



SEARCH AND RESCUE



MEOSAR & GPS
ICG WG-B
Sochi, November 2016

The background of the slide features a satellite in space with red wavy lines representing signal waves. Below the satellite, a small white aircraft is shown in a field of tall grass, with a dark, stormy sky in the background.

Dr. Lisa Mazzuca, Mission Manager
NASA Search and Rescue Office
Goddard Space Flight Center



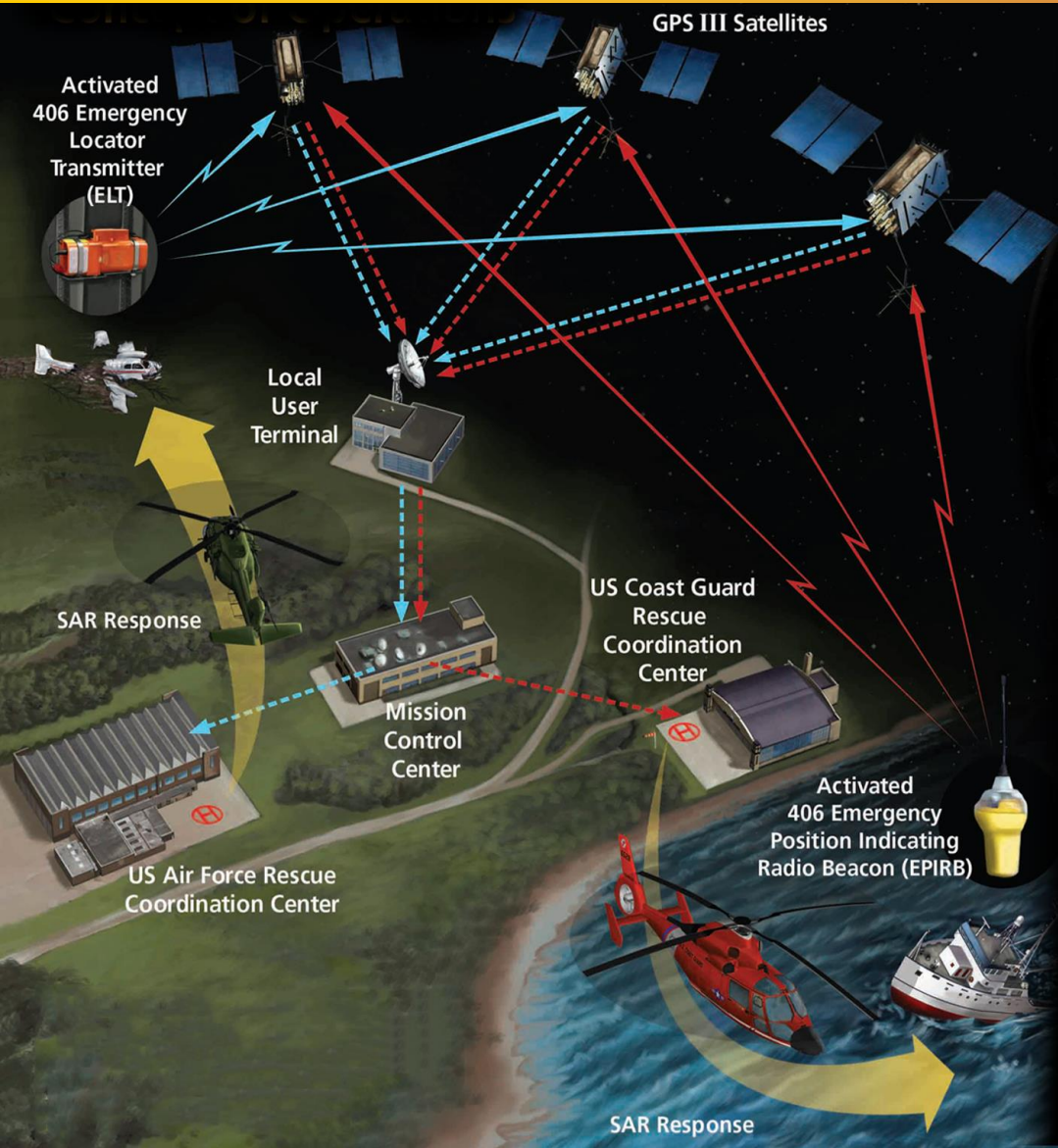
Overview



- 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: CONCEPT OF OPERATIONS



SAR/GPS

*Search and Rescue-
Global Positioning Satellite System*



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



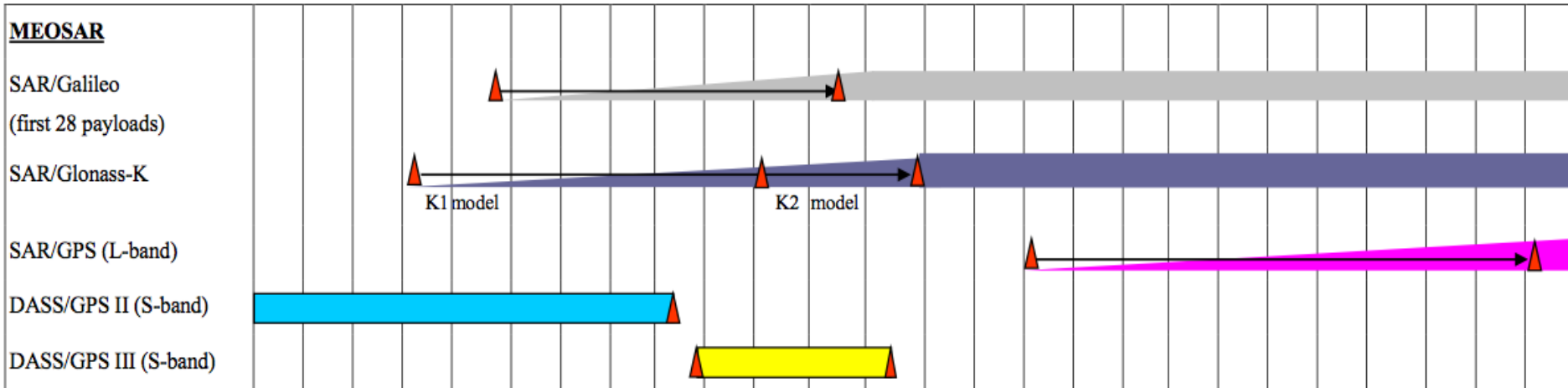


MEOSAR Launch Schedule



Figure 1: MEOSAR Space Segment Tentative Launch Schedule

2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033



- 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



GPS and SAR



- 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

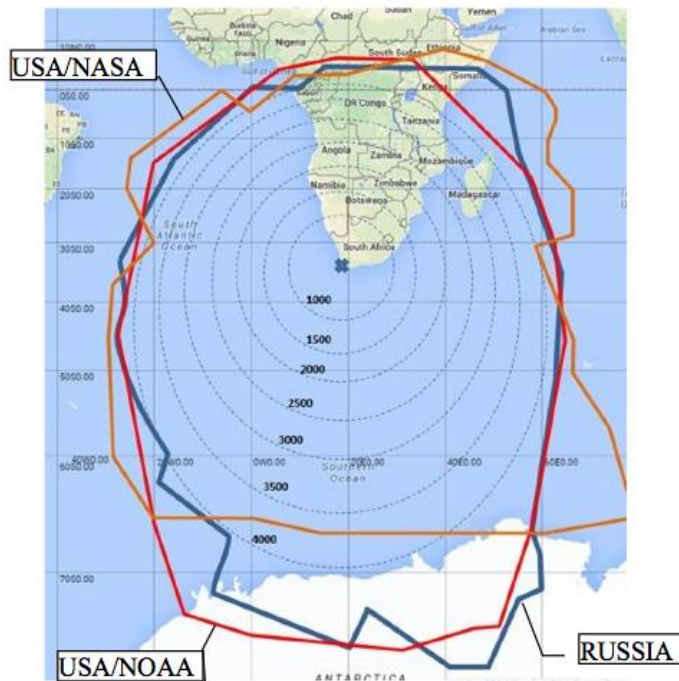


- Cospas-Sarsat Program writing Payload Description document for current suite of GNSS payloads, including DASS (proof of concept payloads). Areas include:
 - Interoperability parameters: modulation of downlinks, downlink frequencies, downlink EIRPs and polarization, repeater bandwidth
 - Functional 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



6-antennas, no beacon elevation limitation, 10 min performance

Parameter	Criteria/Value
Space Segment	List of satellites with their payload properties.
Ground Segment	List of Antennas (and their properties) along with their associated MEOLUT.
Networking (yes/no)	Stand-Alone or as commissioned
MEOLUT Minimum Elevation Angle	5 degrees
Beacon Minimum Elevation Angle	5 degrees
Beacon Motion	Static beacons
Number of Bursts	13 transmitted bursts
Allowable Wait Time	10 minutes (after first burst transmission)
Start Time	A given day and time
Length of Simulation	At least 10 days
Simulation Step Size	Maximum 15 minutes
Grid Size	Range of the latitude, longitude, typically covering the whole Earth
Grid Resolution	220km x 220km, which corresponds to 2 degrees at the equator
Number of Satellites required to locate	at least 3



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)