Cospas-Sarsat System Overview (Part 1 of 2)

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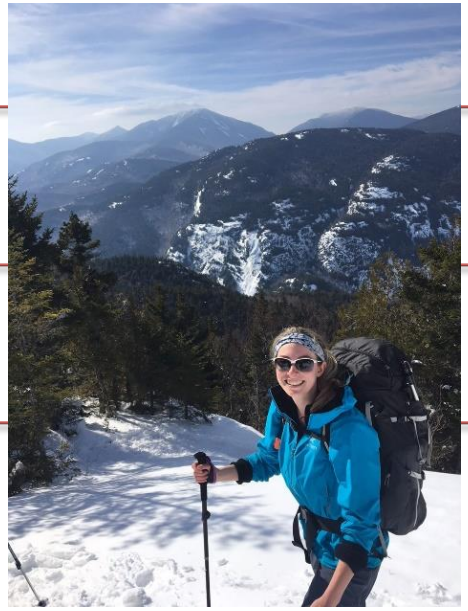
Cospas-Sarsat Secretariat

ICAO Seminar on Satellite-Aided Distress Tracking

October 2022

Contents

- Cospas-Sarsat Programme and organization
- System overview and principles of operation
- System Use (statistics)
- MEOSAR, RLS and SGBs
- GADSS and ELT(DT)s
- SPOC agreements



International Cospas-Sarsat Programme

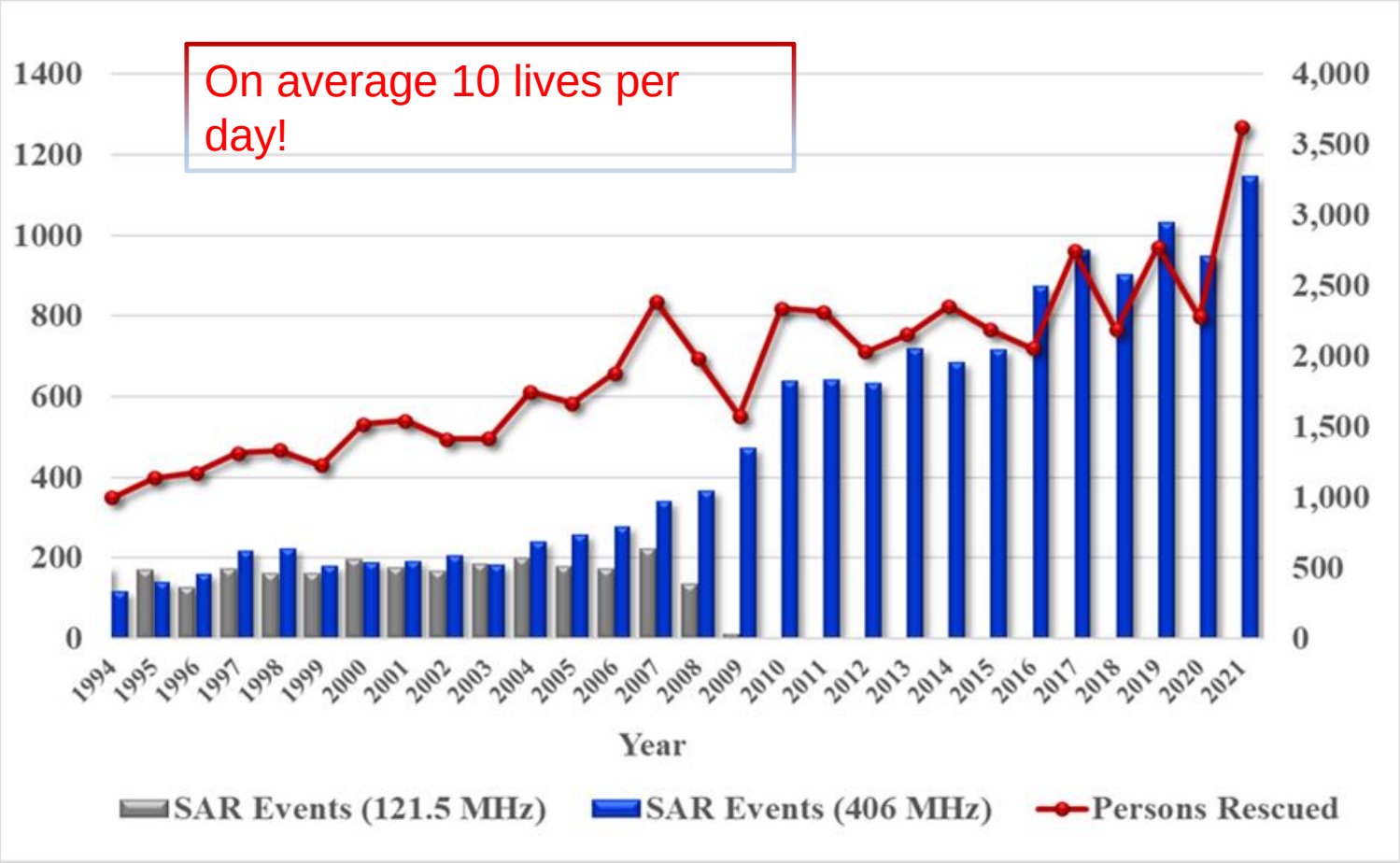
- C/S provides distress alert and location information to Rescue Coordination Centres (RCCs) for aviation, maritime and land users in distress

- Services are provided world-wide and free of charge for the user in distress

- Alerts are provided using satellite systems to relay and process the transmissions of distress radio-beacons operating on 406 MHz (Satellite detection of 121.5 MHz alert ended in Feb 2009)


COSPAS
GEO
Glonass
GPS
Galileo
LEO
Return Link Message
GPS
Glonass
Galileo
GEO
LEO
Autonomous distress tracking of aircraft in flight
RLSP/ GALILEO
BEACON ALERT
SAR Crew Tasked
Distress Notification & Location
Processed Distress Beacon Data
RCC
MCC

Steady Growth and Exponential Success



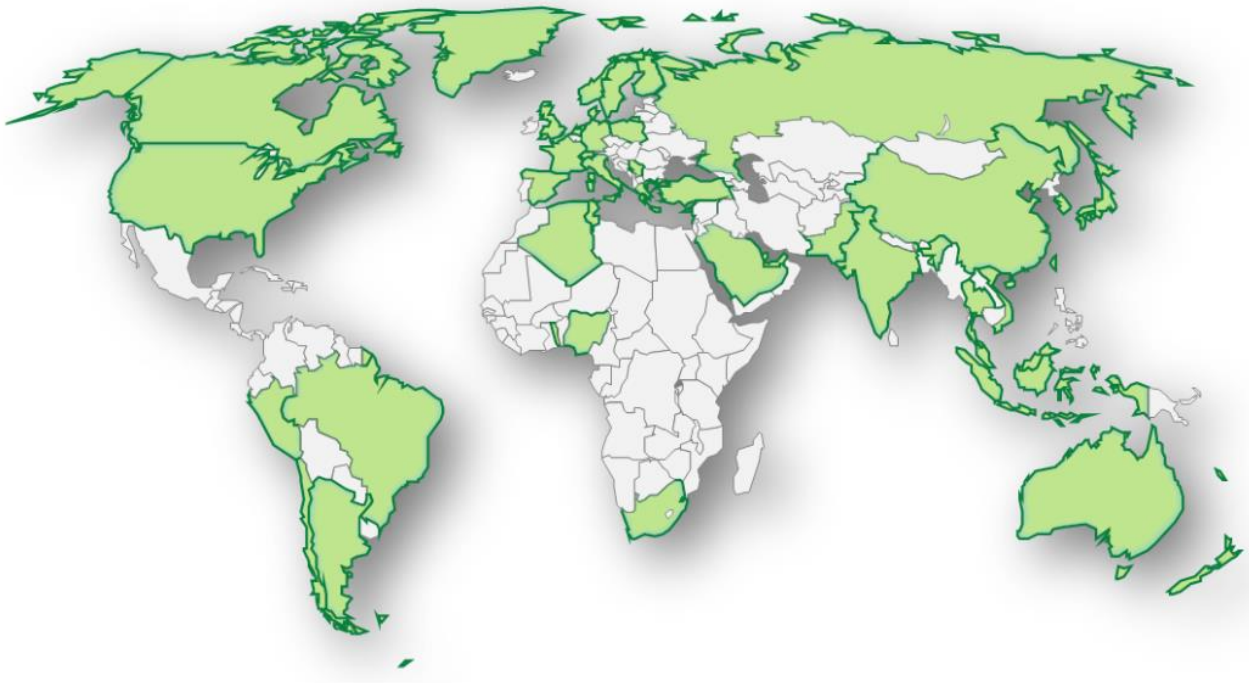
Since September 1982, the Cospas-Sarsat System has provided assistance in rescuing at least 57,413 persons in 17,663 SAR events

International Organization

- Initially developed under interagency Memorandum of Understanding signed in 1979 (USSR, USA, Canada, France)
- System declared operational in 1985
- 406 MHz beacons accepted by IMO for GMDSS in 1988
- International Cospas-Sarsat Programme Agreement (ICSPA) signed on July 1, 1988 among the governments of Canada, France, the former U.S.S.R and the United States
- ICSPA ensures continuity of the space system and availability to all States on a non-discriminatory basis

Cospas-Sarsat

Participating Countries in 2022



4 Founders: Canada, France, Russia and the USA

30 Ground Segment Providers

9 User States

2 Organisations

45 PARTICIPANTS

Algeria
Argentina
Australia
Brazil
Canada
Chile
China (P.R.)
Cyprus
Denmark
Finland
France
Germany
Greece
Hong Kong
India
Indonesia
Italy
ITDC
Japan
Korea (R. of)
Malaysia
Netherlands
New Zealand
Nigeria
Norway
Pakistan
Peru
Poland
Qatar
Russia
Saudi Arabia
Serbia
Singapore
South Africa
Spain
Sweden
Switzerland
Thailand
Togo
Tunisia
Turkey
UAE
UK
USA
Vietnam

Cospas-Sarsat welcomes new Participating States!

Contribute to the distress alerting system and management of the Programme

As a Ground Segment Provider -
Acquire/Manage your own alert data

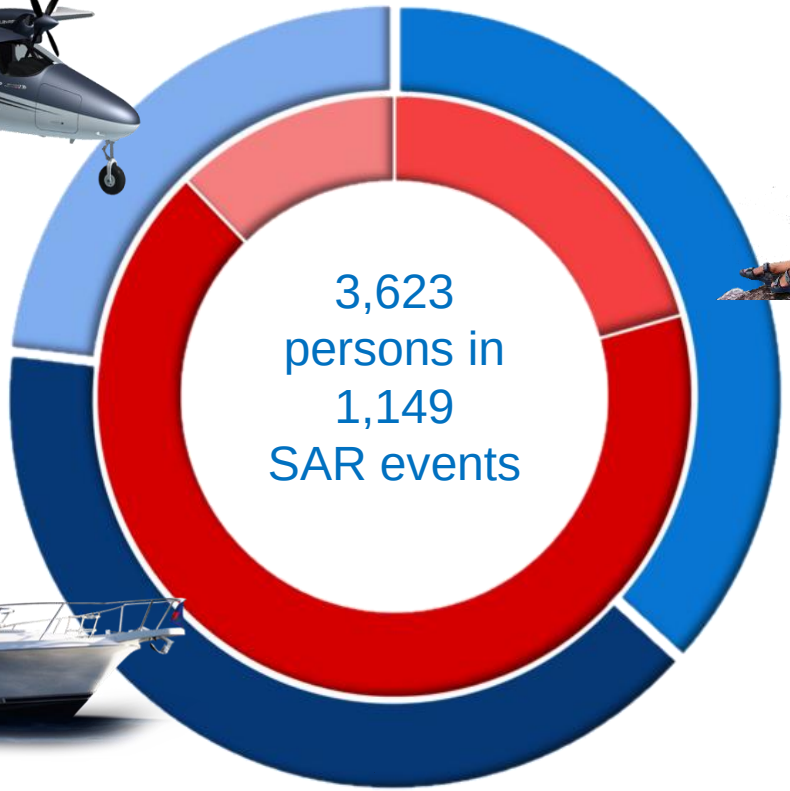
- Manage your Mission Control Center
- Receive your own alerting data
- Share the data via the C/S Network
- (Distribute the data to SPOCs)

As a User State -
Participate in C/S Meetings to

- Learn more about Cospas-Sarsat
- Develop relationships with neighbours
- Discuss beacons standards
- Improve alert data distribution
- Discuss System evolution
- Bring your feedback and experience

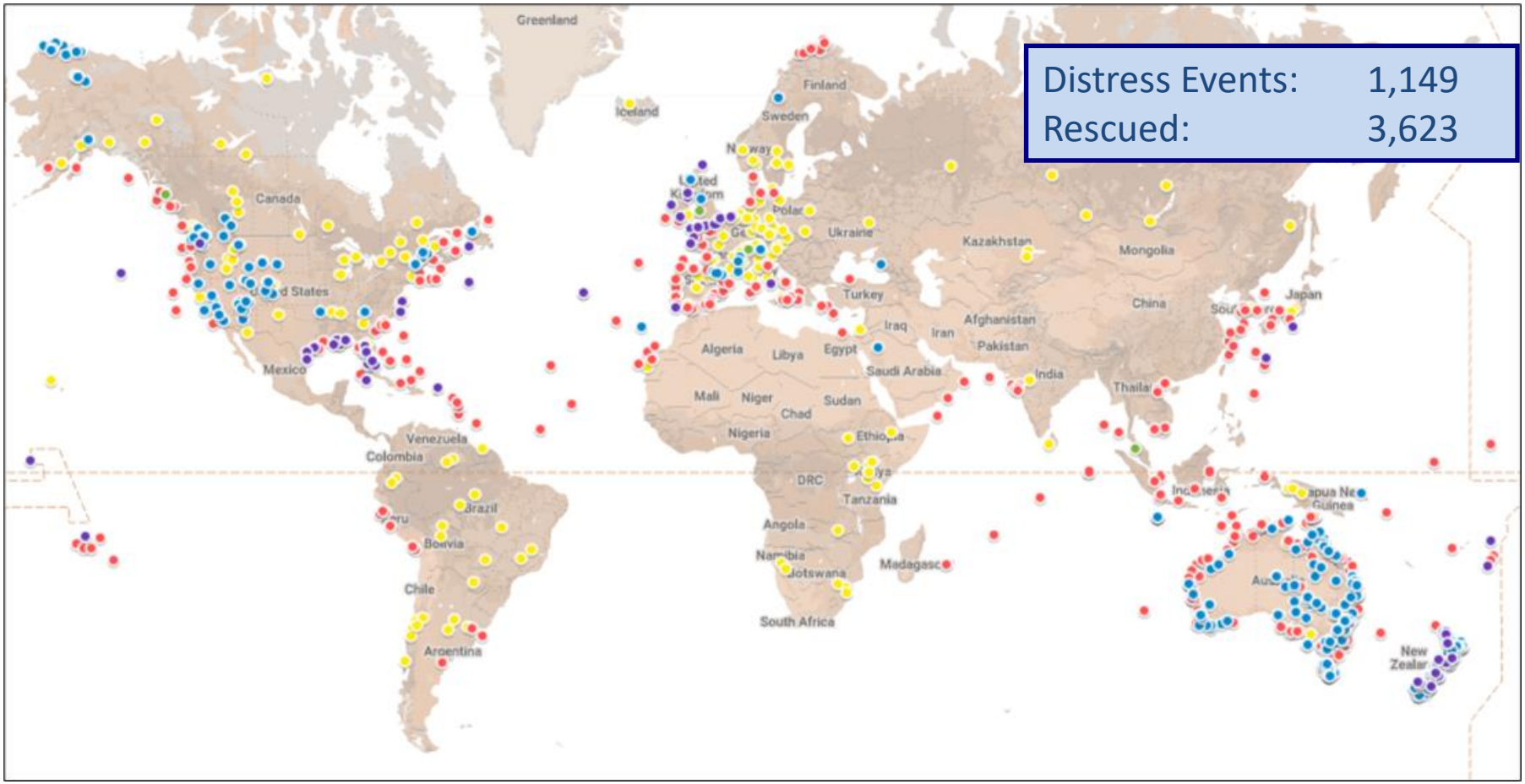
Membership: CAD 68,000 ~ USD 50,000 / year

Type of SAR Events and Persons Rescued (2021)



Aviation 18%, Land 45%, Maritime 37%

Distribution of SAR Events (2021)



Legend: ELTs (yellow), EPIRBs(red), Land PLBs (blue), Aviation PLBs (green), Maritime PLBs (purple)

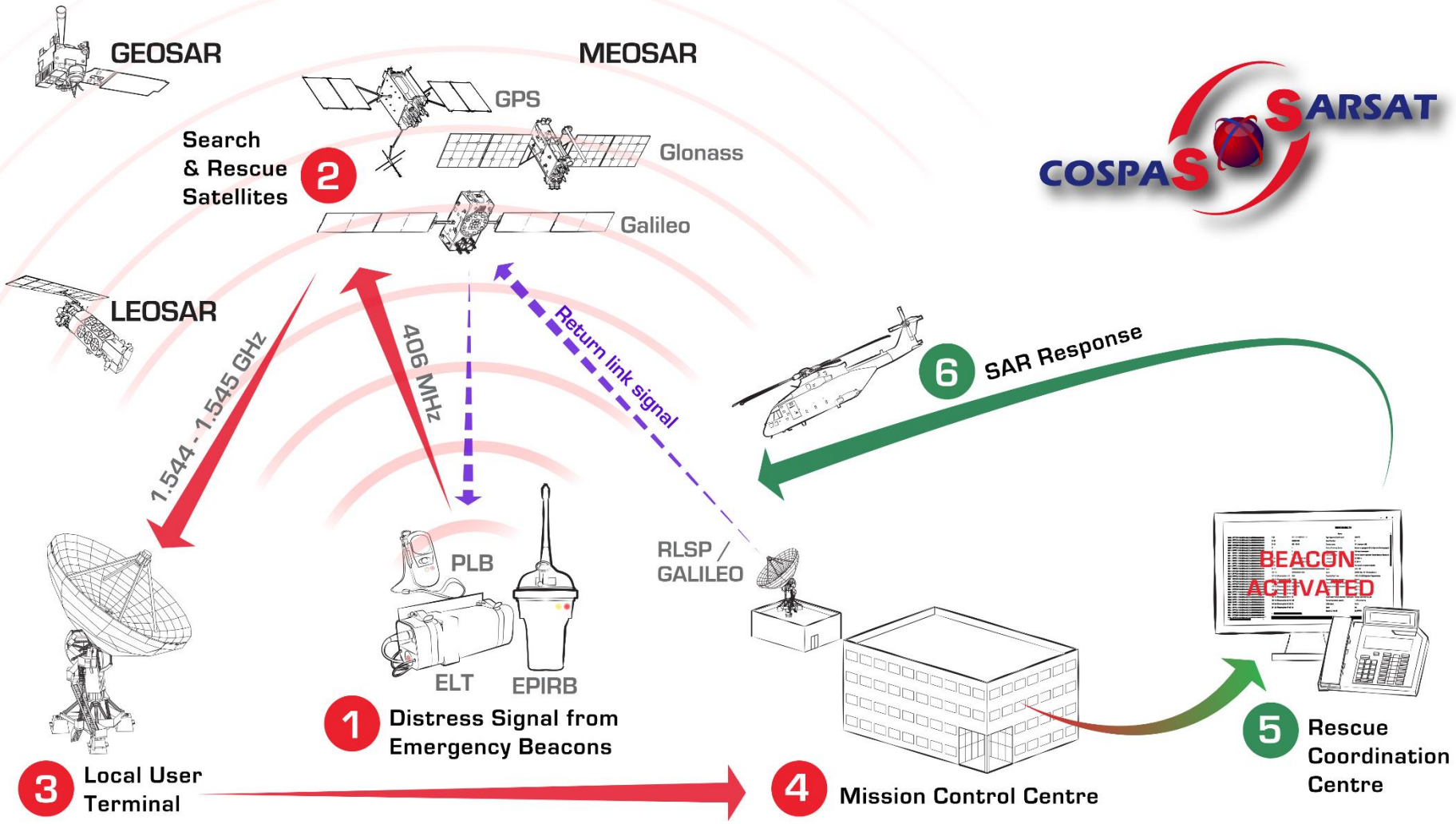
Looking forward: MEOSAR, SGBs, ELT(DT)s and RLS

MEOSAR

Medium-Altitude Earth Orbiting Satellites for Search and Rescue

"It's improving our beacon location accuracy from kilometers to meters," said NASA SAR chief engineer George Theodorakos. "With a signal burst, we can calculate an accurate latitude and longitude location, significantly faster than the previous system."

Principles of Operation



MEOSAR EOC

MEOSAR Early Operational Capability, December 2016

Early analysis of data has shown that MEOSAR data provides an average of **5** minutes lead time over GEO alerts and **27** minutes over LEOLUT alerts (depending on geography)

Towards MEOSAR Initial/ Full Operational Capability

- At IOC, all ground segment equipment deployed will meet documented system performance requirements, and limitations observed at the entrance to EOC are anticipated to be resolved
- IOC readiness expected by 2023
- Full Operational Capability (FOC) will add global coverage
- FOC readiness will be declared by the Council as the system evolves

Beacon Evolution

- **1970’s: 121.5 MHz Beacons**
  - Loose specifications
  - Low transmit power
  - Analogue signal (no unique identification)
  - Regional coverage with low position accuracy (20 km)

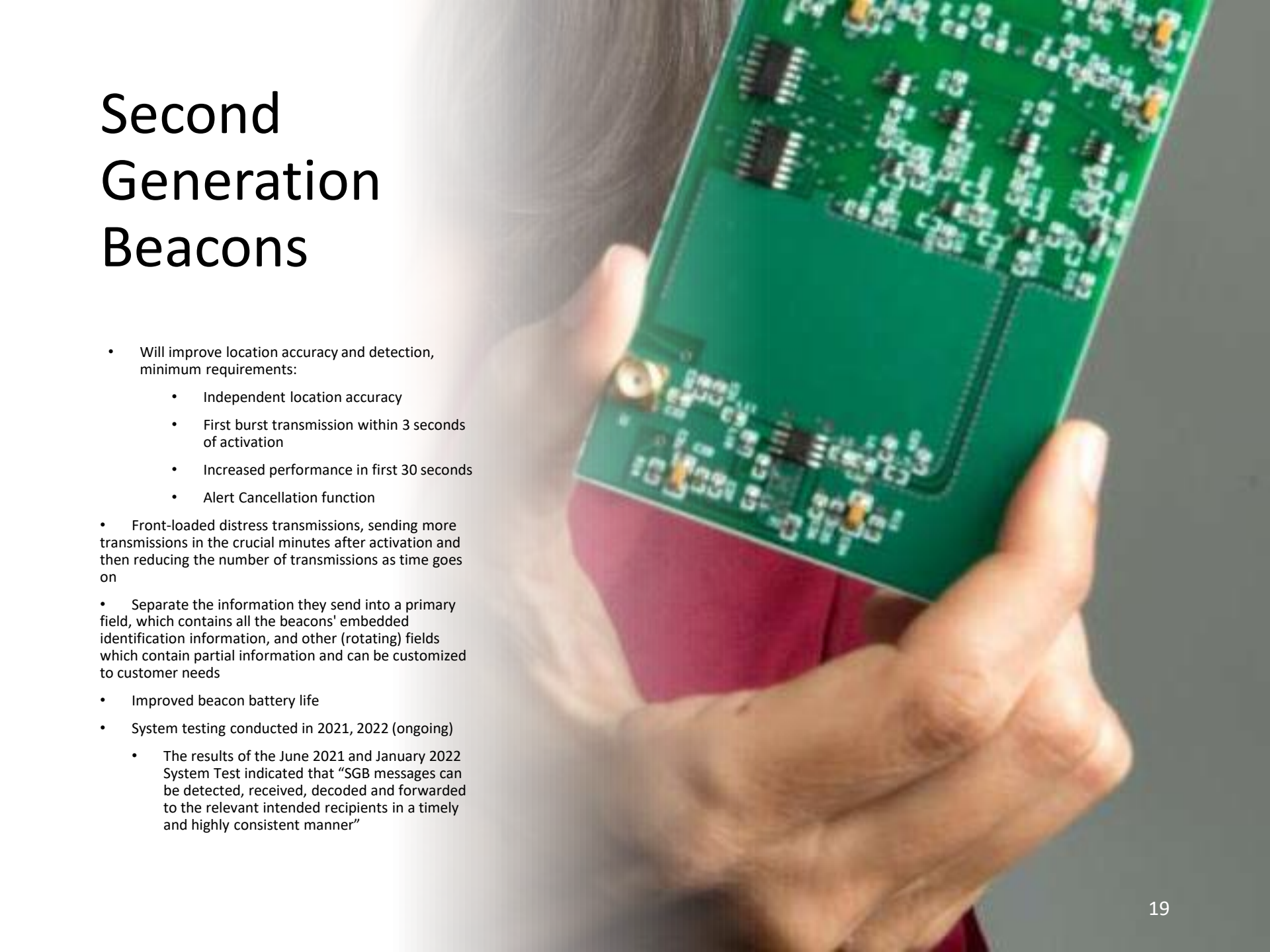
- **1980’s: 406 MHz Beacons**
  - Tighter specification and type approval process
  - Digital signal = unique identifier for each beacon
  - Designed specifically for satellite detection
  - Global coverage with improved accuracy (< 5 km)

- **1990's: 406 MHz Beacons with navigation signal input**
  - Size of beacon decreasing
  - Improved location accuracy (< 500 m)

- **2020’s: Second Generation 406 MHz Beacons**

Second Generation Beacons

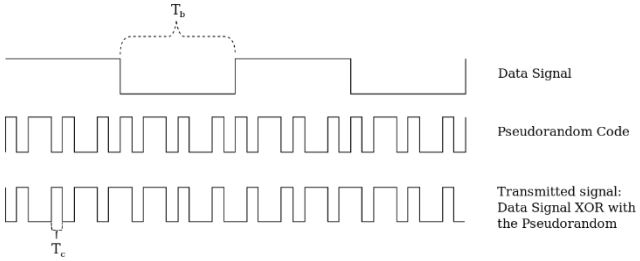
- Will improve location accuracy and detection, minimum requirements:
  - Independent location accuracy
  - First burst transmission within 3 seconds of activation
  - Increased performance in first 30 seconds
  - Alert Cancellation function
- Front-loaded distress transmissions, sending more transmissions in the crucial minutes after activation and then reducing the number of transmissions as time goes on
- Separate the information they send into a primary field, which contains all the beacons' embedded identification information, and other (rotating) fields which contain partial information and can be customized to customer needs
- Improved beacon battery life
- System testing conducted in 2021, 2022 (ongoing)
  - The results of the June 2021 and January 2022 System Test indicated that “SGB messages can be detected, received, decoded and forwarded to the relevant intended recipients in a timely and highly consistent manner”



SGB Transmissions

Wideband (spread spectrum) approach: beacon transmission of each burst is spread over the 406.0 to 406.1 MHz band

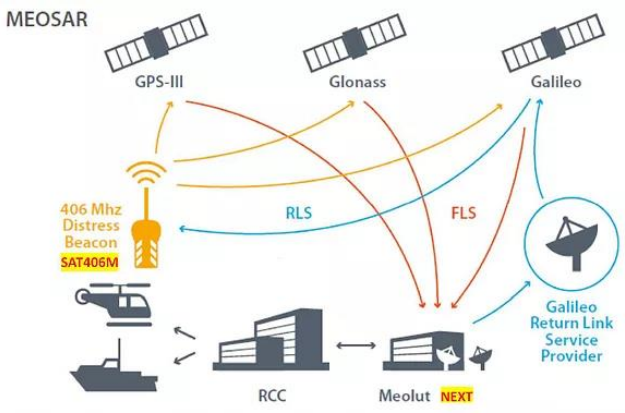
- Optimized for MEOSAR
- Utilizes technology to spread the signal spectrum over the wider 406.0 to 406.1 MHz band to:
  - increase resistance to interference
  - improve TOA measurements to achieve better MEOSAR independent location accuracy
  - change some component requirements (e.g., oscillator, amplifier) to help reduce beacon cost and complexity
- Commonly used in satellite communication, cell phones
- Requires significant changes to current homing equipment, unless a 406 MHz NB carrier signal is broadcast, or 121.5 MHz homing is maintained



RLS- Return Link Service

Equipped 406-MHz beacon models provide an indication (e.g., a light or text display) confirming to the beacon user that the distress signal has been received and the beacon-position localized by the Cospas-Sarsat System and forwarded to government authorities for action.

- March 2021- RLS declared at FOC within Cospas-Sarsat
- Countries should:
  - ensure beacon registries can properly register RLS beacons
  - Update information on permissible coding and proper registration of beacons on your territory or using your “country code” (Handbook of Beacon Regulations)



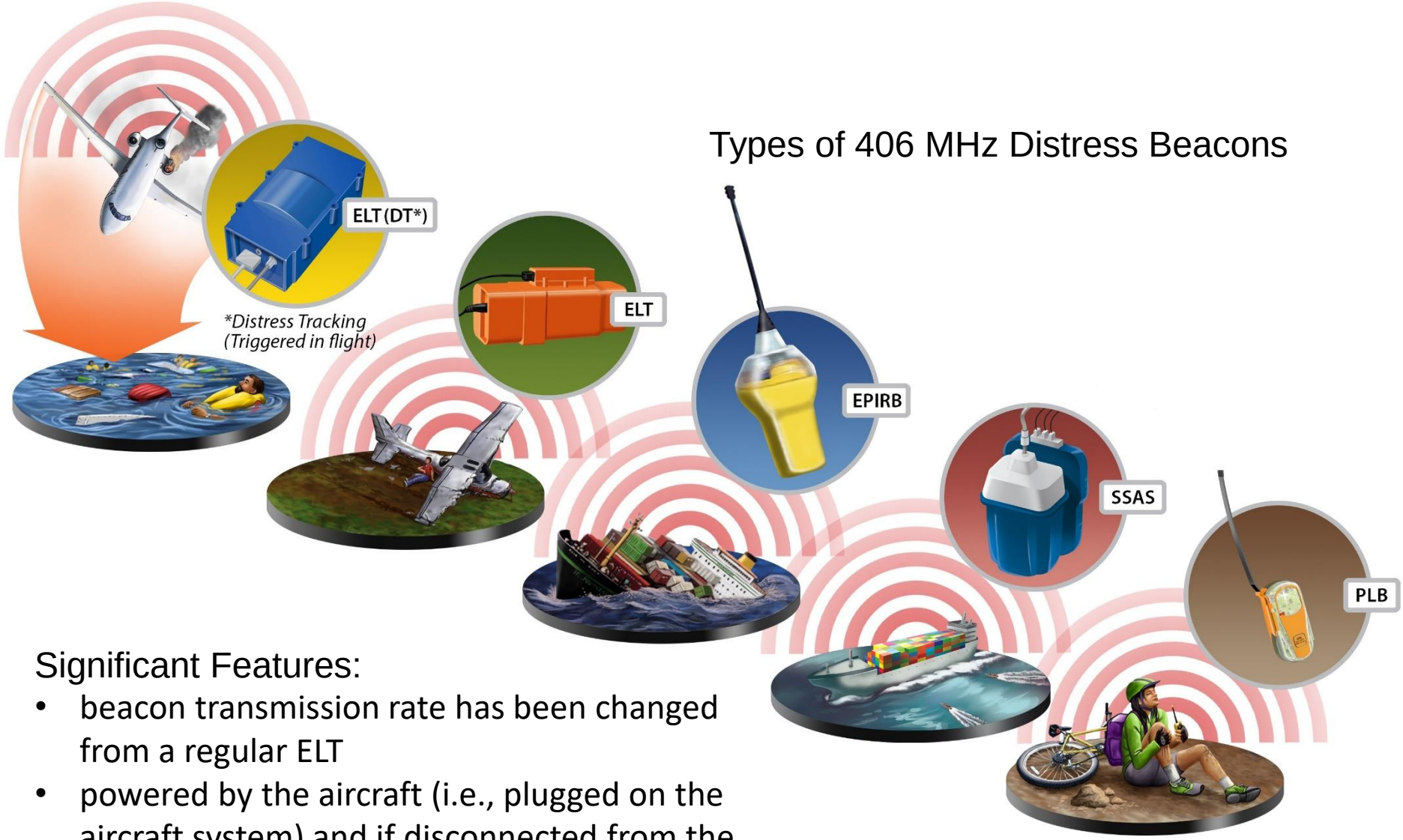
ELT(DT)s and GADSS

Concept of Operations

Global Aeronautical Distress & Safety System (GADSS)

Version 6.0

Types of 406 MHz Distress Beacons



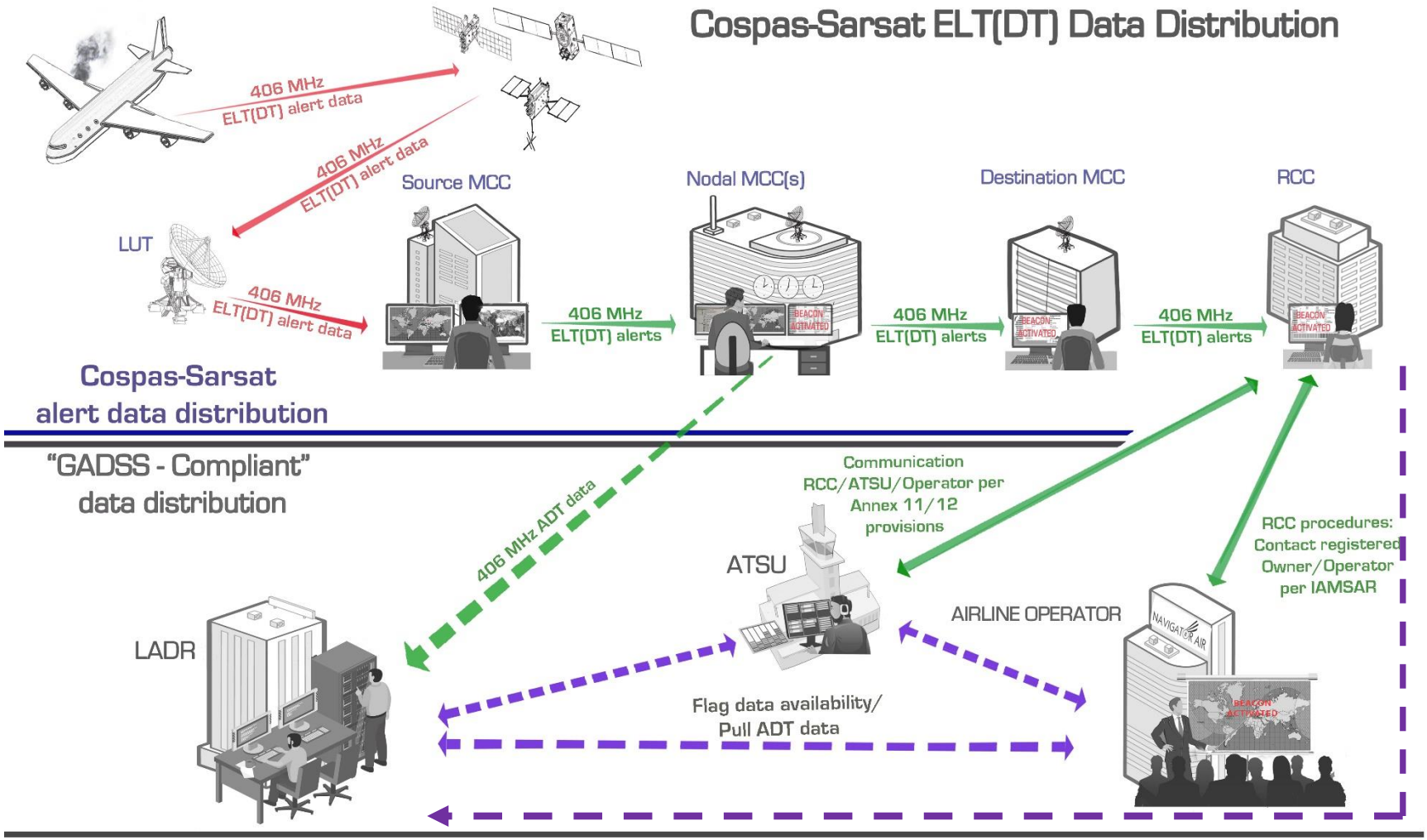
Significant Features:

- beacon transmission rate has been changed from a regular ELT
- powered by the aircraft (i.e., plugged on the aircraft system) and if disconnected from the aircraft power, will have enough battery lifetime to transmit for at least 370 minutes,
- a cancellation function has been implemented for ELT(DT)s

ELT(DT) and GADSS Data Distribution Implementation Timeline

- The new SARPs are applicable to new aeroplanes with take-off mass greater than 27,000 kg from **1 January 2024*** (and Recommended for >5,700 kg) with a mandatory-equipage deadline of 1 January 2025,
- Cospas-Sarsat continues to work towards a deadline for ELT(DT) readiness of **1 January 2023**, to support timely installation by Airline Operators

- * 1 year delay expected to be formalized by ICAO in November 2022
- **an aircraft certificated in January 2024 that would be non-compliant would need to be retrofitted for compliance before 1 January 2025


Cospas-Sarsat ELT(DT) Data Distribution
406 MHz
ELT(DT) alert data
406 MHz
ELT(DT) alert data
LUT
406 MHz
ELT(DT) alert data
Source MCC
406 MHz
ELT(DT) alerts
Nodal MCC(s)
406 MHz
ELT(DT) alerts
Destination MCC
406 MHz
ELT(DT) alerts
RCC
Cospas-Sarsat
alert data distribution
"GADSS - Compliant"
data distribution
406 MHz ADT data
Communication
RCC/ATSU/Operator per
Annex 11/12
provisions
ATSU
RCC procedures:
Contact registered
Owner/Operator
per IAMSAR
AIRLINE OPERATOR
LADR
Flag data availability/
Pull ADT data

Rationale for ADT early alerting to RCCs: BEA Report on Triggered Transmission of Flight Data, March 2011

- For all accidents studied, after triggering criteria* are met:
  - 50% of aircraft impact the ground within 30 seconds,
  - 85% of aircraft impact the ground within 3 minutes, and
  - 95% within 5-6 minutes

- * based on ED-237, i.e., a/c very likely to be in distress

ICAO: performance based, non-technology specific specifications

Major aircraft manufacturers of which we are aware have selected the ELT(DT) to comply with the new ICAO Annex 6 requirements.

Airbus, Boeing, Bombardier, and Embraer (OEMs) have selected the ELT(DT) to satisfy the European operational requirements (see ED-237) and ICAO GADSS recommendations.

ELT(DT) Characteristics

- will provide a GNSS position, altitude and how current this information is
- start transmitting after a maximum of 5 seconds after its activation
- transmit as frequently as once every 5 seconds
- will provide the Aircraft Operator 3-letter designator (3LD)
- will include a user cancellation function
- provide data in rotating fields

Possible loss of 121.5 MHz Homing

- ELT(DT) is an ADT device, and differs from the ELT which has additional requirements (survive accidents, 121.5 homing)
- Many ELT(DT) devices will combine with ELT functionality

ICAO LADR (Location of an Aircraft in Distress Repository)

- ICAO requires that the last known position of an aircraft in distress shall be made available to RCCs, air-traffic service units (ATSUs) and the aircraft operator (airline)
- ICAO plans to implement a Location of an Aircraft in Distress Repository (LADR) as a single database, to collect and distribute the required information.
- To satisfy the ICAO data-sharing requirements, Cospas-Sarsat nodal MCCs will input ELT(DT) data received in alert messages into the LADR.
- ICAO has announced that the LADR will be hosted by EUROCONTROL (Brussels, Belgium)

Towards ELT(DT) Operations

Declaration of operational capability of the System to support FGB ELT(DT)s and SGB ELT(DT)s will be based on:

- **System tests (2021-2022)**
  - End-to-end FGB and SGB ELT(DT) tests successful, with modification of ELT(DT) distribution procedures
  - Do No Harm test demonstrated no risk for SGB ELT(DT) operations
- **Current and projected (MEOLUT) coverage**
  - already global for FGB ELT(DT)
  - planned to be global by Oct. 2022 for SGB ELT(DT)
- **Commissioned MCC capabilities**
  - FMCC-USMCC cross commissioning completed for FGB, in progress for SGB
- **Confirmed availability of type approval test laboratories**
  - First ELT(DT) completed the type process (July 2022)
- **Interface with LADR**
  - Ongoing work by teleconference

Sample ELT(DT) SIT message

FGB ELT(DT)

1. **DISTRESS TRACKING** COSPAS-SARSAT DOA POSITION CONFLICT ALERT

2. MSG NO 21013 CMCC REF 1D1200F03BBFDFF

3. BEACON MESSAGE INFORMATION

BEACON TYPE **ELT DISTRESS TRACKING**

AIRCRAFT 24 BIT ADDRESS 01E077 ASSIGNED TO G BRITAIN

AIRCRAFT OPERATOR DESIGNATOR MMB

HEX ID 1D1200F03BBFDFF

COUNTRY OF BEACON REGISTRATION 232/G BRITAIN

ACTIVATION TYPE MANUAL

GNSS POSITION PROVIDED BY EXTERNAL DEVICE

4. ALERT POSITION INFORMATION

DETECTED AT 04 AUG 20 101501 UTC BY MEOSAR

ALERT LAST DETECTED AT 04 AUG 20 101501 UTC

GNSS - 01 54.40 N 045 37.53 E

UPDATE TIME WITHIN 2 - 60 SECONDS OF DETECTION TIME

ALTITUDE OF GNSS LOCATION BETWEEN 1600 AND 2200 METRES (BETWEEN 5200 AND 7200 FEET)

DOA - 02 00.1 N 046 06.2 E

5. OTHER INFORMATION

GNSS POSITION UNCERTAINTY PLUS-MINUS 2 SECONDS OF LATITUDE AND LONGITUDE

DETECTION FREQUENCY 406.0400 MHZ

POSITION CONFLICT BASED ON DISTANCE SEPARATION OF AT LEAST 20 KM

ELT(DT) POSITION DOES NOT REFERENCE ANY PREVIOUS POSITION

6. REMARKS

THIS DISTRESS TRACKING MESSAGE IS BEING SENT TO APPROPRIATE SAR AUTHORITIES

PROCESS THIS ALERT ACCORDING TO RELEVANT REQUIREMENTS

END OF MESSAGE

Sample ELT(DT) SIT message

SGB ELT(DT)

1. **DISTRESS TRACKING** COSPAS-SARSAT DOA POSITION MATCH ALERT
2. MSG NO 00192 AUMCC REF B27400F81FD4710
3. BEACON MESSAGE INFORMATION
 BEACON TYPE SGB – **ELT DISTRESS TRACKING**
 AIRCRAFT 24 BIT ADDRESS 7100CE ASSIGNED TO SAUDI
 TAC 62 SERIAL NO 509
 HEX ID B27400F81FD4 7100CE00000
 COUNTRY OF BEACON REGISTRATION 403/SAUDI
 ACTIVATION TYPE AUTOMATIC BY BEACON (G-SWITCH/PROBABLE CRASH)
4. ALERT POSITION INFORMATION
 DETECTED AT 03 MAY 19 085310 UTC BY MEOSAR
 ALERT LAST DETECTED AT 03 MAY 19 085310 UTC
 GNSS – 02 24.40 N 046 04.11 E
 TIME OF GNSS POSITION UPDATE: 03 MAY 19 085308 UTC
 TIME SINCE GNSS LOCATION GENERATED: 0 MINUTES
 ALTITUDE OF GNSS LOCATION: 125 METRES (410 FEET)
 DOA – 02 25.1 N 046 06.2 E
5. OTHER INFORMATION
 BEACON CHARACTERISTICS PER TAC DATABASE PROVIDED IN A SEPARATE MESSAGE
 GNSS POSITION UNCERTAINTY PLUS-MINUS 1.7 METRES
 ELAPSED TIME SINCE ACTIVATION: 0 HOURS
 REMAINING BATTERY CAPACITY BETWEEN 75 AND 100 PERCENT
 DETECTION FREQUENCY 406.0500 MHZ
 ELT(DT) POSITION DOES NOT REFERENCE ANY PREVIOUS POSITION
6. REMARKS
 THIS DISTRESS TRACKING MESSAGE IS BEING SENT TO APPROPRIATE SAR AUTHORITIES.
 PROCESS THIS ALERT ACCORDING TO RELEVANT REQUIREMENTS.

END OF MESSAGE

Advice to RCCs:

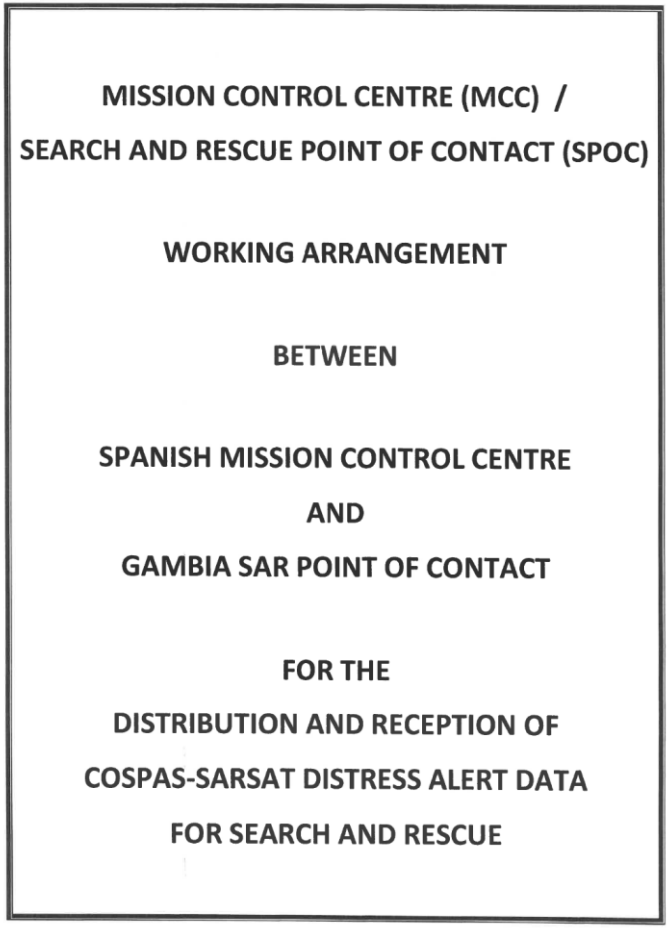
Letter from supporting MCC

- ATS and RCCs should adapt their operating procedures and practices to handle ELT(DT) alerts, originating from an a/c that may still be in flight

1. Note that the SIT 185 message is reporting the detection of a signal from the new beacon type, the ELT(DT), as Paragraph 1 of the SIT 185 message contains “DISTRESS TRACKING” and Paragraph 3 clearly identifies the source of the message as “ELT DISTRESS TRACKING”.
2. Study the basic event information provided in the ELT (DT) SIT 185 message:
   - Paragraph 3 will provide the registration “flag” State of the aircraft decoded from the ICAO 24-bit address, and the aircraft operator, both contained in the beacon message,
   - Paragraph 4 will provide the aircraft position.
3. If your agency has subscribed to the LADR for the geographic region in which the ELT(DT) is located and has elected to receive notifications, review the notifications received by email, SMS or AFTN/AMHS (as set in your LADR user profile), informing you that data that might be of interest is available.
4. Login to the LADR to access all available information for the event, including the aircraft’s last known position (LKP).
5. Contact the appropriate ATSU(s) (and possibly the airline operator) per ICAO Annexes 11 and 12 to exchange further information about the possible (or confirmed) distress event. The contact information for both ATSU and Aircraft operator should be available within the Ops Control Directory.
6. If necessary, request that the sending MCC limit the continuous transmission of SIT 185 alerts for the beacon event[2] to reserve the AFTN/AMHS terminal for other important information related to the event or other possible distress alerts in your SRR.
7. Monitor the LKP available in the LADR to assist in determining the trajectory of the aircraft to support coordination with the appropriate ATSU and neighbouring RCCs, as appropriate.
8. Contact your supporting MCC for any necessary clarifications about the content of a SIT 185 message.
9. Prepare for a SAR operation, while monitoring incoming messages for a possible cancellation message (in a SIT 185 cancellation message, Paragraph 1 contains “DISTRESS TRACKING COSPAS-SARSAT USER CANCELLATION ALERT”).
10. Launch SAR activities appropriate to your SRR (and IAMSAR Manual guidance) and/or communicate with the appropriate SAR authorities to inform them of the event in order to provide a proper response.

MCC-SPOC Agreements

- Recommended by ICAO and IMO
- Proven to improve SPOC communication test results
- Model agreement/arrangement can be found on the Cospas-Sarsat website (406.org/en/documents-pro/document-templates)
- Can be used to describe unique arrangements between the supporting MCC and a SPOC, e.g., use of WhatsApp for communication



MISSION CONTROL CENTRE (MCC) /
SEARCH AND RESCUE POINT OF CONTACT (SPOC)

WORKING ARRANGEMENT

BETWEEN

SPANISH MISSION CONTROL CENTRE
AND
GAMBIA SAR POINT OF CONTACT

FOR THE
DISTRIBUTION AND RECEPTION OF
COSPAS-SARSAT DISTRESS ALERT DATA
FOR SEARCH AND RESCUE

Completed MCC- SPOC Agreements (*2022)

- Chilean MCC – Republic of Paraguay
- French MCC - Andorra, Antille-Guyane, *Austria, CROSS Gris-Nez, German SPOC, La Reunion SPOC, Tahiti SPOC, *Monaco, Moroccan Maritime Rescue Coordination Centre, *Saint Pierre and Miquelon, *Switzerland, Tunisia Area Control Center
- Indian MCC – Nepal SPOC
- Italian MCC – Republic of Macedonia, Republic of Serbia, Sudan Civil Aviation Authority, Somali Civil Aviation Authority
- Norwegian MCC – Swedish Maritime Administration
- Saudi Arabia MCC – Lebanon SPOC
- South Africa MCC – Mozambique ARCC
- Spanish MCC – *Benin SPOC, *Gambia SPOC, *Ghana SPOC
- UK Maritime and Coast Guard – Irish Coast Guard
- USA MCC - Corporación Centroamericana de Servicios de Navegación Aérea (COSESNA), Dominican Republic, Dutch Caribbean Coastguard, Government of Bermuda, Republic of Ecuador, Republic of Haiti, Republic of Panama, Trinidad and Tobago,
- Vietnam MCC – Civil Aviation Cambodia, Lao PDR

For More Info…

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