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Europe's Contribution to Emergency Operations

Larnaca / JRCC ICAO Workshop 5-6 October 2023

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AGENDA

- 1. SAR Galileo State of Play**
- 2. SAR Galileo new Services**



When there are no other means: QuickFacts 2022



- SAR Events: 1144
- People Rescued: 3.223
- In Europe: 390 events which in contributed to ~ 100 people (2.8 people per event)





SAR/Galileo Programme General Overview

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Galileo Services

Open Service (OS)
Public Regulated Service (PRS)
Search and Rescue Service (SAR)
High Accuracy Service (HAS)
Commercial Service-Authentication (CS)
Emergency Warning Service (EWS)



1



2

2 Forward Link Service Coverage Areas (ECA and IOCA) as a contribution to Cospas-Sarsat MEOSAR Programme with:

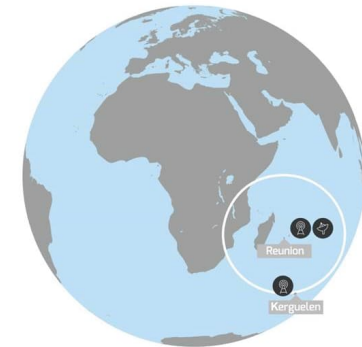
- 4 European MEOLUT acting as one deployed in: Maspalomas (Spain) , Spitzbergen (Norway) , Larnaca (Cyprus), Reunion (France).
- 24 SAR L-Band SAR repeaters onboard the Constellation
- 1 Coordination and Monitoring Facility deployed in the SAR/Galileo Service Centre in Toulouse.
- 7 Reference Beacons spread over the Service Areas for Service Monitoring purposes.

Return Link Service a global service enabling a communication link back to the originating emergency beacon through the Galileo Navigation Signal in Space (I/NAV E1) sending a confirmation message (RLM) to the user that the distress signal has been localized by the System.

European Coverage Area (ECA)



Indian Ocean Coverage Area (IOCA)





SAR Galileo

Contribution to the worldwide SAR effort in Cospas-Sarsat

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- 1 SAR payloads on board of Galileo satellites
- 2 Ground Segment for the Forward Link
- 3 Ground Segment for the Return Link



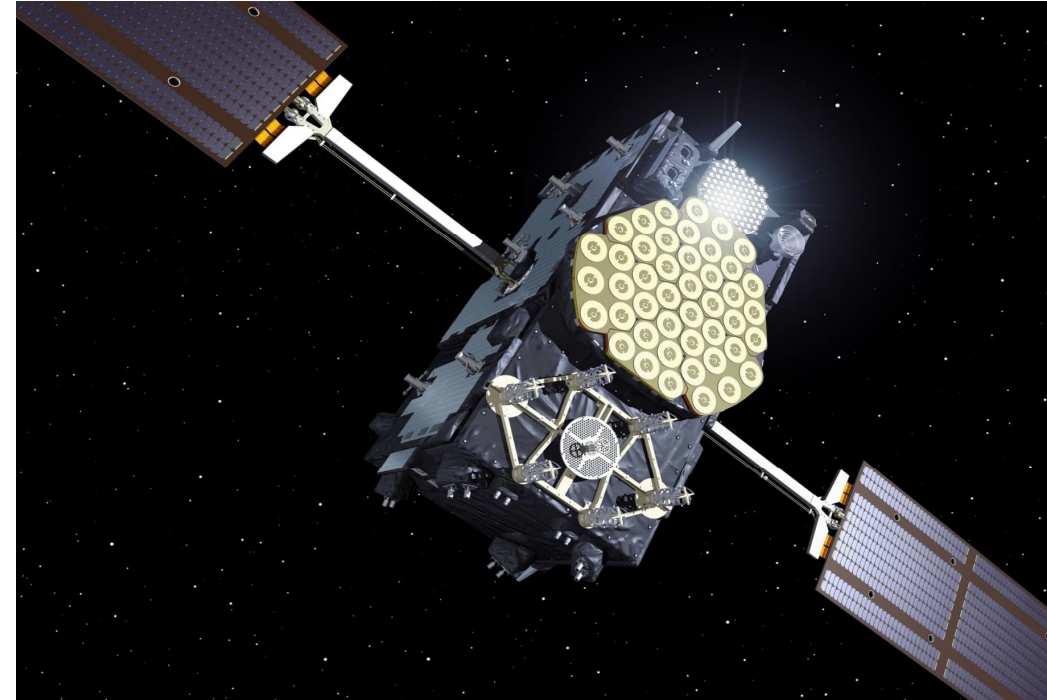
+ Galileo Contribution

- the largest Space Segment (L-band) contributor
- the largest Ground Segment contributor (4 MEOLUTS)
- the only Return Link Service Provider





SAR/Galileo Space Segment



Launch of GSAT0103 and GSAT0104 first two Galileo Satellites with SAR payloads on 12th of October 2012

+ Today

- 24 Operational Satellites
- 2 new more ready to be added



SAR/Galileo Space Segment

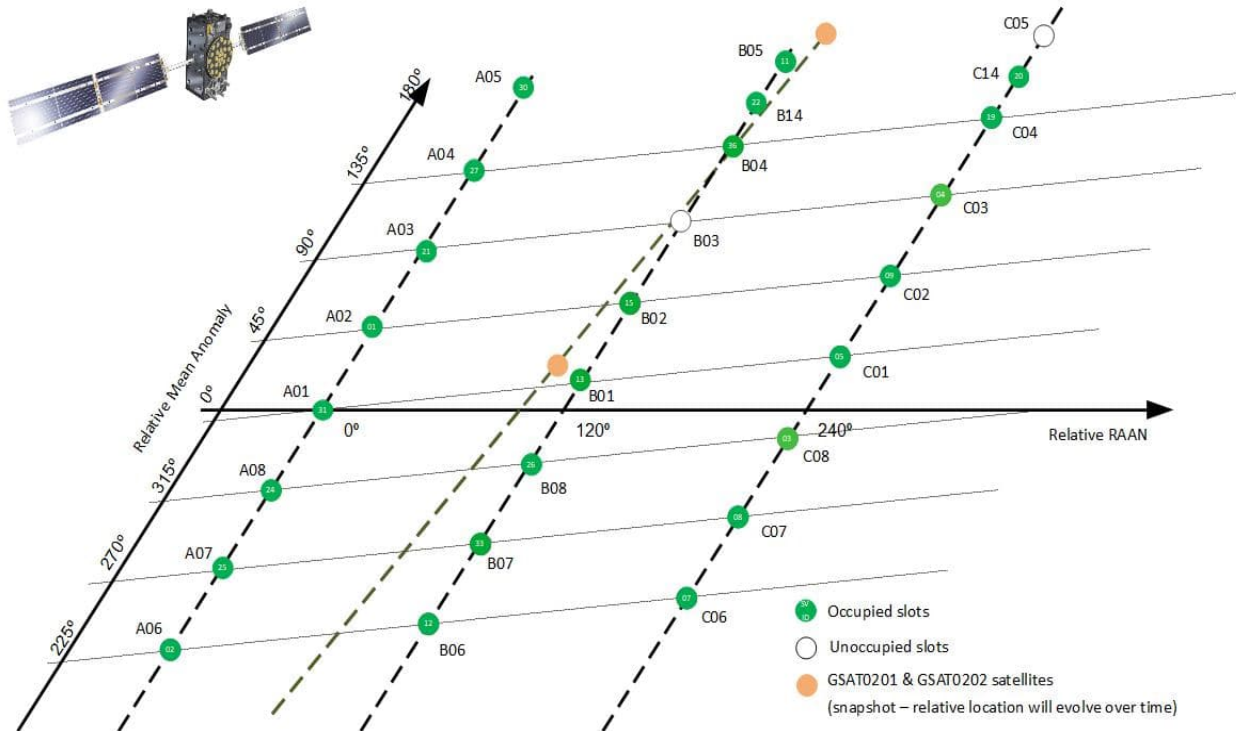
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Current Status

Reported at the Galileo GNSS Service Centre

<https://www.gsc-europa.eu/>



Satellite Name	SV ID (PRN)	Cospas-Sarsat ID	Operating Mode [kHz]	FLS Operational Status	RLS Operational Status
GSAT0101 ¹	E11	N/A	-	N/A	USABLE
GSAT0102 ²	E12	N/A	-	N/A	USABLE
GSAT0103	E19	419	ALC90	F	USABLE
GSAT0104 ²	E20	420	ALC90	F	NOT AVAILABLE
GSAT0201	E18	418	ALC90	F	USABLE
GSAT0202	E14	414	ALC90	F	USABLE
GSAT0203	E26	426	ALC90	F	USABLE
GSAT0204 ²	E22	422	ALC90	OFF	NOT USABLE
GSAT0205	E24	424	ALC90	F	USABLE
GSAT0206	E30	430	ALC90	F	USABLE
GSAT0207	E07	407	ALC90	F	USABLE
GSAT0208	E08	408	ALC90	F	USABLE
GSAT0209	E09	409	ALC90	F	USABLE
GSAT0210	E01	401	ALC90	OFF	NOT USABLE
GSAT0211	E02	402	ALC90	F	USABLE
GSAT0212	E03	403	ALC90	F	USABLE
GSAT0213	E04	404	ALC90	F	USABLE
GSAT0214	E05	405	ALC90	F	USABLE
GSAT0215	E21	421	ALC90	F	USABLE
GSAT0216	E25	425	ALC90	F	USABLE
GSAT0217	E27	427	ALC90	F	USABLE
GSAT0218	E31	431	ALC90	F	USABLE
GSAT0219	E36	436	ALC90	F	USABLE
GSAT0220	E13	413	ALC90	F	USABLE
GSAT0221	E15	415	ALC90	F	USABLE
GSAT0222	E33	433	ALC90	F	USABLE
GSAT0223	E34	434	ALC90	F	USABLE
GSAT0224	E10	410	ALC90	F	USABLE



SAR/Galileo Ground Segment: Overview



1. New SAR/Galileo Site in Greenland hosting the 8th Reference Beacon expected to be ready this fall.
2. All EU MEOLUTs are now fully **technology refreshed** in 2023 - obsolescence free and ready to support Cospas-Sarsat evolutions (i.e. Second Generation Beacons).
3. New MEOLUT in La Reunion and Reference in Kerguelen in support of Indian Ocean Coverage.
4. Backup RLSP infrastructure under procurement for a redundant and more **robust** Return Link



SAR/Galileo Ground Segment: The MEOLUTs (1/2)



SPITSBERGEN MEOLUT
Norway



MASPALOMAS MEOLUT
Spain



LARNACA MEOLUT
Cyprus



SAR/Galileo Ground Segment: The MEOLUTS (2/2)

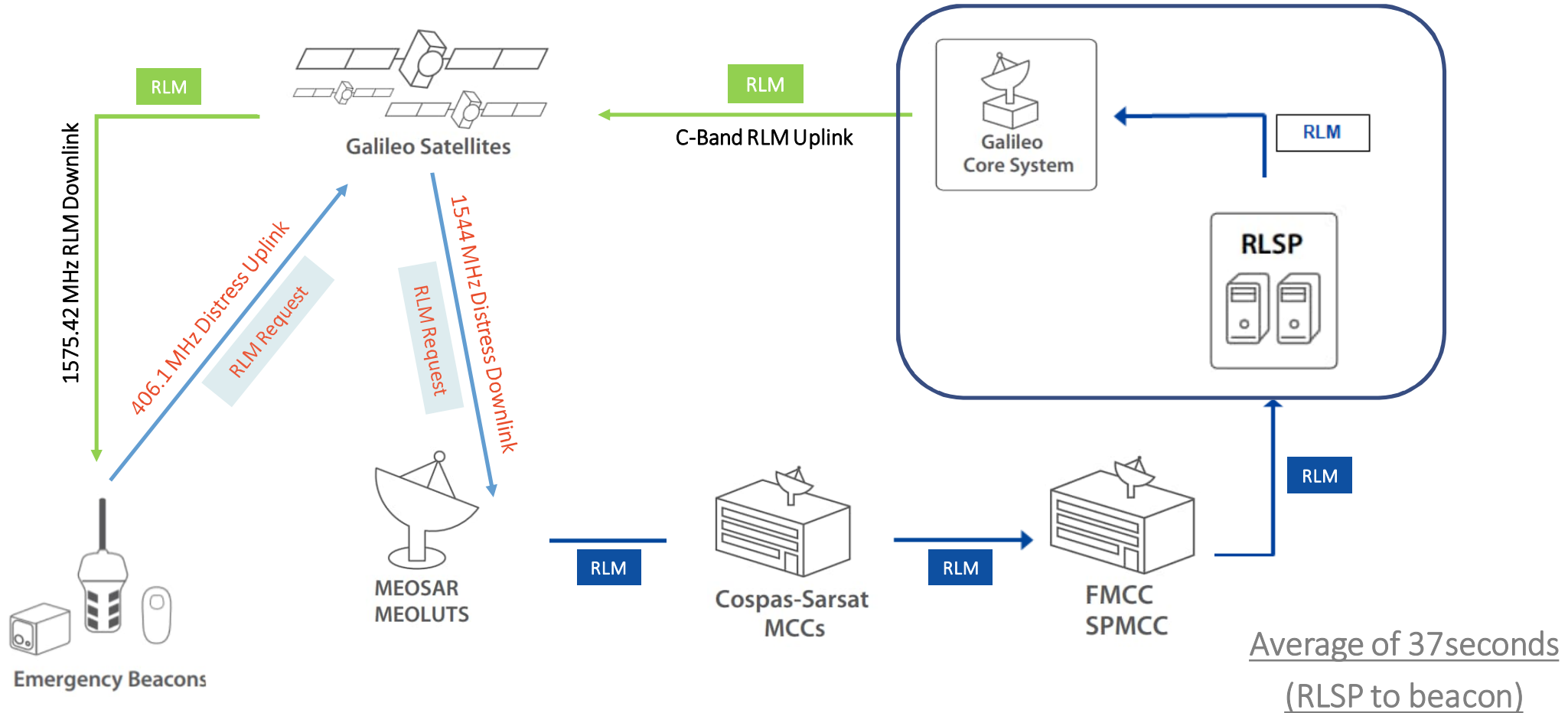


Providing Data since November 2022





SAR/Galileo Ground Segment: The Return Link Service Provider (RLSP)



RLS is the backbone for future Galileo Services

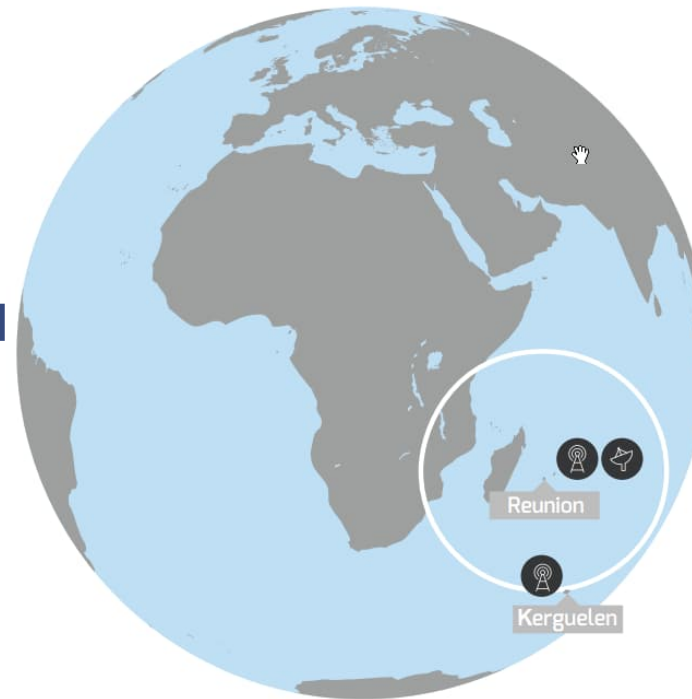


SAR/Galileo Service: The Coverage Areas

European Coverage Area (ECA)



Indian Ocean Area Coverage Area (IOCA)



7 Reference Beacons continuously transmitting are used for Service Monitoring



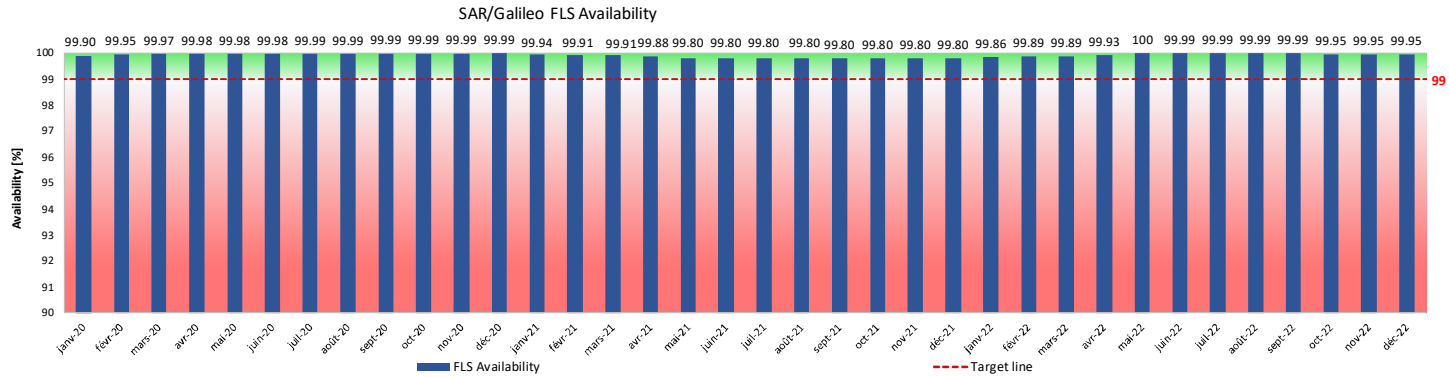
SAR/Galileo Service Performance

Service Availability [2020-2022]

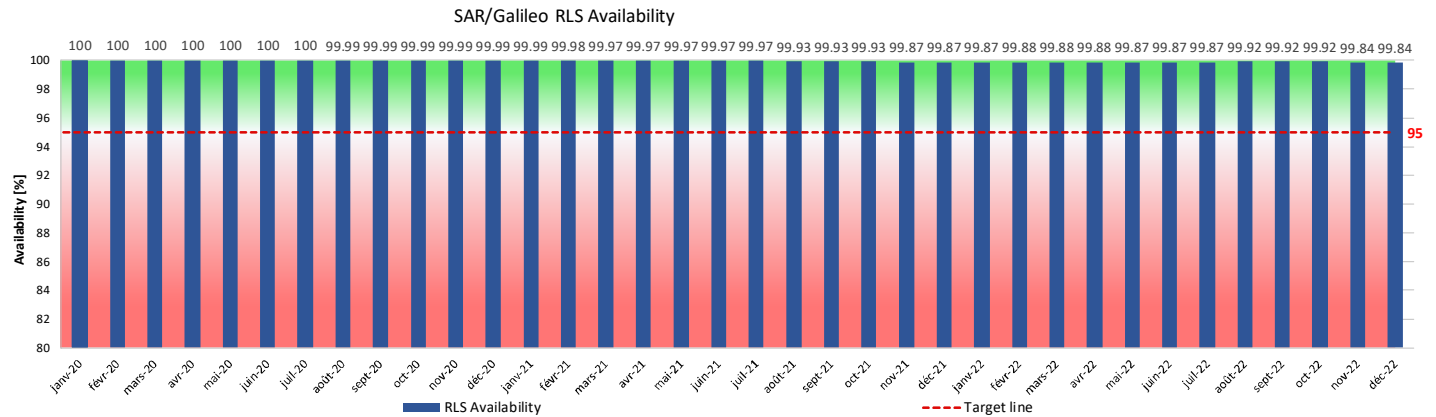
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Galileo
Search and Rescue
Forward Link



Galileo
Search and Rescue
Return Link

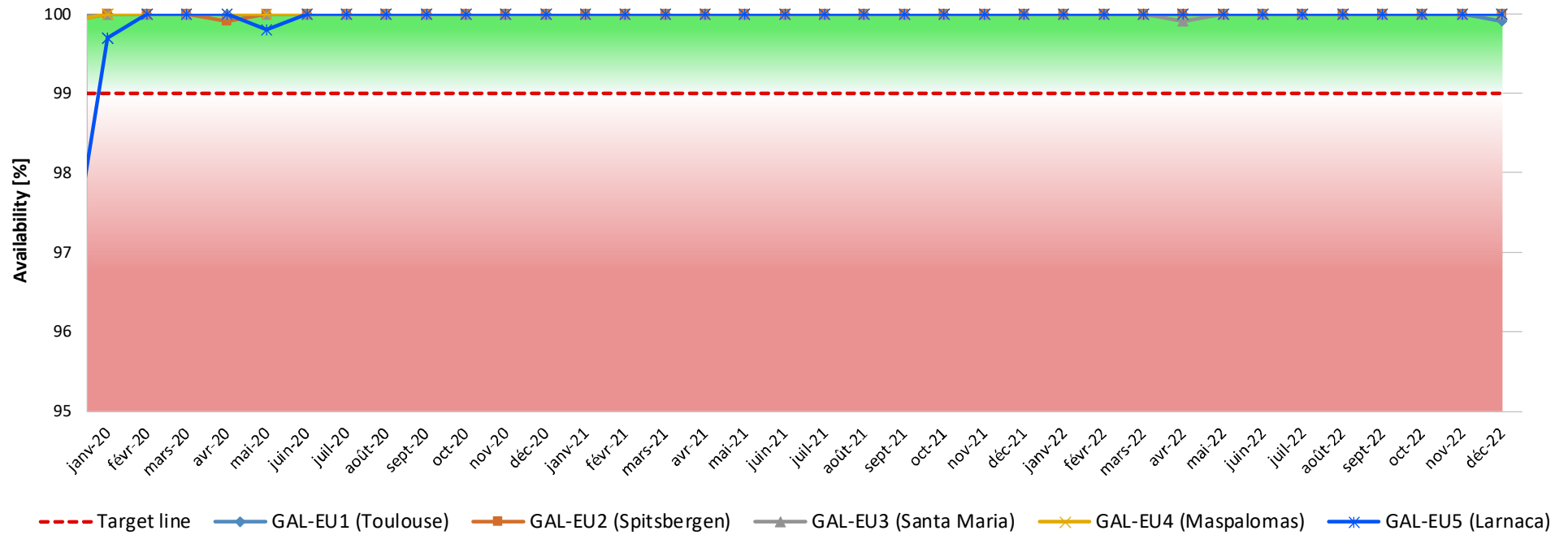




SAR/Galileo Service Performance: Probability of Detection [2020-2022]



Probability of Detection - Valid Message (Nominal or Degraded Status)



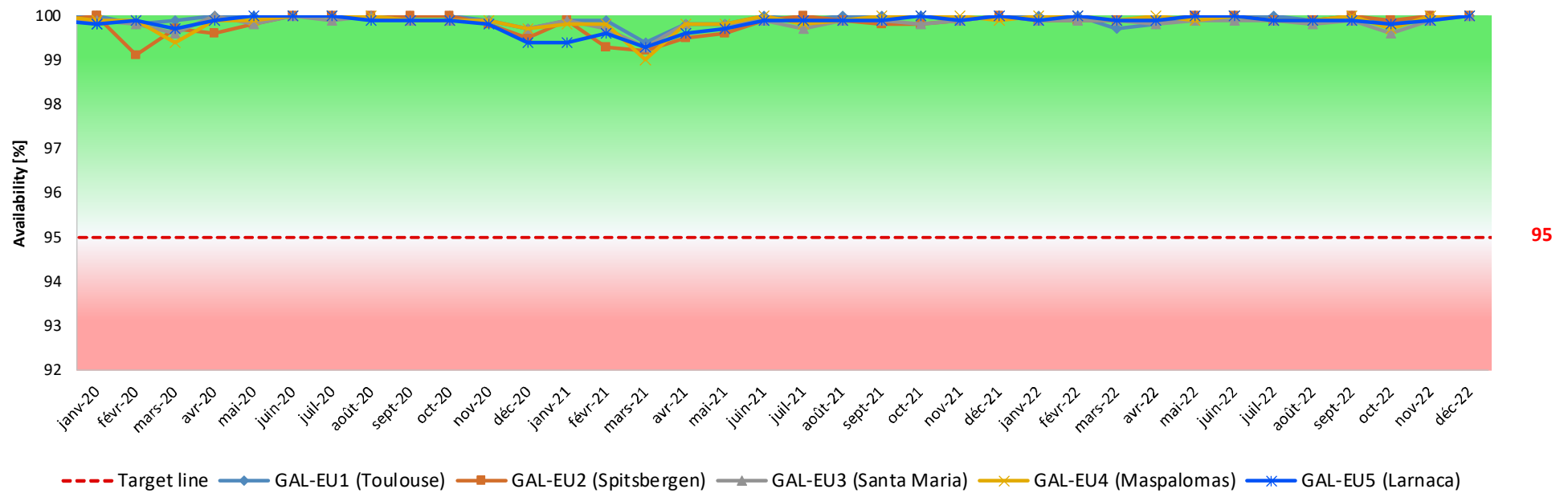


SAR/Galileo Service Performance: Location Probability in 10min within 5km [2020-2022]

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Availability of Successful Location within 5 [km] - From 1 to 12 bursts



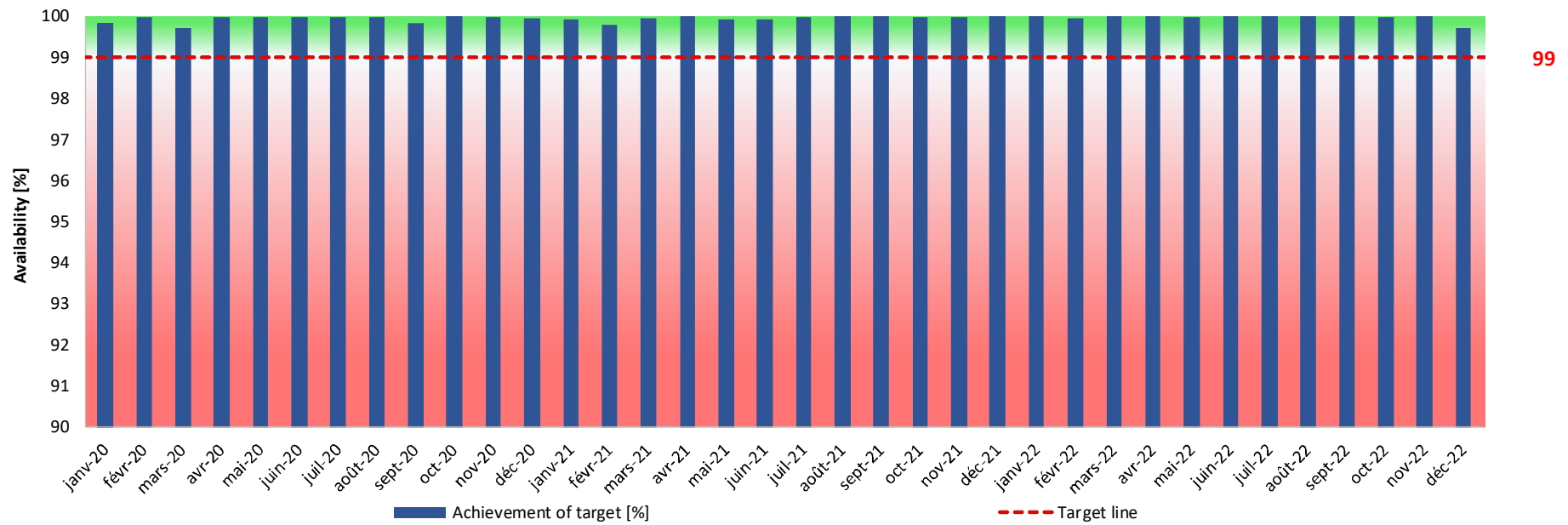
Mean Location Accuracy 784m;



SAR/Galileo Service Performance: Return Link Delivery Latency [2020-2022]



SAR/Galileo RLM Delivery Latency < 15 [min]



The average RLS delivery latency achieved is under 1min computed from Galileo to Beacon.



SAR/Galileo Service Performance: Summary



- Excellent Forward and Return Link Availability $\geq 99.9\%$ which contributed to 390 SAR events with approx. 1,389 people rescued within EU territories during 2022.
- All Service commitments (MPLs) were met.
- Main Performance Metrics:
 1. Forward Link Detection Probability constantly at 100%;
 2. Location Accuracy within 5km $\geq 99.8\%$
 3. Mean Location Accuracy 784m;
 4. Return Link Delivery Latency $<1\text{min}$



All SAR/Galileo Service performance commitments for both Forward and Return Link are published on a Quarterly Basis at the Galileo Service Centre Website (www.gsc-europa.eu)



AGENDA

1. SAR Galileo State of Play
2. SAR Galileo new Services



Galileo Future Services: Enhancing the Galileo Emergency Solutions Portfolio

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1

Galileo

SAR/Remote
Beacon
Activation

The diagram shows a satellite in orbit emitting a yellow beam of light towards a red and white airplane and a blue boat on the water. A yellow signal icon is positioned between the satellite and the ground targets.

2

Galileo

Two Way
Communication

The diagram shows a satellite in orbit emitting a yellow beam of light towards a grey speech bubble on the ground labeled '2W'. A yellow signal icon is positioned between the satellite and the ground target.

The Return Link Channel is the backbone of future evolutions with the following characteristics:

- Low bit rate (10 bits/s); Short messages (80 or 160 bits)
- Global coverage; Reliable (multiple satellites, available with no ground infrastructure)

3

Galileo

Distress
Position
Sharing

The diagram shows a satellite in orbit emitting a yellow beam of light towards a red location pin on a blue circular base. Concentric yellow circles radiate from the pin, and a yellow signal icon is positioned between the satellite and the ground target.

4

Galileo

Emergency
Warning
Service

The diagram shows a satellite in orbit emitting a yellow beam of light towards a smartphone on the ground displaying an 'Alert' message. The smartphone is on a blue circular base with icons for a house, a car, and a person. A yellow signal icon is positioned between the satellite and the ground target.



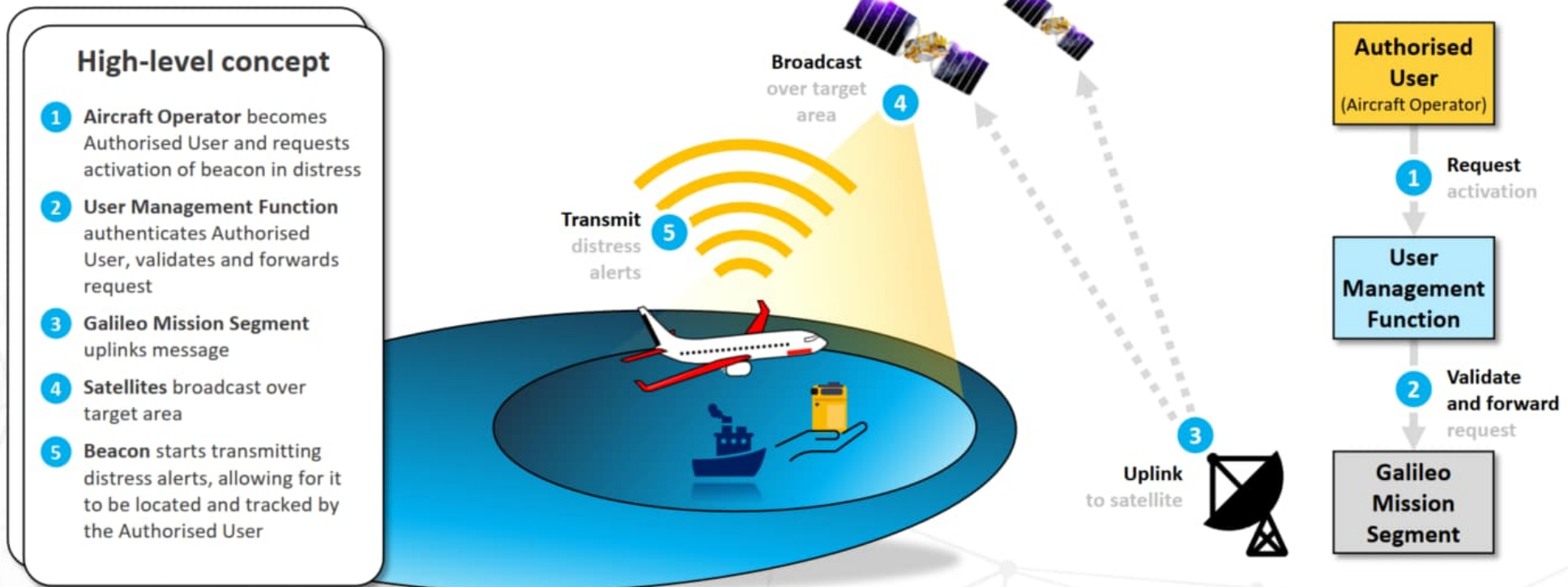
Remote Beacon Activation (RBA)

On-Demand Activation and Tracking of Distress Beacons

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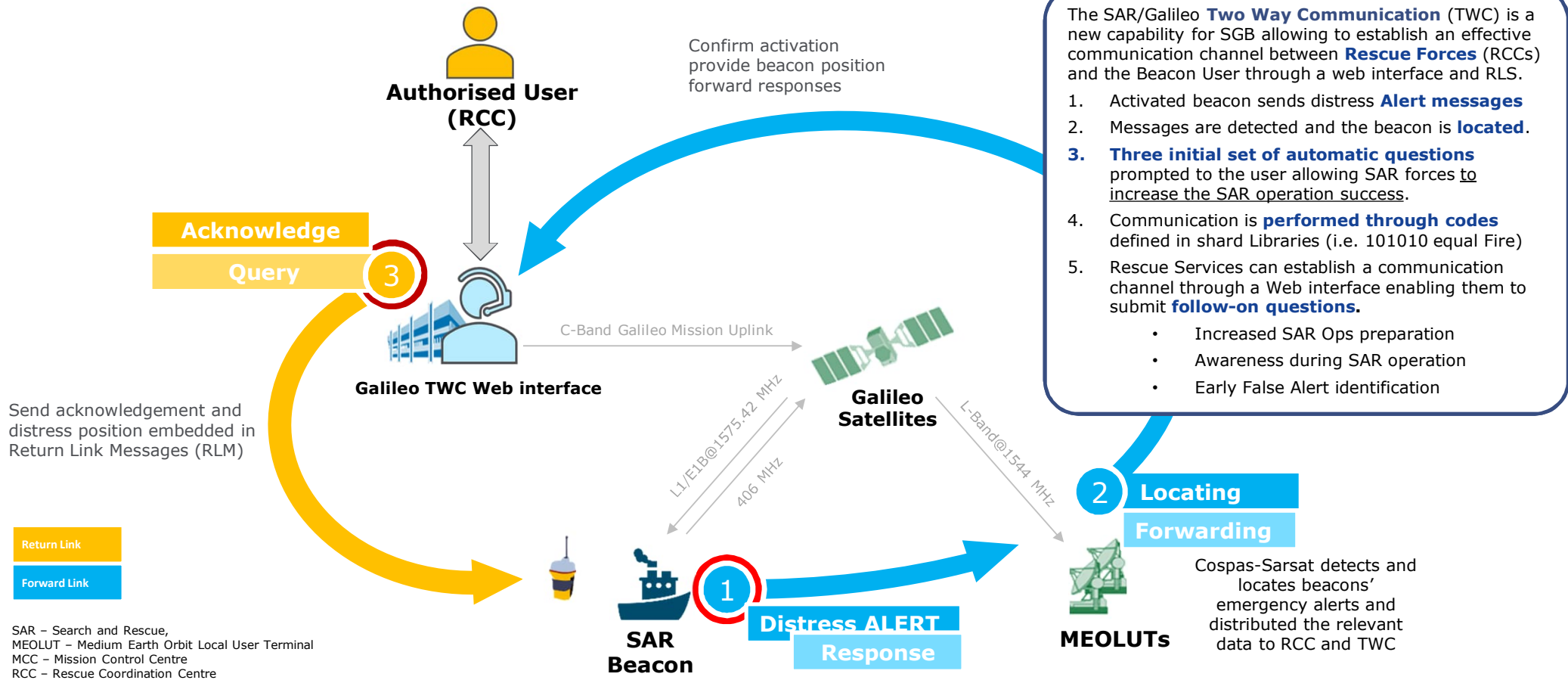
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Two Way Communication (TWC)

Enabling basic but effective communication between the RCC and the persons in distress

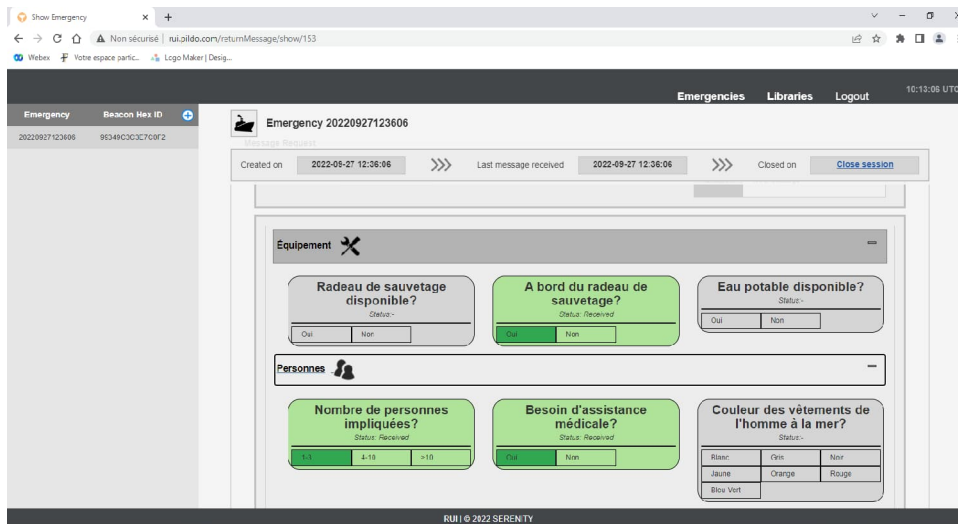


SAR – Search and Rescue,
 MEOLUT – Medium Earth Orbit Local User Terminal
 MCC – Mission Control Centre
 RCC – Rescue Coordination Centre



Two Way Communication (TWC) Maturity Level

2



Cospas-Sarsat expressed general agreement that TWC would be a desirable capability. Work is on going to define the general requirements and delineation of roles as well as the implementation timelines.



SAR/Galileo Distress Position Sharing

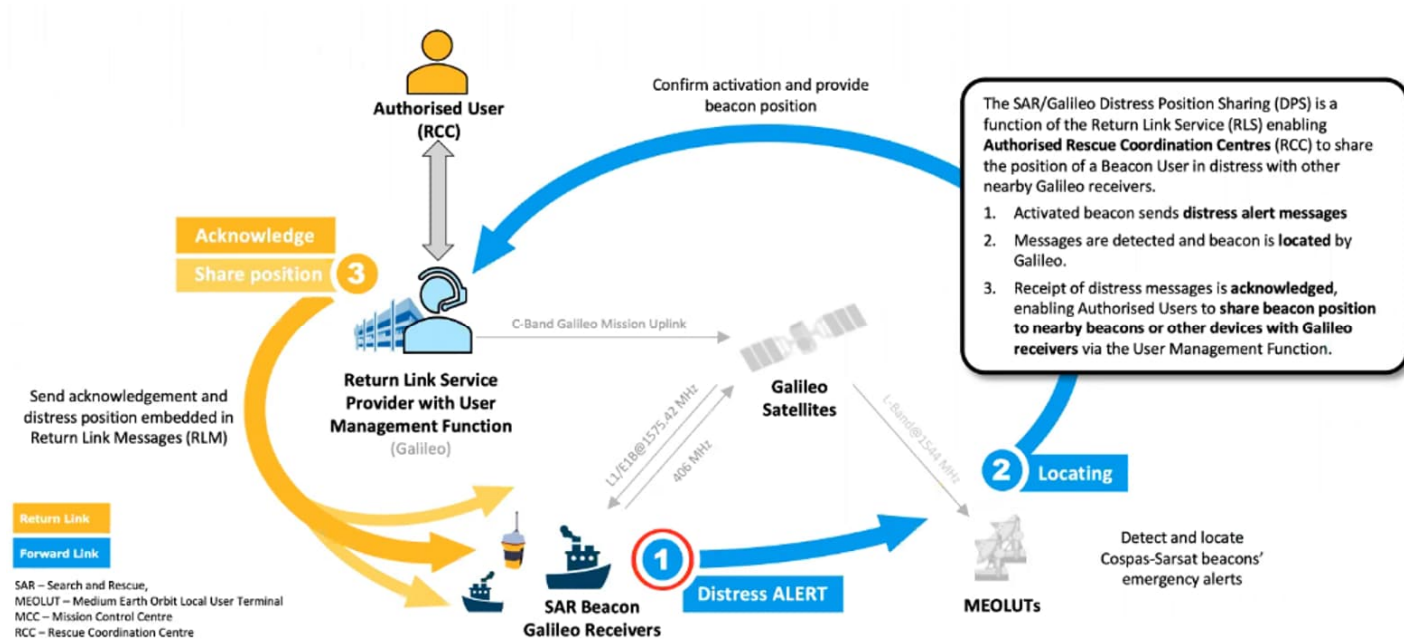
Location Sharing of Distressed People to Potential Help Nearby



3

+ High Level Concept:

- Enrichment of current SAR/Galileo RLS enabling a Authorised SAR Forces to shared confirmed Distress situation with other nearby users or pre-defined groups to accelerate SAR rescue :
- Two identified use cases:
 - At Sea: Inform nearby vessels of the mayday (similar to Distress Alert Relay)
 - At Land: Reach linked people on-zone (other trekking people equipped to react)



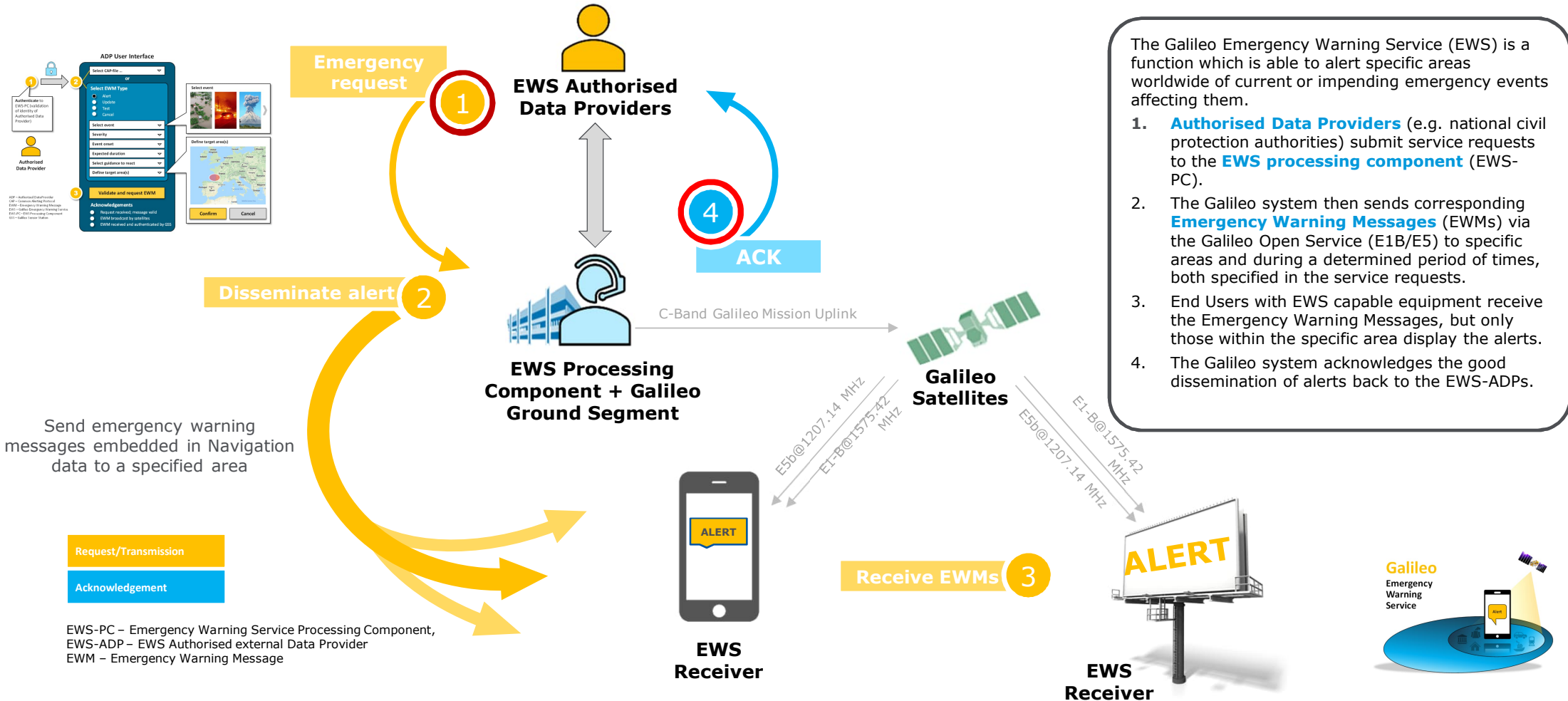


Galileo Emergency Warning Service (EWS)



on-demand broadcast of alert messages and associated guidance to affected population in minutes

4



The Galileo Emergency Warning Service (EWS) is a function which is able to alert specific areas worldwide of current or impending emergency events affecting them.

- 1. Authorised Data Providers** (e.g. national civil protection authorities) submit service requests to the **EWS processing component** (EWS-PC).
- The Galileo system then sends corresponding **Emergency Warning Messages** (EWMs) via the Galileo Open Service (E1B/E5) to specific areas and during a determined period of times, both specified in the service requests.
- End Users with EWS capable equipment receive the Emergency Warning Messages, but only those within the specific area display the alerts.
- The Galileo system acknowledges the good dissemination of alerts back to the EWS-ADPs.

EWS-PC – Emergency Warning Service Processing Component,
 EWS-ADP – EWS Authorised external Data Provider
 EWM – Emergency Warning Message

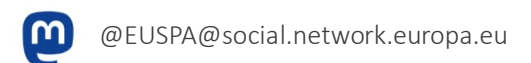
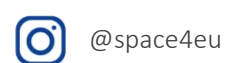
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