Overview

- Cospas-Sarsat System
- GNSS-enabled Medium Earth Orbit SAR (MEOSAR)
- MEOSAR launch schedule
- SAR GPS payload
- MEOSAR ground coverage
- MEOSAR operational capability phases
- Current status
MEOSAR: NEXT GENERATION OF SATELLITE-AIDED SAR

• For USA, based on the use of SAR Repeaters carried onboard GPS

• Benefits...
  – Multiple satellites in view of the beacon anywhere in the world at all times
  – Advanced location process using time and frequency measurements of beacon signal to triangulate its location

• Near instantaneous beacon detection and location, globally, at all times

• Mitigates terrain blockage because of multiple look angles from multiple moving satellites

• Simple space segment repeater allows for development of higher performance beacon signal
MEOSAR Launch Schedule

**Figure 1: MEOSAR Space Segment Tentative Launch Schedule**

- **SAR/Galileo**: The first 30 Galileo satellites carrying a total of 28 SAR payloads; currently 10 payloads available for SAR use on orbit; 14 Galileo spacecraft on orbit
- **SAR/Glonass-K**: SAR payloads planned to be carried on the Russian GNSS Glonass-K1 and Glonass-K2 satellites
- **SAR/GPS**: launch-ready date is 2023. After first launch, a GPS constellation of 24 satellites with SAR payloads should be in place within 10 years
- **SAR/GPS/DASS**: currently 20 DASS payloads onboard GPS. Planned 8 more payloads (Block III) – next launch May 2017
• U.S. SAR Operational Space Segment
  – Repeater payload will be provided by Canadian government built to C-S specifications including interoperability with Galileo and GLONASS
    • Canada releasing RFP for prime payload contractor Fall 2016
  – Development underway with first operational payload planned to launch on board GPS III SV-11
    • NASA role is safety and mission assurance oversight for payload build and integration into GPS
MEOSAR Payload Description

• Cospas-Sarsat Program writing Payload Description document for current suite of GNSS payloads, including DASS (proof of concept payloads). Areas include:
  – Interoperability parameters: modulation of downlinks, downlink frequencies, downlink EIRPs and polarization, repeater bandwidth
  – Functional descriptions
  – Spectrum characteristics
  – Repeater coverage area
  – Repeater performance and transmitter parameters

• DASS use is not mandated by Cospas-Sarsat but its data is available for incorporation into the system for operational use
  – USA will use DASS data indefinitely but is optimizing system to use L-band (Galileo) payloads
MEOSAR Coverage Area

- Cospas-Sarsat Program analyzing multiple simulations to show ground footprints of MEOLUTs around the world to ensure full Earth coverage
  - France, Russia, and USA producing independent computer models to compare against

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Criteria/Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space Segment</td>
<td>List of satellites with their payload properties.</td>
</tr>
<tr>
<td>Ground Segment</td>
<td>List of Antennas (and their properties) along with their associated MEOLUT.</td>
</tr>
<tr>
<td>Networking (yes/no)</td>
<td>Stand-Alone or as commissioned</td>
</tr>
<tr>
<td>MEOLUT Minimum Elevation Angle</td>
<td>5 degrees</td>
</tr>
<tr>
<td>Beacon Minimum Elevation Angle</td>
<td>5 degrees</td>
</tr>
<tr>
<td>Beacon Motion</td>
<td>Static beacons</td>
</tr>
<tr>
<td>Number of Bursts</td>
<td>13 transmitted bursts</td>
</tr>
<tr>
<td>Allowable Wait Time</td>
<td>10 minutes (after first burst transmission)</td>
</tr>
<tr>
<td>Start Time</td>
<td>A given day and time</td>
</tr>
<tr>
<td>Length of Simulation</td>
<td>At least 10 days</td>
</tr>
<tr>
<td>Simulation Step Size</td>
<td>Maximum 15 minutes</td>
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<tr>
<td>Grid Size</td>
<td>Range of the latitude, longitude, typically covering the whole Earth</td>
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<tr>
<td>Grid Resolution</td>
<td>220km x 220km, which corresponds to 2 degrees at the equator</td>
</tr>
<tr>
<td>Number of Satellites required to</td>
<td></td>
</tr>
<tr>
<td>locate</td>
<td>at least 5</td>
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</tbody>
</table>
MEOSAR Operational Capability Phases

- Cospas-Sarsat Program transition to MEOSAR will occur in phases:
  - EOC: Early Operational Capability
    - Allow for global distribution of MEOSAR alert data for operational use with S and L-Band payloads
    - USA has commissioned both U.S. MEOLUTs and will enter EOC in mid-November
    - Seven (7) MEOLUTs globally have been commissioned for EOC use – USA, France, EC (Spain, Norway, Cyprus), Turkey
    - Two (2) nodal Mission Control Centers (U.S. and France) commissioned
    - USA entering EOC by December 2016
  - IOC: Initial Operational Capability
    - D&E testing using operational satellites only (L-band) completed
    - The MEOSAR system need not necessarily provide global coverage
  - FOC: Full Operational Capability
    - Full Earth ground station coverage
    - Full complement of L-Band MEO spacecraft payloads
MEOSAR Current Status

- Demonstration and Evaluation of the MEOSAR system continues to progress
  - Phase I & II completed
    - Verified compliance with EOC performance criteria using combined S and L band SAR payloads
  - Phase III (last phase) will test system performance with only L-Band payloads

- By January 2017....
  - 38 satellites with SAR payloads total
    - 16 SAR/Galileo
    - 2 SAR/GLONASS
    - 20 SAR/DASS
  - 12 MEOLUTs globally

- By January 2018...
  - 44 satellites with SAR payloads total
    - 20 SAR/Galileo
    - 2 SAR/GLONASS
    - 22 SAR/DASS
  - 93% Earth coverage (gap only exists in South Africa)