “Auto”
   (a) installed in an easily accessible position;
   (b) ready to be manually released and capable of being carried by one person into a survival craft;
   (c) capable of being activated manually, if required.

**Travel Safely and Enjoy!**
Fact Sheet 3 – Return Link Service for Next-Generation COSPAS- SARSAT Beacons

Another feature of the MEOSAR system will be the ability to send a Return Link Signal to the beacon. This feature is available only through Galileo satellites today. Essentially, the ground segment - Mission Control Center will forward a message to the Galileo constellation operator who will then “place” a message in the Galileo navigation signal which will be transmitted and addressed to the specific distress beacon. This is the “return link” feature.

"With this functionality, great improvements are expected in the search and rescue process. We can send a confirmation message back to the beacon acknowledging that the emergency signal was received. We could possibly monitor the beacon transmission or even confirm if the emergency signal is an real distress situation or a false alert. But also, one of a major step in the aviation safety, could be the possibility to activate a beacon on-board an aircraft from ground in an abnormal situation, such as the MH370 airplane. This functionality can be a huge improvement to determining the location an aeroplane potentially in distress and not responding”

Alain Bouhet, H2020 HELIOS Program Coordinator at McMurdo Group

This return link capability/functionality will require next-generation emergency beacons. The standards for next-generation 406MHz beacons are currently being defined. They will include some of the following requirements and features.

1. Compatible with both MEOSAR and the existing COSPAS-SARSAT systems.
2. Designed to increase performance and independent beacon location accuracy to within 100m, 95% of the time within 30 minutes of activation (1 km within 10 min) compared to today’s target of 5km, 95% of the time within 45 minutes. This is a huge improvement in performance.
3. Include this return link service.
4. Future aircraft beacons (called also ELTs) will have an automatic activation function on the indication of suspicious flight parameters as opposed to being impact activated today; this feature is part of the proposed Triggered Transmission of Flight Data (TTFD) solution for commercial aircraft.
## Fact Sheet 4 - A revolution in the Search & Rescue

<table>
<thead>
<tr>
<th>Description</th>
<th>COSPAS-SARSAT LEOSAR and GEOSAR</th>
<th>COSPAS-SARSAT MEOSAR NEXT GEN. SAR SATELLITES</th>
<th>COSPAS-SARSAT MEOSAR + 2ND GENERATION OF BEACON</th>
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<tbody>
<tr>
<td>Numbers of satellites</td>
<td>12 satellites</td>
<td>From end of 2016, 18 Galileo satellites will enable a new era of early MEOSAR service</td>
<td>With 72 new medium orbit satellites to be launched and operational from 2020 (28 of which will be Galileo satellites). This upgrade will offer a much better location accuracy and detection time</td>
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</tbody>
</table>
| Beacon Localisation Performance | **406MHz Beacon without GPS (GNSS)**  
- Typical 5km radius precision  
- 45min average detection time | **Determine independent beacon location within 5km, 95% of the time within 30 seconds of beacon activation**  
| **406MHz Beacon with GPS (GNSS)**  
- +/- 60m radius  
- New updates every 20 minutes  
- Under 30 minutes to respond if within GEO footprint. | **First burst transmission timeliness 3 seconds**  
| | Determine independent beacon location within 1km, 95% of the time within 5 minutes of beacon activation | **Determine independent beacon location within 100m, 95% of the time within 5 minutes of beacon activation** |
| Return Link Service | | | **Return Link Service confirms to person in distress that their alert message was received and their location identified** |
| Optional features of the 2nd generation of beacons | | | **Cancellation of false alerts** |
Fact Sheet 5 - McMurdo is leading the development of next-generation search and rescue distress beacons

In November 2015, the European Commission (EC) selected McMurdo to lead the development of next-generation search and rescue distress beacons under the Horizon 2020 Research and Innovation Program’s HELIOS project.

Several of the life-saving improvements are expected to be implemented, these include near-instantaneous alert detection, pinpoint location positioning and remote acknowledgement and activation of distress beacon signals.

Horizon 2020 is the European Union’s largest Research and Innovation program

This program providing nearly €80 billion of funding from 2014 to 2020 to create more breakthroughs, discoveries and world-firsts by taking great ideas from the lab to the market.

Second Generation Beacon

The HELIOS project aims at providing a Second Generation range of Beacons and associated antennas designed to operate with the full capability of the new Meosar Cospas/Sarsat International Programme, embedded in the Navigation Satellite Systems as GALILEO.

As project coordinator, McMurdo will receive nearly €2.4 million of the total HELIOS development budget (over three years). The award will be used to create several innovative aviation, maritime and outdoor search and rescue products that are based on proven satellite-based distress beacon technology. Several of the life-saving improvements expected to be implemented include near-instantaneous alert detection, pinpoint location positioning and remote acknowledgement and activation of distress beacon signals.

McMurdo to lead the consortium

As the Resilient PNT global leader with a relentless commitment to product, market, and technological innovation, McMurdo will lead a consortium of well-established, proven European companies and industry experts including Air France, France’s government space agency CNES, and other companies with expertise in aircraft manufacturing, protective clothing design, aerospace and satellite communications, distress beacon development and search and rescue operations.

These companies will form the core of the HELIOS project’s key partners and stakeholders. Under McMurdo’s guidance, the HELIOS consortium are tasked with delivering a number of solutions utilizing MEOSAR, the next-generation Cospas-Sarsat satellite-based search and rescue system.

MEOSAR is expected to streamline search and rescue efforts by accurately detecting and locating a distress beacon signal almost instantaneously instead of taking up to hours in the worst case today. MEOSAR is currently being deployed worldwide and uses the European Galileo global navigation satellite system satellite as one of its primary satellite constellations.

6. Acronyms, Abbreviations, Contacts

Because acronyms abound in the world of SAR (Search and Rescue), we have gathered the most popular in one page. If for some reasons you have not found the one you were looking for us, please let us know.

**Automatic Activation:** A distress beacon that is activated when it comes in contact with water.

**Automatic Deployment:** A distress beacon that is automatically released from its housing when the integral hydrostatic unit is submerged in water.

**COSPAS-SARSAT:** International satellite system for search and rescue. A joint operation between France, Canada, Russia and the USA who monitor the 406 MHz satellite system.

**ELT:** Emergency Location Transmitter (an aircraft beacon).

**EPIRB:** Emergency Position-Indicating Radio Beacon (a maritime beacon).

**GALILEO:** Galileo is a global navigation satellite system (GNSS) currently being built by the European Union (EU) and European Space Agency (ESA).

**GEOSAR:** Geostationary Search And Rescue system. Part of the COSPAS-SARSAT satellite system.

**GMDSS:** Global Maritime Distress and Safety System.

**HELIOS:** Part of the H2020 program, the European Union’s largest research and innovation program, providing nearly McMurdo was selected by the European commission to lead development of next-generation search and rescue beacons. The project is called Helios.

**LEOSAR:** Low-altitude Earth Orbiting Search And Rescue System.

**LUT:** Local User Terminal. A ground receiving station that picks up the initial distress signal and relays it to the Mission Control Center. Calculates the position from which the signal was transmitted.

**MCC:** SARSAT Mission Control Center. The SARSAT Mission Control Center is a management of all national SARSAT data, communications, and Local User Terminals.

**MEOSAR:** Medium-altitude Earth Orbiting Search And Rescue System.

**PLB:** Personal Locator Beacon (used by outdoor enthusiasts)

**RCC:** Rescue Coordination Center

**SART:** Search And Rescue Transponder.
7. Photo Gallery & Free Tutorials

Learn more! Visit our MEOSAR Knowledge Center!
In addition to free-webinars, McMurdo provides education and awareness to the Search and Rescue communities. Join us on line for thoughtful and insightful presentations on a variety of relevant topics.

http://www.mcmurdogroup.com/meosar-knowledge-center/
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GALILEO
a technological revolution
in the domain of Search & Rescue

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