



SAR/Galileo Service Status **European Commission**

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- ★ **SAR/Galileo Service Definition**
- ★ **SAR/Galileo Forward Link Service Overview**
 - ★ **Infrastructure**
 - ★ **Performances**
- ★ **SAR/Galileo Return Link Service Overview**
 - ★ **Infrastructure**
 - ★ **Standardization**
 - ★ **Beacon impacts**
- ★ **SAR/Galileo Service Roadmap**

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Article 4 (e) of GNSS Regulation 1285/2013

"4. The specific objectives of the Galileo programme shall be to ensure that the signals emitted by the system established under that programme can be used to fulfil the following functions:

.....

(e) to contribute to the search and rescue support service (SAR) of the COSPAS-SARSAT system by detecting distress signals transmitted by beacons and relaying messages to them"

- ★ **The Search and Rescue (SAR) Service of Galileo consists of two distinct elements:**
 - ★ **The Forward Link Alert Service:** Contribution to the *Cospas-Sarsat* MEOSAR Programme:
 - ★ Contributes to MEOSAR Global coverage by providing space and ground segment contribution
 - ★ Contributes to Cospas-Sarsat system by detection/localization data of 406MHz distress beacons
 - ★ **The Return Link Alert Service:** it provides the users in distress an acknowledgment message informing them that the alert has been detected and located

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SAR/Galileo Forward Link Service



Contribution to Cospas-Sarsat MEOSAR Programme with an operational infrastructure qualified according to Cospas-Sarsat Standards



Ground Segment Component: 3 EU MEOLUTs in Network

- EU/Maspalomas MEOLUT
- EU/Spitzbergen MEOLUT
- EU/Larnaca MEOLUT
- MEOLUT Tracking Coordination Facility in Toulouse

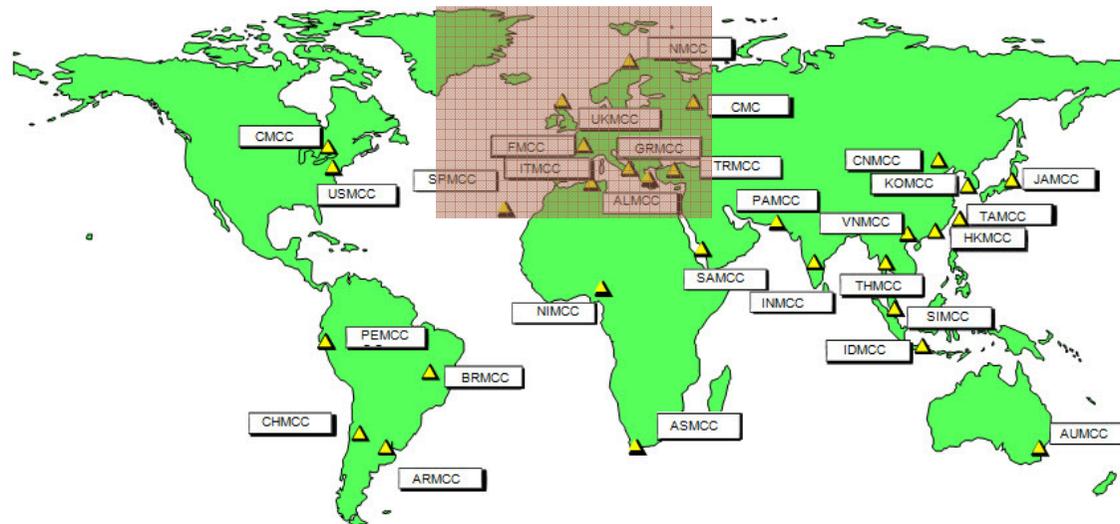


Space Segment Component: SAR Repeaters on board each Galileo satellite:

- 2 IOV SARR (No SARR on IOV FM1/FM2)
- 22 FOC SARR (in deployment)

★ SAR/Galileo Forward Link Service Users:

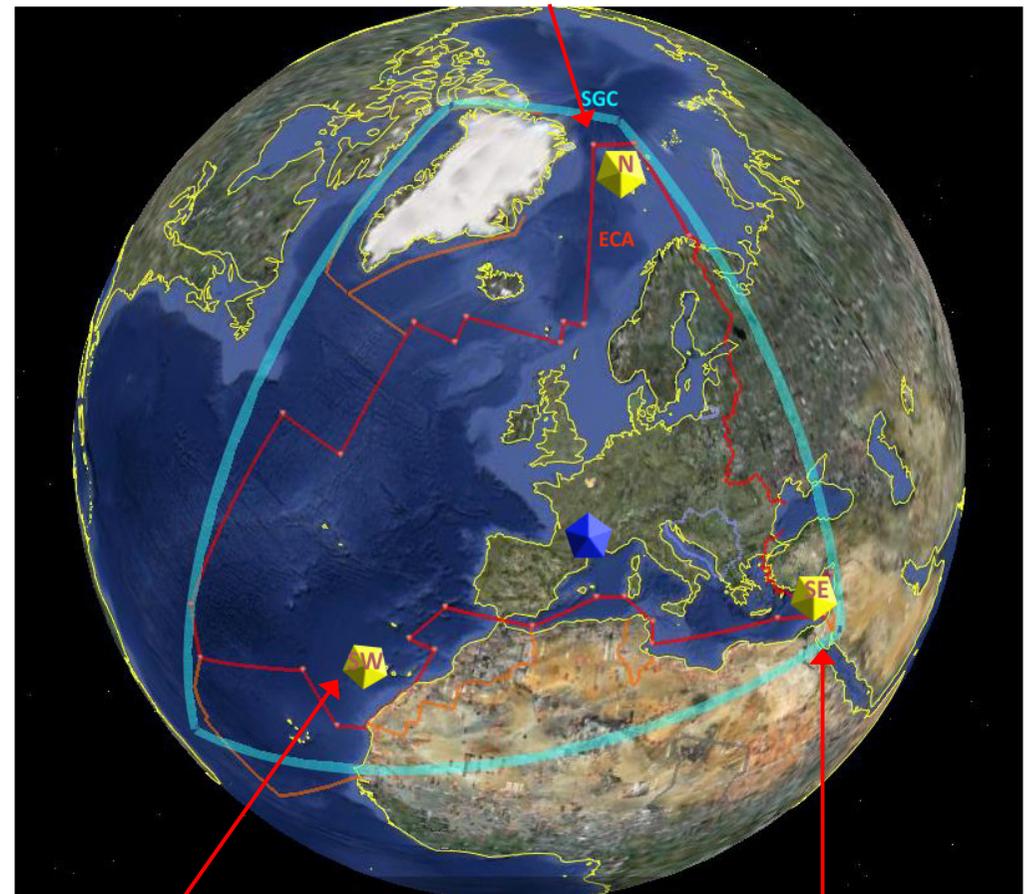
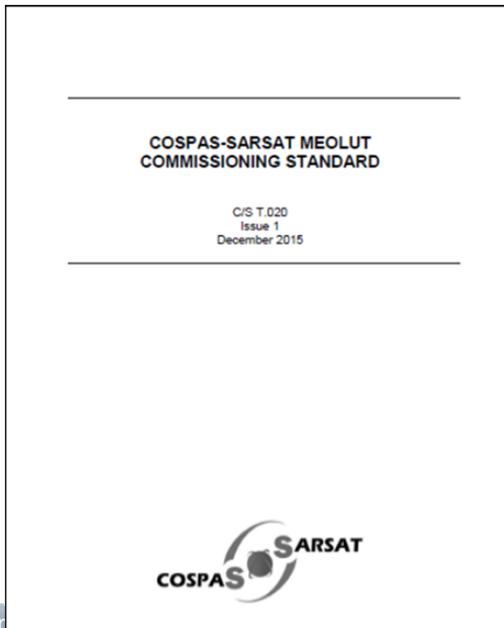
- ★ All Cospas-Sarsat MEOLUTs: MEOLUTs are directly receiving the distress signals relayed by the SARR
- ★ Cospas-Sarsat MCC: All the MCCs which are at least partially within the European SAR Coverage Area of Galileo
- ★ Indirectly: all beacon owners



★ **3 MEOLUTs to cover SAR areas over geographical Europe**

1. EU/ MASPALOMAS MEOLUT
2. EU/LARNACA MEOLUT
3. EU/SPITZBERGEN MEOLUT

★ **Infrastructure compliant with Cospas-Sarsat Standard**



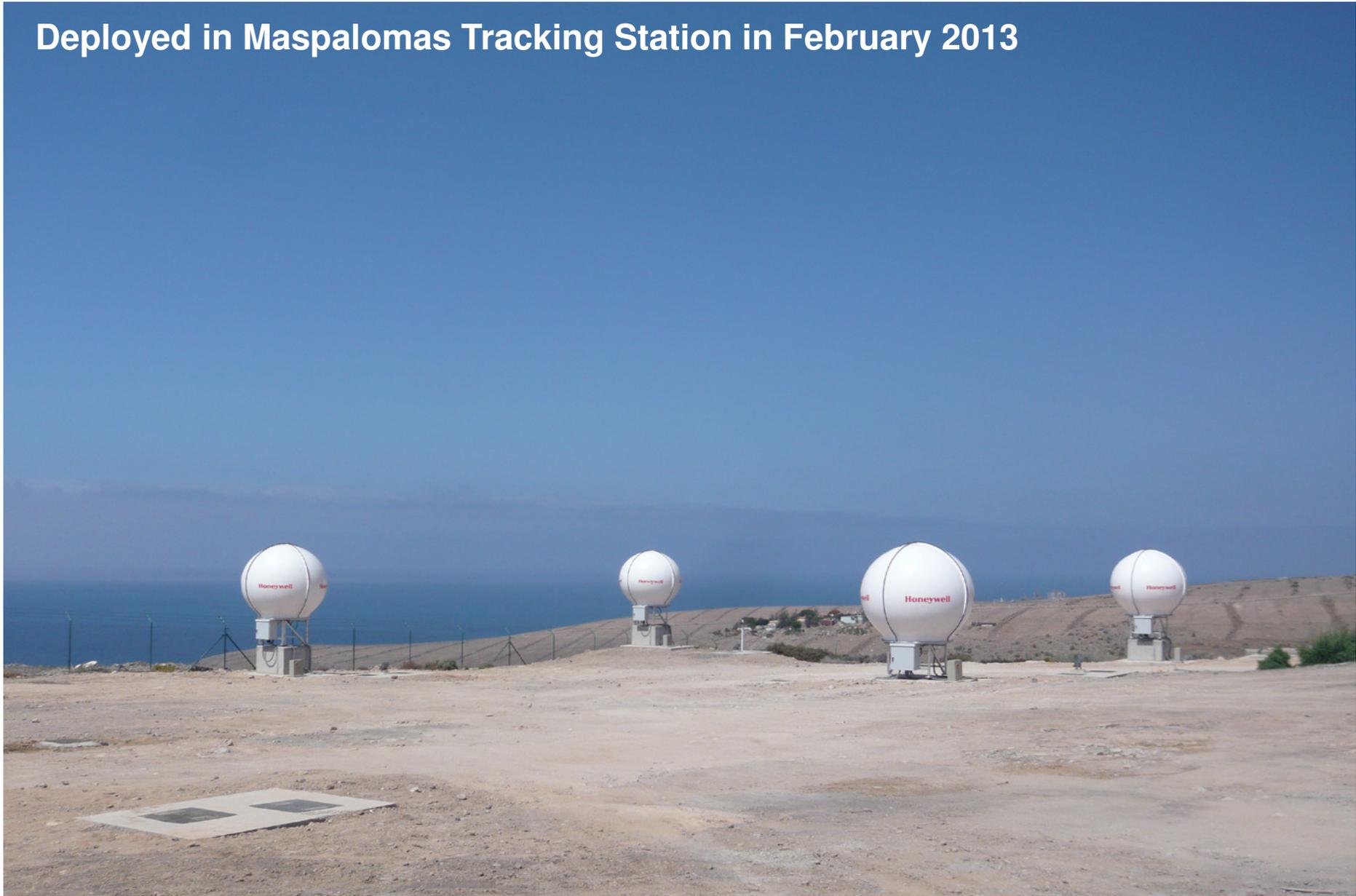
EU/Spitzbergen MEOLUT

EU/Masplomas MEOLUT

EU/Larnaca MEOLUT

EU/MASPALOMAS MEOLUT

Deployed in Maspalomas Tracking Station in February 2013



Deployed in Makarios Teleport in July 2013



Deployed in Svalsat Station in November 2013



★ **MEOLUT Tracking Coordination Facility (MTCF)**

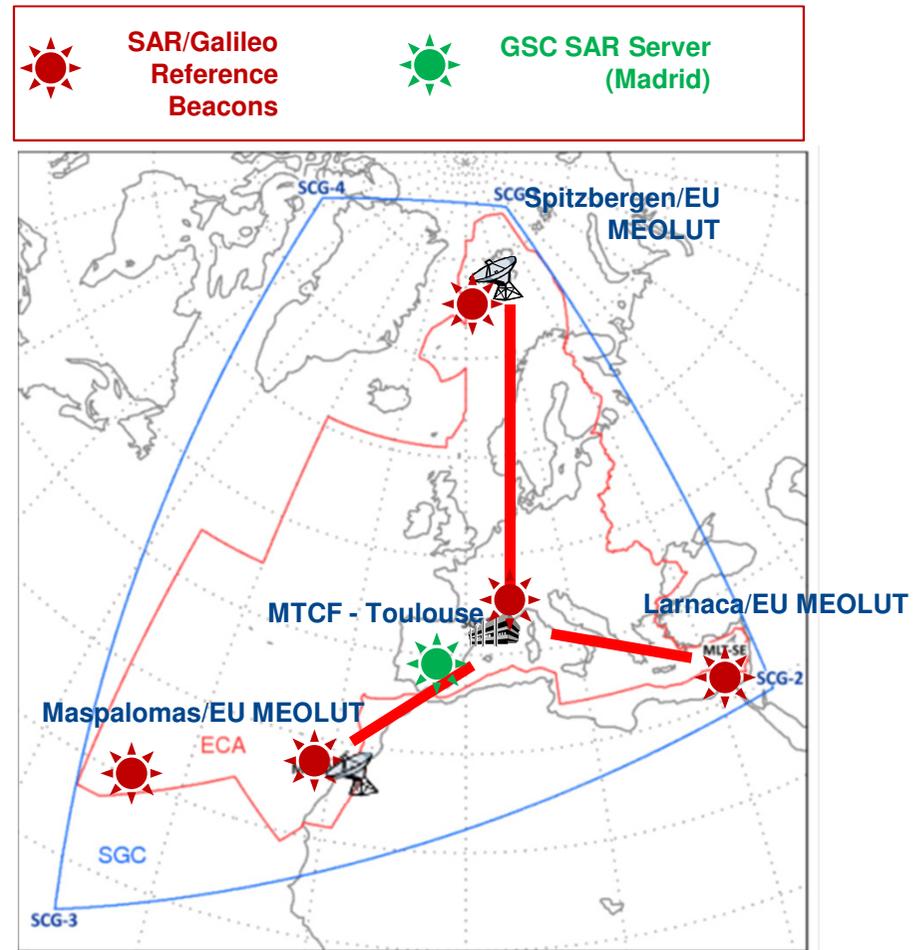
- ★ Coordinates the tracking of the MEOLUTs to improve the performances
- ★ Allow exchange of data with other MEOLUTs

★ **5 MEOSAR Reference Beacons**

- ★ Monitoring the performances of the services

★ **GSC SAR Server**

- ★ Distribution of orbit data to MEOSAR users



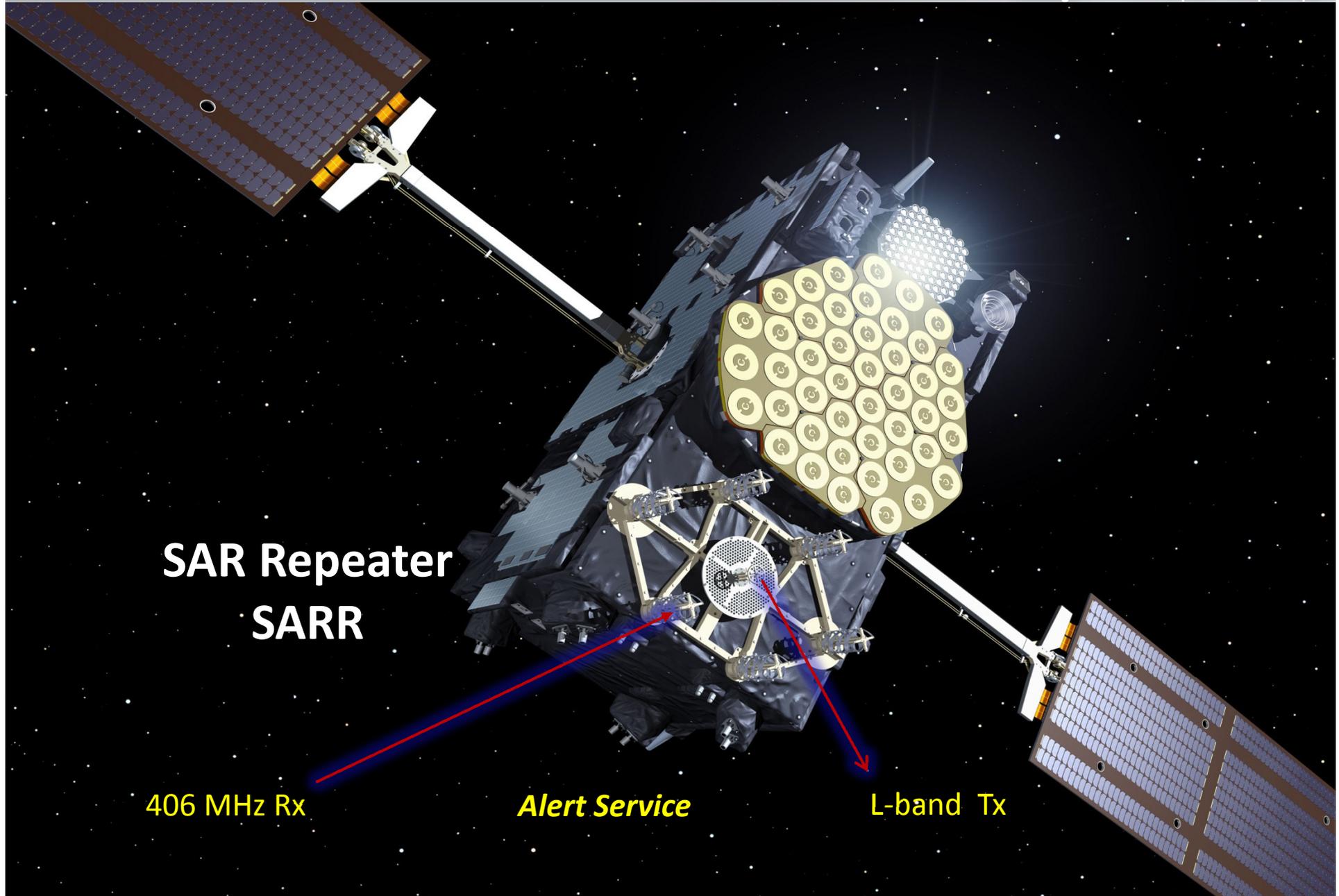
- ★ **Search and Rescue Repeaters on board each Galileo satellite***
- ★ **Main Characteristics:**
 - ★ **Reception: RHCP in uplink frequency 406.05 MHz, G/T ~ -13 dB/K**
 - ★ **Transmission: LHCP in downlink frequency of 1544.1 MHz, EIRP ~17dBW**
 - ★ **Several operating modes**
 - ★ **Narrow Band (50kHz) / Wideband (90kHz)**
 - ★ **Automatic Level Control (ALC) / Fixed Gain Mode (FGM)**
 - ★ **Default Mode: ALC 90kHz**
- ★ **The SAR Repeaters are being commissioned following Cospas-Sarsat Standard**
- ★ **Full description provided under Cospas-Sarsat T.16 Document**

* (except IOV FM1/FM2)

SAR/Galileo Forward Link Service Space Segment



Navigation solutions powered by Europe



**SAR Repeater
SARR**

406 MHz Rx

Alert Service

L-band Tx

SAR/Galileo Service Space Segment Deployment

Cospas-Sarsat Satellite ID	GALILEO Satellite Name	Orbital Slot	Launch ID	Launch Date	Availability Date for SAR	CS Commissioning Report
411	GSAT 0101	B5	L1	21 October 2011	2012	No SARR; only RLS
412	GSAT 0102	B6		21 October 2011	2012	No SARR; only RLS
419	GSAT 0103	C4	L2	12 October 2012	2013	June 2013
420	GSAT 0104	C5		12 October 2012	2016	June 2013
414	GSAT 0202	Ecc	L3	27 March 2015	Jan 2016 - April 2016	JC-September 2016
418	GSAT 0201	Ecc		27 March 2015	August 2014	Jan 2016 - April 2016
426	GSAT 0203	A3	L4	27 March 2015	January 2016	JC-September 2016
422	GSAT 0204	A4		27 March 2015	January 2016	JC-September 2016
424	GSAT 0205	A5	L5	10 September 2015	December 2015	JC-September 2016
425	GSAT 0206	A8		10 September 2015	December 2015	JC-September 2016
409	GSAT 0209	C2	L6	17 December 2015	April 2016	JC-September 2016
408	GSAT 0208	C7		17 December 2015	April 2016	JC-September 2016
410	GSAT0210	A2	L7	24 May 2016	September 2016	Council December 2016
411	GSAT0211	A6		24 May 2016	September 2016	Council December 2016

12 Operational SAR Repeaters by September 2016 !

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- ★ **Unique feature of Galileo to provide return channel to the distress beacon for multiple purposes (distress acknowledgment, beacon activation, beacon control...)**
 - ★ Currently under deployment for providing an acknowledgment service to the beacon through a Return Link Message (RLM)
 - ★ Development in coordination with Cospas-Sarsat for full integration into the Cospas-Sarsat MEOSAR system
- ★ **Use the Galileo L1 Navigation Message to broadcast the acknowledgment messages**

- ★ **During the development process two types of acknowledgments are considered in the Return Link Service:**

- ★ **Acknowledgment Type 1 (also called system acknowledgment):**

The Galileo system is the solely responsible for the automatic transmission of a Return Link Message (RLM) to the emitting beacon once the alert has been detected and located

- ★ **Acknowledgment Type 2 (also called RCC acknowledgment):**

The Galileo system sends the RLM to the emitting beacon once it has received the authorization of the RCC (Rescue Coordination Center). This acknowledgment would inform the user that the distress has been received by the RCC.

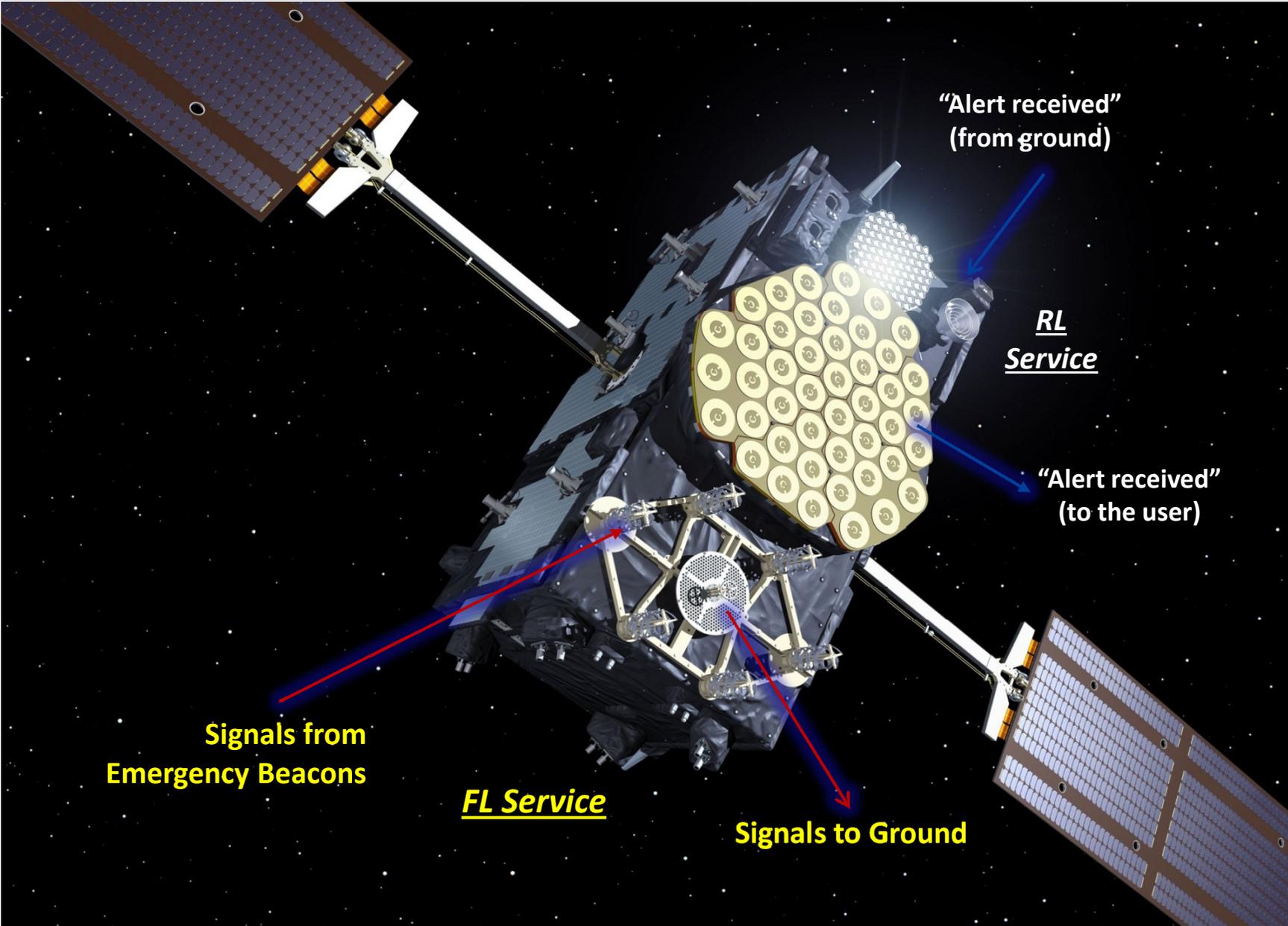
- ★ In March 2012, the European Commission participated to the COMSAR 16 (IMO) and presented a paper on the Return Link Service
 - ★ Outcome of COMSAR 16:

6.22 The Sub-Committee endorsed:

*.4 the acceptability of the Return Link Message (RLM) Type-1 including the optional inclusion of this particular functionality within distress beacons;
and*

.5 the further consideration of the complex matter of RLM Type-2 messages by the ICAO/IMO Joint Working Group.

SAR/Galileo RLS Space Segment Component



- ★ **The RLSP is the Galileo Service Facility in charge of the generation of the Return Link Messages (RLM)**
- ★ **Interface with the Galileo Ground Segment for uplinking of RLM**
- ★ **Interface with the Cospas-Sarsat system (through French MCC) for receiving RLM requests (information of activated distress beacons with RLM capability)**
- ★ **The facility is located in the SAR/Galileo Service Centre, Toulouse France**
- ★ **Operated by the SAR/Galileo Data Service Provider (CNES)**
- ★ **Procurement of the RLSP facility is launched; deployment foreseen at the end of 2017**

- ★ **Return Link Message Request (RLM Request)**
 - ★ **Message sent by the distress beacon (specific RLS protocol on the 406 MHz uplink signal) to the Return Link Service Provider (RLSP) to indicate that it has a Return Link capability**
 - ★ **The protocol is defined for the current generation (T.001) of beacons and is being adapted for the next generation of Cospas-Sarsat beacons**
 - ★ Protocol Applicable as from January 2017
 - ★ **The RLM request is received at the RLSP through the Cospas-Sarsat network**
 - ★ Is included as part of the SIT message (SIT135)
 - ★ Follows a specific routing through the FMCC which interfaces with RLSP

- ★ **Return Link Message (RLM)**
 - ★ Message sent by the Galileo system to the beacon through the Galileo L1 signal (1575.42 MHz)
 - ★ Defined in Galileo Signal in Space ICD, version 1.2 (May 2014)
 - ★ Two types of RLMs: short RLM (80 bits) and long RLM (160 bits)

Return Link Service	Beacon ID		Message Code				Short-RLM Parameters Field																
	60		4				16																
	Bit 1**	To..	Bit 60	Bit 61	Bit 62	Bit 63	Bit 64	Bit 65	Bit 66	Bit 67	Bit 68	Bit 69	Bit 70	Bit 71	Bit 72	Bit 73	Bit 74	Bit 75	Bit 76	Bit 77	Bit 78	Bit 79	Bit 80
Acknowledgment Service Type-1	15 HEX ID		0	0	0	1	1	0	Spares														Parity
Test Service	15 HEX ID		1	1	1	1	Spares														Parity		

★ RLM reception at the distress beacon

- ★ The RLMs message will be sent through 2 satellites in visibility of the beacon. The choice of the satellite is made by the RLSP based on the beacon location information and perceived link quality
- ★ The beacon cannot detect which satellites will be used for RLM transmission
→ needs to track all Galileo satellites in view
- ★ The GNSS receiver in the beacon must be maintained ON during certain periods to ensure the reception of the RLM (activation sequence is described in Cospas-Sarsat Documentation)
- ★ Upon Reception of the Return Link Message, the Beacon will modify its forward link alert message (FLAM) to indicate to the system that the RLM has been well received (to trigger the end of the RLM transmission by Galileo)

- ★ **Standardization Activities in IEC**
 - ★ Interface between the GNSS receiver and distress beacon is standardized: IEC has developed a new IEC 61162-1 NMEA sentence for the RLS message



National Marine Electronics Association

International Marine Electronics Association

Technical Bulletin

Amendment to NMEA0183 Version 4.10

AT 0183 20150806

NMEA 0183 Amendment

An amendment is a technical specification that is publically available and will be added to this version at a later date altering this version to a new version.

This document contains the final approved NMEA 0183 / IEC 61162-1 sentence for:

- RLM – Return Link Message

This Amendment had been reviewed and approved by NMEA and IEC TC80 Working Group 6 with assistance from Cospas Sarsat Council.

RLM – Return Link Message

The RLM sentence is used to transfer a Return Link Message received by a Return Link Service (RLS) compatible GNSS Receiver from a Cospas-Sarsat recognized Return Link Service Provider (RLSP) to an RLS compliant Cospas-Sarsat 406 MHz Beacon.

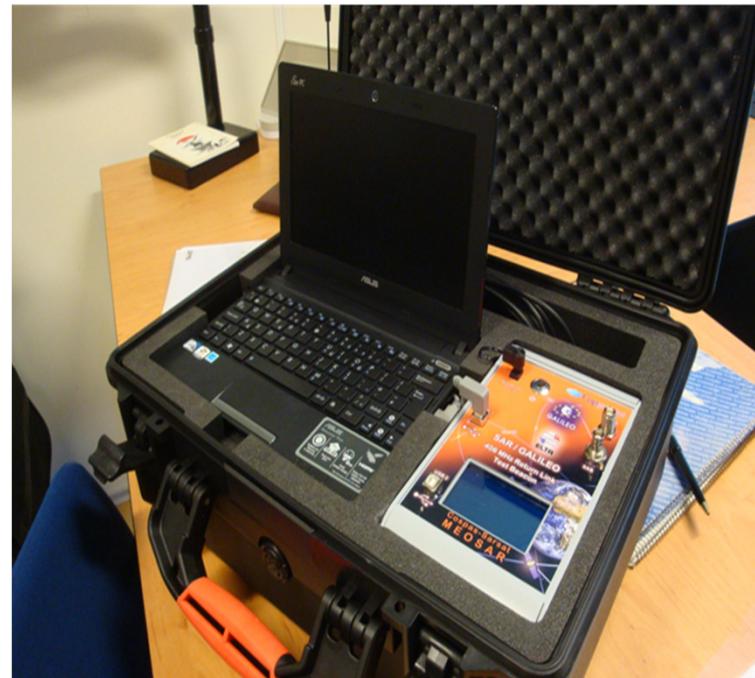
The RLM sentence supports communications to an emitting beacon once a distress alert has been detected, located and confirmed. The communications may include acknowledgement of the alert to the emitting beacon as well as optional text messages, and may also include remote beacon configuration and testing.

The European GNSS (Galileo) Open Service Signal In Space Interface Control Document Issue 1.2 (Galileo OS SIS ICD) defines the content and structure of Fields 1, 3, and 4.

This sentence cannot be queried. All fields in the RLM sentence cannot be null.

- ★ **IOV Test Campaign executed from October 2013 to March 2014**
 - ★ RLS Capacity (GMS + Satellites)
 - ★ RLM delivery time by the GALILEO System and Global coverage
 - ★ End-to-end (Forward + Return Link) Loop

- ★ **Cospas-Sarsat MEOSAR D&E Test Campaign – Operational Test #5**
 - ★ Large scale test campaign involving several Cospas-Sarsat MCCs
 - ★ Beacon spread globally
 - ★ Q4 2016



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Galileo Initial Service Declaration in Sept. /Oct. 2016



Readiness of the SAR/Galileo Forward Link Service Infrastructure

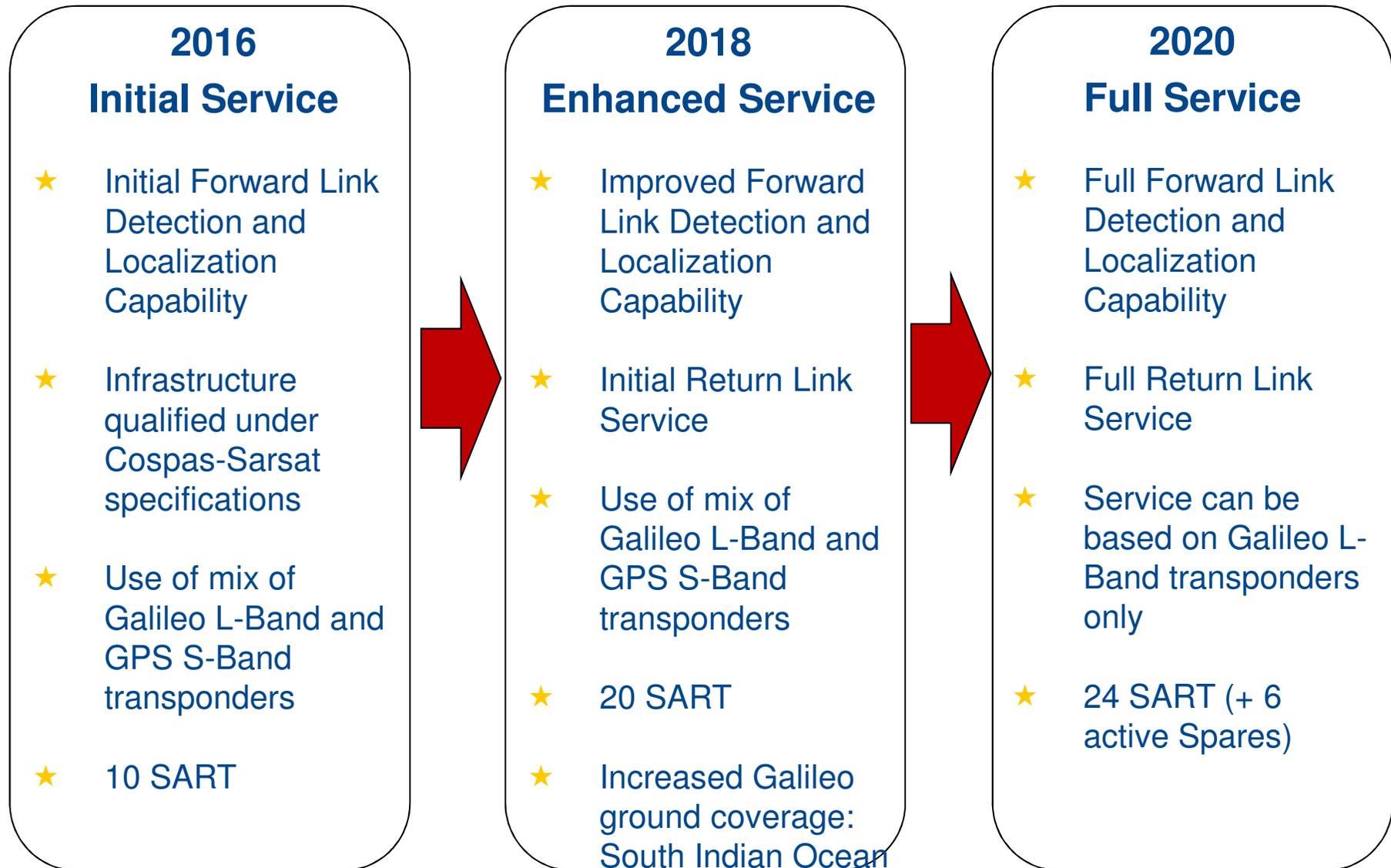
- ★ **Contribution to Cospas-Sarsat MEOSAR Early Operational Capability (EOC) phase**
 - ★ **Declaration of EOC by Cospas-Sarsat Council expected in December 2016**

- ★ **Based on commissioned infrastructure: 10 SART and 3 MEOLUTs**

- ★ **Service Operations managed by the CNES (acting as SAR/Galileo Data Service Provider)**

KPI	Description
KPI #1	Detection Service Availability: 99%
KPI #2	<p>Quality of the Localization Service</p> <ul style="list-style-type: none"> • 98% of localization in 5 km • 80% of localization in 2 km <p>Assessed in single burst and after 10 minutes</p>
KPI #3	<p>Per MEOLUT Availability</p> <ul style="list-style-type: none"> • 97.6% in Nominal mode • 99.9% in Nominal or Degraded Mode

- ★ **Mid-2016: Kick-Off Operational RLSP Development**
- ★ **End 2016: Pre-Operational RLSP available for Cospas-Sarsat Test Campaign on RLS**
- ★ **Mid-2017: Deployment of operational RLSP in SAR/Galileo Service Center (CNES, Toulouse)**
- ★ **End-2017: Connection of operational RLSP to Galileo Operational Chain for system validation and qualification**
- ★ **Beginning-2018: Operational RLSP available for testing purposes (RLS Test Protocol)**
- ★ **Mid-2018: Start of Initial Return Link Service**



- ★ **Forward Link Service:**
 - ★ **Extension of the SAR Ground Segment to further contribute to Cospas-Sarsat MEOSAR global coverage**
 - ★ **Compatibility with Second Generation Beacons**

- ★ **Return Link Service: additional services**
 - ★ **RLS Type-2**
 - ★ **Remote Beacon Activation**
 - ★ **Two-way messaging**

- ★ **A substantial infrastructure and operations have been procured by the Galileo Programme to support the Search and Rescue applications, in particular in support to Cospas-Sarsat MEOSAR Programme (close to 100M€ over 10 years)**
- ★ **A significant step will be achieved with the Initial Service Declaration in 2016**
- ★ **The Return Link Service implementation is well on its way and will provide significant added value to the SAR Service**
- ★ **Strong interaction between user community, beacon manufacturers and the Galileo Programme is required in order to develop the right features**