SARSAT Search and Rescue

World-wide: over 37,196 rescues
United States: over 7,347 rescues

Chris O’Connors  DSB Chief, SARSAT PM
NOAA/NESDIS/OSPO/SPSD
NOAA Satellite Conference, April 30, 2015
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>1967</td>
<td>16-year old girl dies after two months waiting for rescue</td>
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<td>1970</td>
<td>Congress mandates carriage of 121.5 ELT on general aviation aircraft</td>
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<td>1972</td>
<td>Congressmen Boggs and Begich lost in Alaska plane crash</td>
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<td>1975</td>
<td>Apollo-Soyuz Test Project</td>
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<td>1982</td>
<td>COSPAS-SARSAT first rescue</td>
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<td>1985</td>
<td>COSPAS-SARSAT Declared Operational</td>
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<td>1998</td>
<td>Geostationary space segment becomes operational</td>
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<td>1998</td>
<td>Cospas-Sarsat announces termination of 121/243 MHz service starting in 2009</td>
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<td>2009</td>
<td>Termination of 121.5 and 243 MHz processing by space segment</td>
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Cospas-Sarsat System Overview

- Cospas-Sarsat (C-S) Program uses dedicated Search and Rescue (SAR) payloads onboard satellites to relay beacons signals to ground stations

- C-S system consists of three segments:
  - User Segment – the emergency beacon transmitters
    - Marine: EPIRB (Emergency Position Indicating Radio Beacon)
    - Aviation: ELT (Emergency Locating Transmitter)
    - Land: PLB (Personal Locating Beacon)
  - Ground Segment – Local User Terminals (LUTs)
  - Space Segment
    - LEOSAR: Low-Earth Orbit - Provides for beacon location using Doppler processing; uses Store & Forward instrument to provide global coverage
    - GEOSAR: Geosynchronous Orbit Performs instantaneous alerting function; no locating capability unless beacon is equipped with GNSS receiver.
    - MEOSAR*: Mid-Earth Orbit SAR – Under development
C-S Participants

- 43 countries and organizations
- Cooperates with International Maritime Organization (IMO), International Civil Aviation Organization (ICAO) and the International Telecommunications Union (ITU)
COSPAS-SARSAT System Overview

1. Distress call utilizing emergency beacon
   - EPIRB
   - ELT
   - PLB

2. Search & rescue satellites

3. Local user terminal

4. Mission control center

5. Rescue coordination center
Current
U.S. Local User Terminals (LUTs)

Alaska
NOAA FCDA
2 LEOLUTs

Guam
Andersen AFB
2 LEOLUTs

Hawaii
USCG COMMSTA Honolulu
2 LEOLUTs
6 antenna MEOLUT

California
Vandenberg AFB

Maryland*
NOAA NSOF
*Maryland has 3 GEOLUTs & 1 LEOLUT
US Mission Control Center

Miami
USCG COMMSTA Miami
2 LEOLUTs
6 antenna MEOLUT
Current SARSAT systems requires 4 Low Earth Orbiting (LEO) satellites
- Beacon detection
  - within 10 min with GEOSAR
  - A few minutes to 2 hours on LEOSAR
- Location determined within 1-2 hours with 5 km accuracy

Search and Rescue Global Position System (SAR/GPS) Medium Earth Orbiting Search and Rescues (MEOSAR) vastly improves capability
- Instantaneous Notification & Location
- Global Coverage
- 100% Availability
- No Terrain Blockage
- Improved Accuracy
  - 1st Gen 1KM
  - 2nd Gen 100-500m

Distress Alerting Satellite System (DASS) Proof-of-Concept includes repeater on GPS IIR, IIR-M, and IIF SVs
- Leveraging existing capability on GPS
- Provides demonstration capability
- 17 satellites in orbit with SAR capability
MEOSAR

Next generation of satellite-aided SAR

- Based on the use of SAR Repeaters carried on board Global Navigation Satellite System (GNSS) satellites
- Global Navigation constellations consist of 24 (or more) satellites in Mid Earth Orbit (GPS, Galileo, GLONASS)
- Provides
  - Near instantaneous beacon detection and location, globally, at all times
  - Advanced location process using time and frequency measurements of beacon signal to triangulate its location
  - Mitigates terrain blockage due to multiple look angles from multiple moving satellites
  - Robust space segment, well maintained and highly redundant
  - Simple space segment repeater allows for development of higher performance beacon signal
MEOSAR Concept of Operations

Concept of Operations

Activated 406 Emergency Locator Transmitter (ELT)

GPS III Satellites

Local User Terminal

US Coast Guard Rescue Coordination Center

Mission Control Center

US Air Force Rescue Coordination Center

Activated 406 Emergency Position Indicating Radio Beacon (EPIRB)

SAR Response

With a footprint over seven times larger than a LEO Satellite, the MEOSAR constellation allows for real-time alerting worldwide without the need to store information in the satellite to relay at a later time. This capability equates to faster alert notices and thus more lives saved.

SAR/GPS

Search and Rescue—Global Positioning Satellite System

Global Search and Rescue System

System Overview Diagram

The fully operational MEOSAR constellation SAR/GPS will provide worldwide coverage with the ability to detect and locate emergency distress beacons accurately in as little as one beacon burst.

...assess the utility and feasibility of hosting secondary payloads on Global Positioning System satellites, including, but not limited to those intended to enhance global search and rescue capabilities for all users...

National Security Presidential Directive-33 (06 DEC. 04)
Message sent by the distress beacon (specific RLS protocol on the 406 MHz uplink signal) to the RLS Provider (RLSP) to indicate it has a Return Link capability
Second Generation 406 Beacons

Project Goals

• Capitalize on MEOSAR space segment and improve system performance to meet or exceed C/S requirements, including:
  - Detection probability, location accuracy and system capacity
  - Reduce cost and complexity of beacons
  - Collaborate with manufacturers to obtain the most competitive end product

Progress to date

• Technology selected - Spread Spectrum (similar to cell phones)
  • Improved detectability
  • Enhanced location performance
• Expanded message content
  • Additional data fields
  • Two-way messaging capability (under discussion)
SGB Current Results

SGB locations over 2-day duration

Location accuracy meets C/S SGB requirements for location accuracy:

- NASA prototype beacon signal transmitted over 48hr period (1 burst every 50 sec) through DASS;
- Locations collected at NASA MEO ground station

Location accuracy meets C/S SGB requirements for location accuracy:

- shows that at least 95% of the results of the 30 minute average are within the 100m (red) circle
- order of magnitude improvement from first generation beacons
Support Search and Rescue
Get Lost!

http://www.sarsat.noaa.gov

http://www.cospas-sarsat.int