SARSAT Overview

SAR Controllers Training 2013
19 – 21 March2013

Jesse Reich
NOAA
Ground Systems Engineer

Agenda

- Cospas-Sarsat Overview
- U.S. SARSAT Organization
- System Description
  - User Segment (Beacons) / Registrations
  - Ground Segment
  - Space Segment
  - SAR Segment
- Future of Cospas-Sarsat

SARSAT

Search **A**nd **R**escue

Satellite-**A**ided **T**racking System

History

•	1950s	First satellites launched & Doppler technology developed
•	1960s	Emergency 121/243 MHz beacons first used by military
•	1970	Congress mandates carriage of 121.5 ELT on general aviation aircraft
•	1972	Congressmen Boggs and Begich lost in Alaska plane crash
•	1975	Apollo-Soyuz Test Project
•	1976	Canada, France and USA begin development of SARSAT program
•	1979	MOU signed between Canada, France, USA and former USSR
•	1982	Launch of Cospas-1 and First Save
•	1983	Launch of SARSAT-1
•	1985	COSPAS-SARSAT declared operational
•	1988	International Cospas-Sarsat Program Agreement signed
•	1992	Russia assumes responsibilities for the former USSR
•	1998	Geostationary space segment becomes operational
•	1998	Termination of 121/243 MHz service starting in 2009 announced
•	2005	U.S. passes 5000 rescues
•	2009	Termination of 121.5 and 243 MHz processing by space segment

Cospas-Sarsat Overview

- COSPAS: Cosmicheskaya Systyema Poiska Aariynyich Sudov (Russian) which translates loosely into "Space System for the Search of Vessels in Distress"
- SARSAT: Search And Rescue Satellite-Aided Tracking

Cospas-Sarsat provides, free-of-charge, distress alert and location information to search and rescue authorities anywhere in the world for maritime, aviation and land users in distress.

In short: C-S takes the "search" out of Search and Rescue

Cospas-Sarsat Rescues

Number rescued world-wide since 1982: over *33,000*

Number rescued in United States since 1982: over *7,019*

Rescues so far this year in the U.S. for CY 2013 (as of 2/21/13): 20

Rescues at sea:	**13** people rescued in **7** incidents
Terrestrial rescues:	**7** person rescued in **5** incidents

CY 2012 – 263 Rescues in 111 Incidents

Rescues at sea:	**182** people rescued in **54** incidents
Aviation rescues:	**22** people rescued in **13** incidents
Terrestrial rescues:	**59** people rescued in **44** incidents

Cospas-Sarsat Overview

International Maritime Organization (IMO)

UN specialized agency responsible for improving maritime safety (Mandates use of emergency beacons)

International Civil Aviation Organization (ICAO)

UN specialized agency responsible for aviation matters and improving civil aviation safety (Mandates use of 406 MHz beacons)

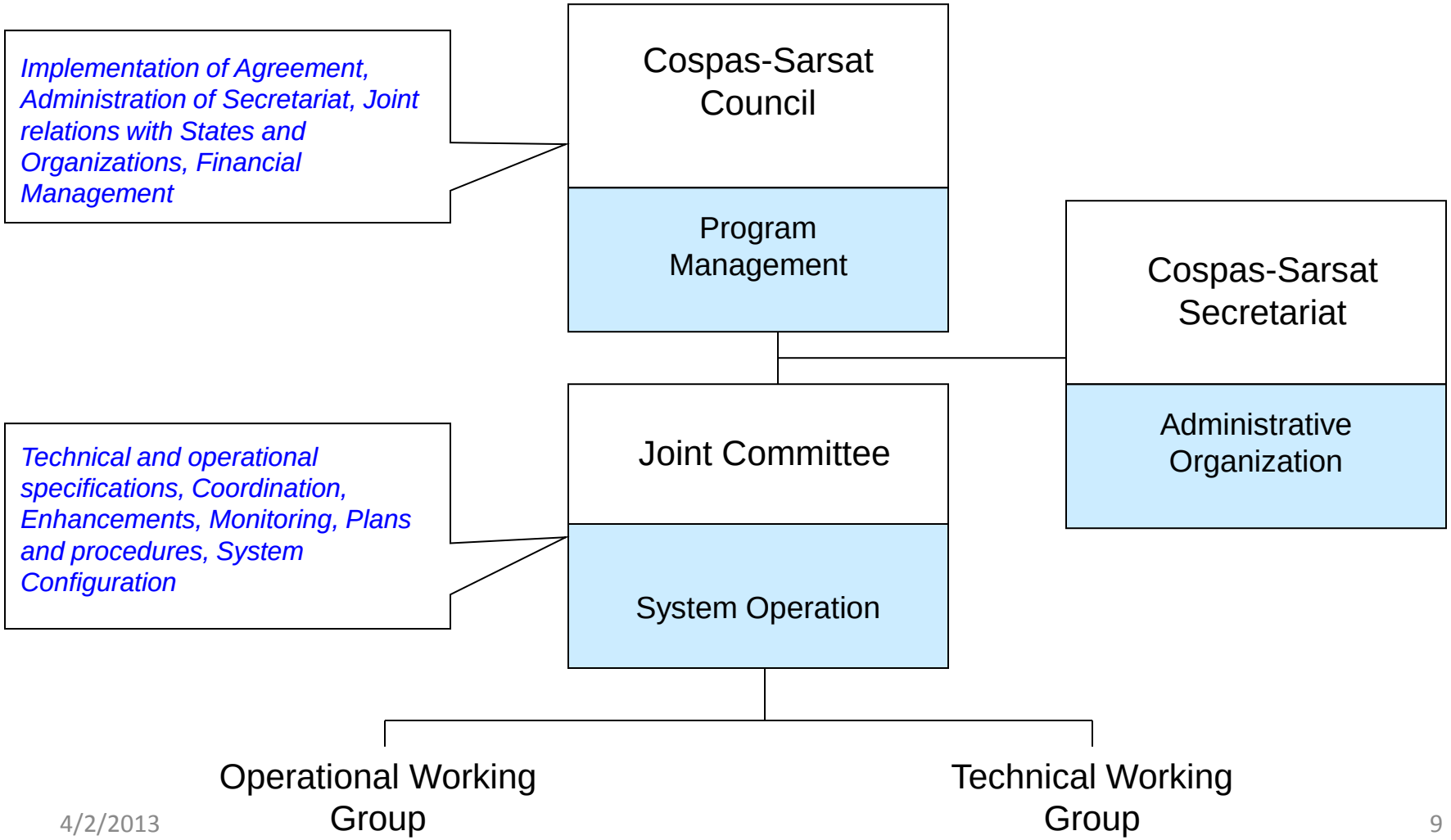
International Telecommunication Union

UN specialized agency responsible for coordinating global telecommunications (406 MHz beacon specifications)

Cospas-Sarsat Participants

Cospas-Sarsat Program Management

International Organization



U.S. SARSAT

The four multi-department agencies involved in the U.S. portion of SARSAT:

Inland SAR

Maritime SAR

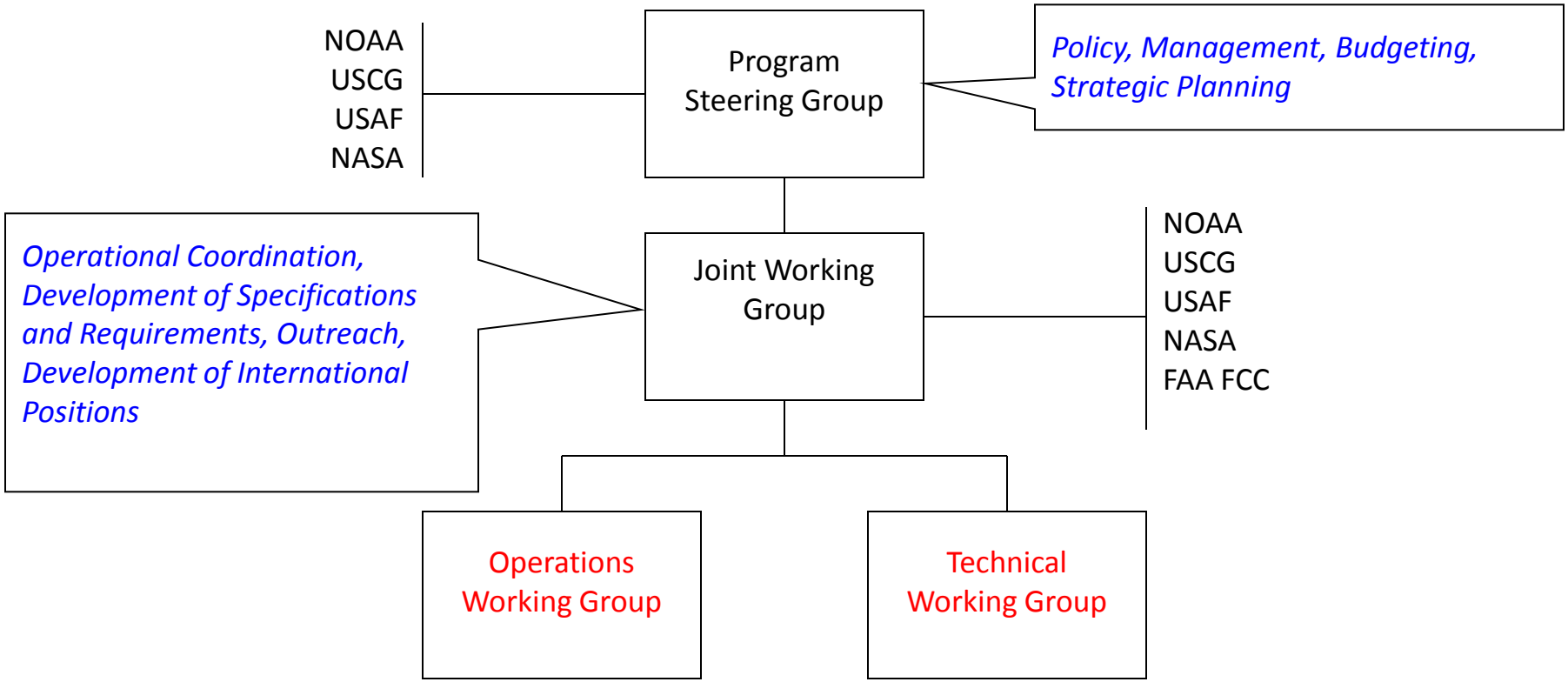
Research & Development

System Operation

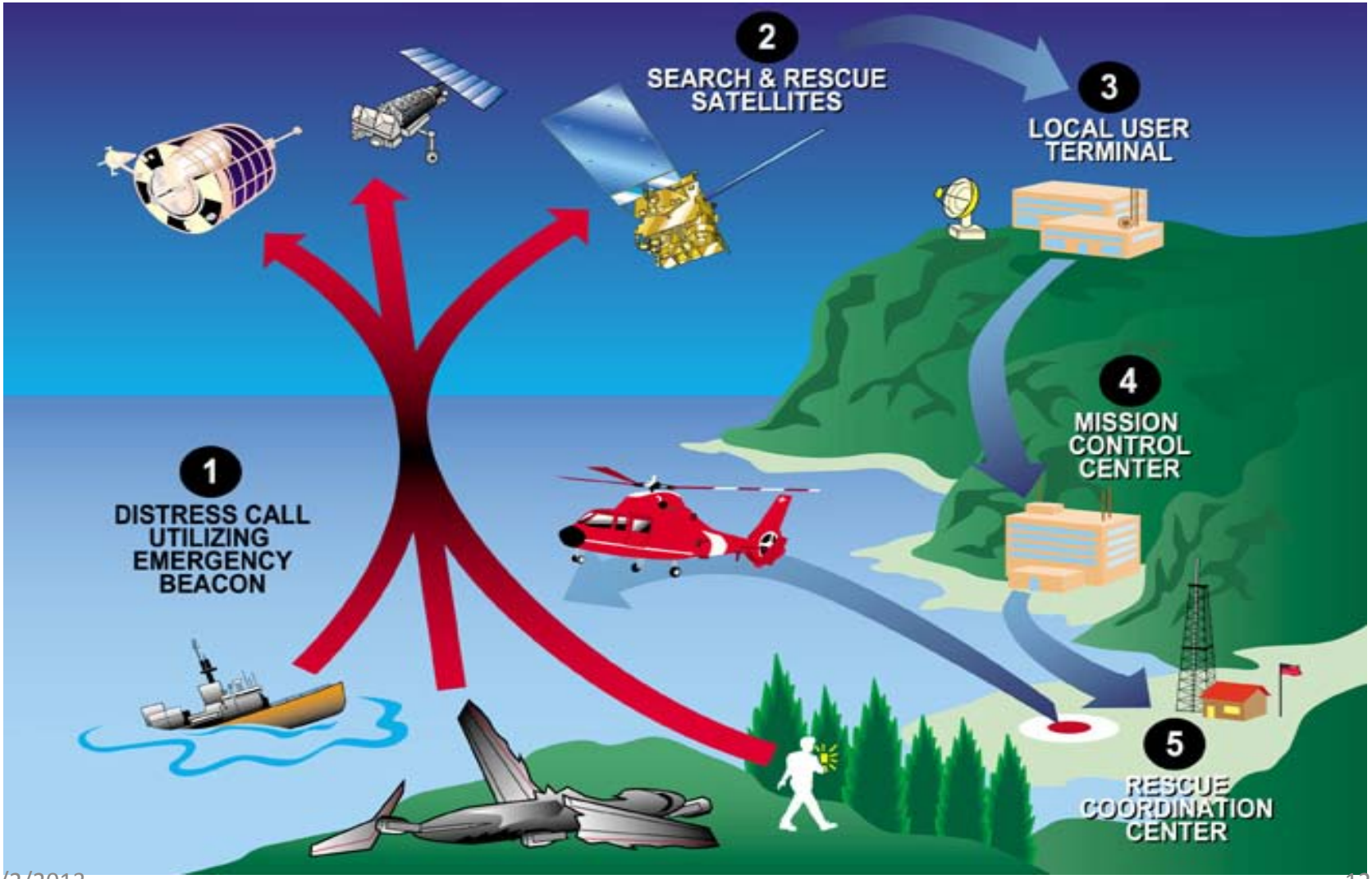
Representative to Cospas-Sarsat Program

U.S. SARSAT Program Management

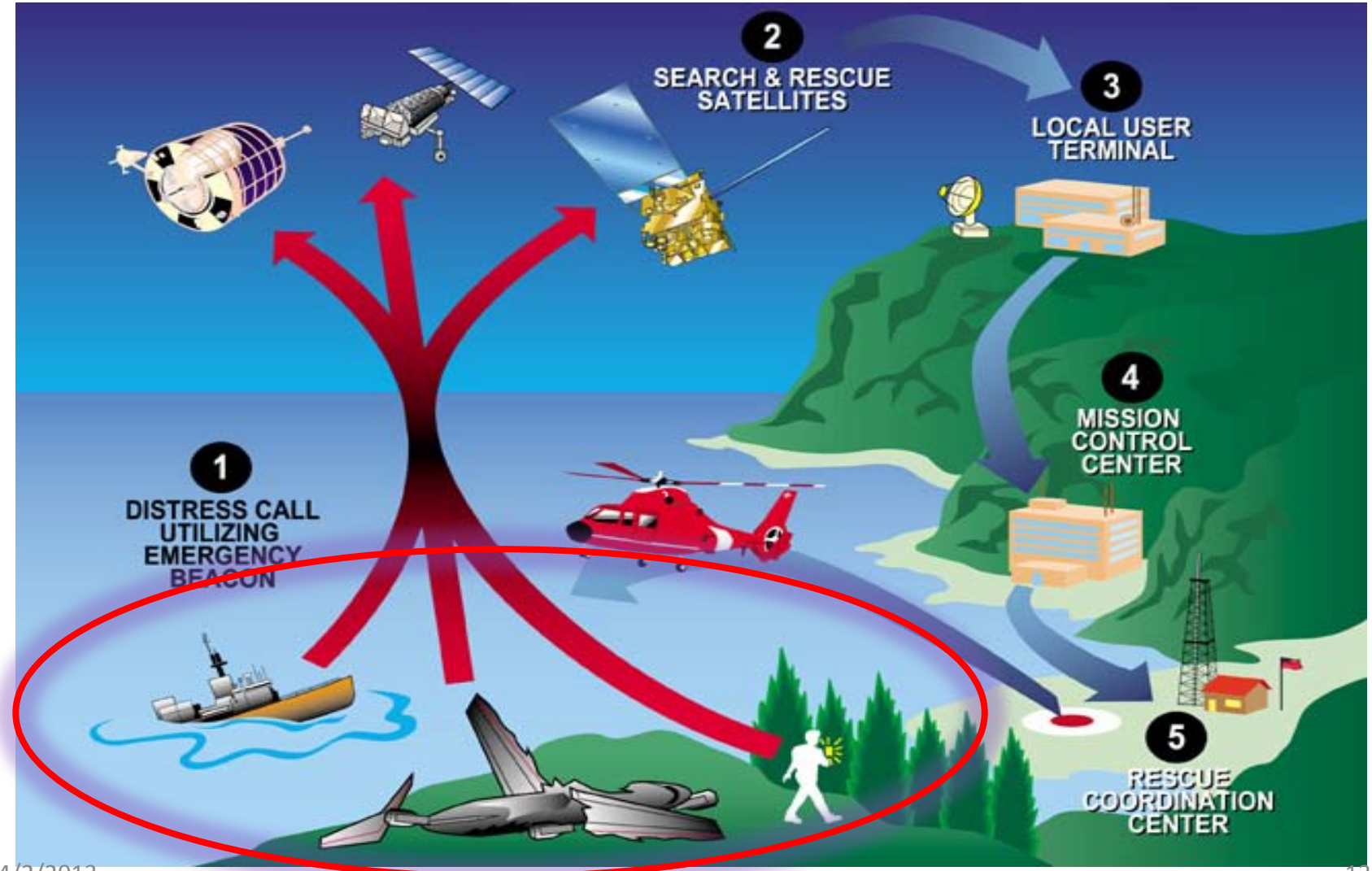
National Organization



Cospas-Sarsat System Overview



Cospas-Sarsat System Overview
User Segment



User Segment – Beacons

Activation:

- **Manual**
- **Automatic (Hydrostatic/G-Switch)**

Signal:

- **406 MHz (Digital)**
- **121.5 MHz (Analog) Homing**
- **Applications:**
- **Maritime - Emergency Position-Indicating Radio Beacon (EPIRB)**
- **Aviation - Emergency Locator Transmitter (ELT)**
- **Personal/Land - Personal Locator Beacon (PLB)**
- **Security – Ship Security Alerting System (SSAS)**

- *** Most U.S. general aviation ELTs are still 121.5 MHz which are no longer monitored by Cospas-Sarsat**

User Segment

- **66,451* aviation users in U.S.**

  All types and uses of aircraft

- **188,035* maritime users in U.S.**

  Divided between commercial and recreational vessels

- **116,987* land-based users in U.S.**

  Recreational use plus some aviation and maritime use

- **Estimate of approximately 1,319,000 users worldwide in 2011 and 1,717,000 worldwide in 2015**

*** Registered U.S. beacons as of March 4, 2013**

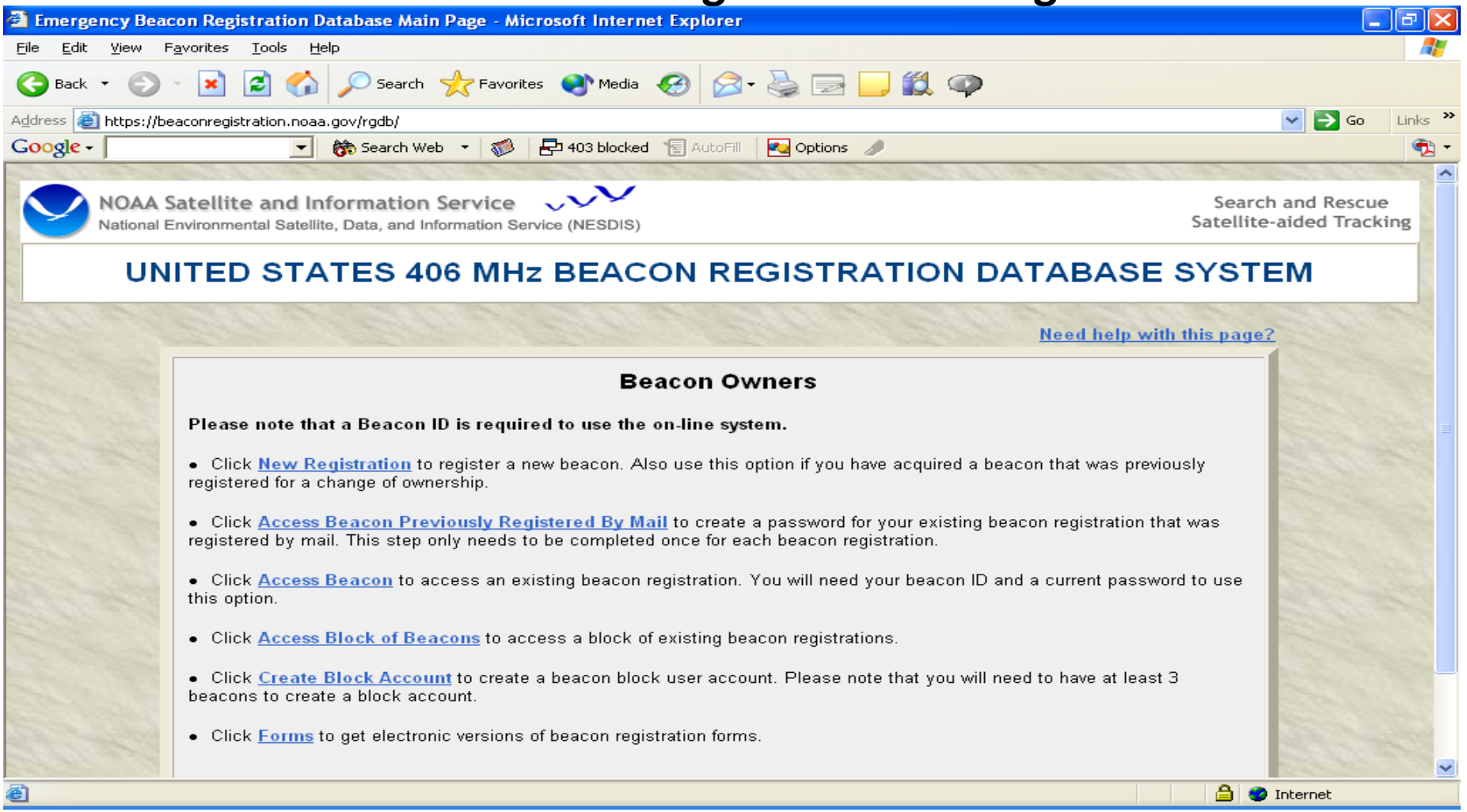
User Segment

Attributes of 406 MHz

- Every beacon has unique 15 hex identification
  - Unique ID allows registration with contact information
  - Non-Distress activations can be terminated with a phone call
  - Reduces stress on SAR assets
- Powerful 5 watt transmitter and digital signal increases accuracy of location by Doppler processing
- The system can discriminate between real beacon transmissions and non-beacon transmissions which reduces the resources spent on tracking interfering sources
- Global coverage provided by store and forward capability of Cospas-Sarsat satellites
- Increased system capacity due to short duration transmission, and spreading of frequency allocation

User Segment – Beacon Registration

www.beaconregistration.noaa.gov



Importance of Registration

Detection

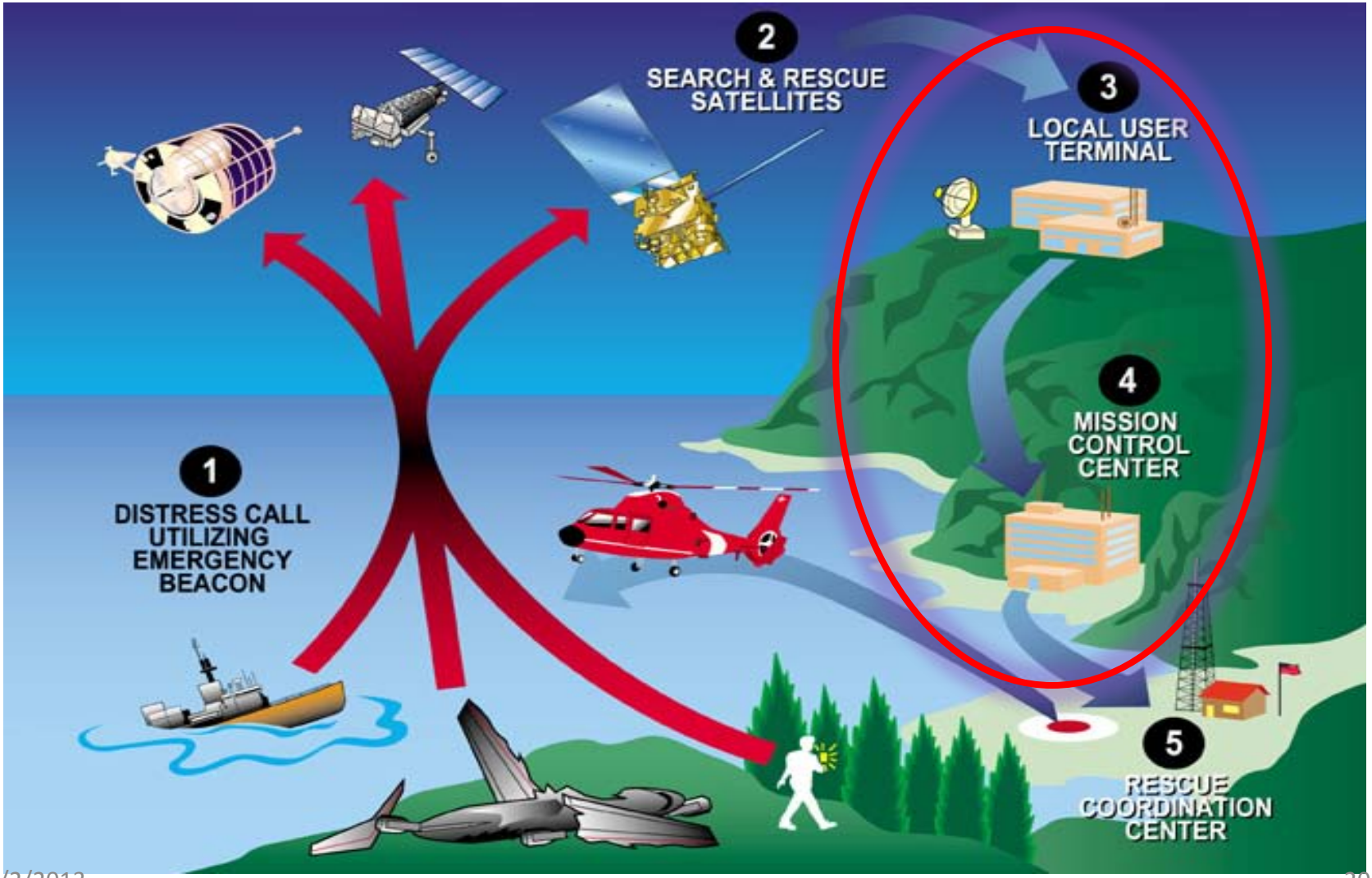
- Near real-time detection of the 406 MHz transmission from an emergency beacon. Even if there is no LEO satellite in view to achieve Doppler for location, GEO satellites work to save lives in 4 ways:
  - Use of Registration Database to contact owner or emergency POC; this allows rescue forces to get more detailed information such as nature of emergency, severity of injuries, number of people involved, etc. and can help determine if alert is actual distress
  - If beacon is equipped with GPS, the position (accurate within 100 meters) is embedded with the alert and given to rescue forces.
  - Has continuous monitoring of nearly 1/3 the Earth's surface.
  - Has a 46-minute mean time "advantage" for first detection.

Importance of Registration

Identification

- Digital data transmitted by beacon provides nationality and type of beacon
- Tail number or other identifying information can be encoded into the beacon
- Registration Database provides additional information such as owner/operator, and can include specifics on aircraft or vessel
- In most cases, false alerts are resolved prior to launch of resources, saving taxpayer $$

Cospas-Sarsat System Overview
Ground Segment

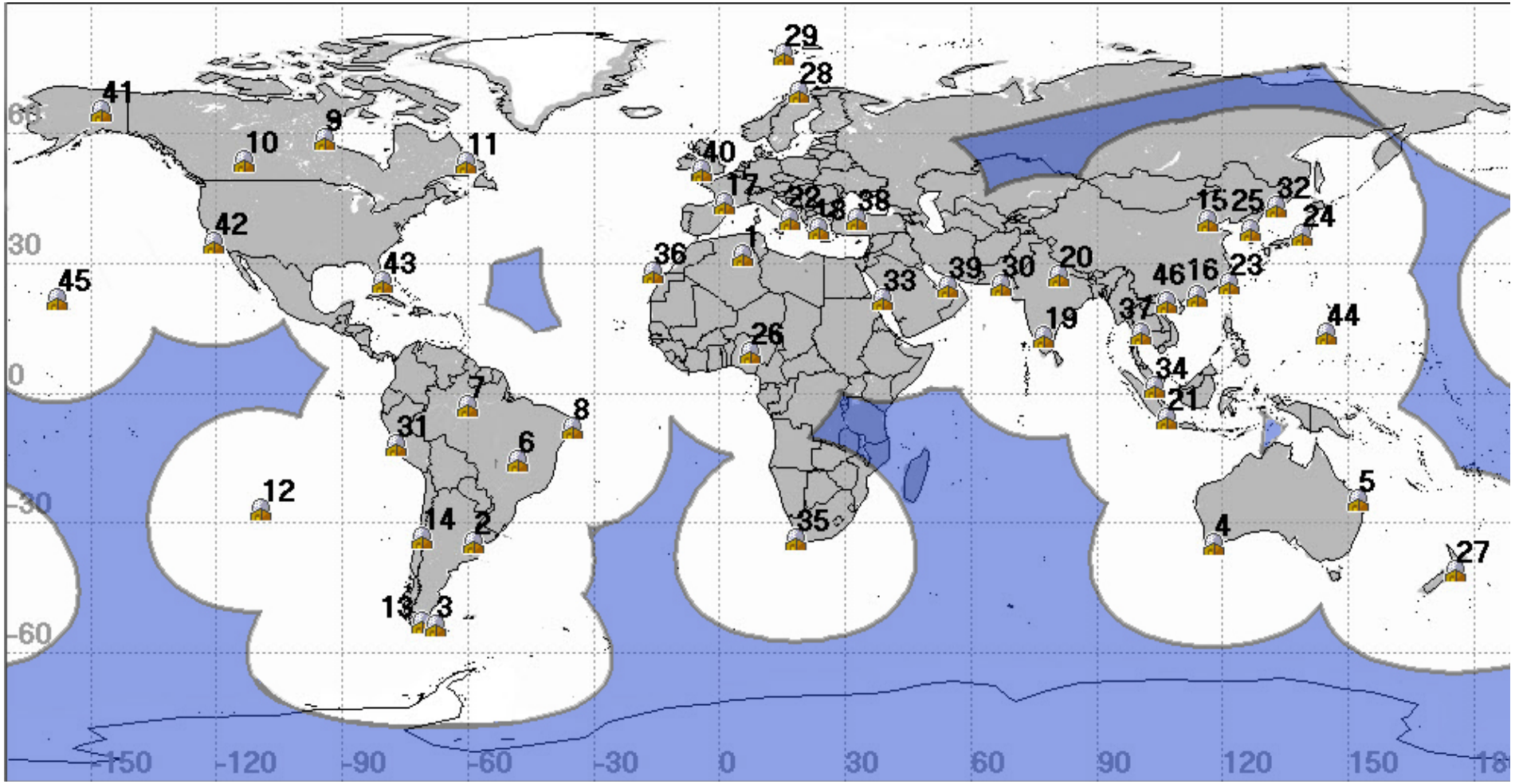


Ground Segment
Local User Terminals (LUTs)

- **LEOSAR Local User Terminals (LEOLUTs):**
  - **Receive and process data from Low Earth Orbit (LEO) satellite search and rescue processors (SARP) and search and rescue repeaters (SARR)**
  - **Combine LEO data with GEO data to improve Doppler processing**
  - **Maintains accuracy by producing a correction of the satellite ephemeris each time a satellite signal is received**
  - **Transmit collected data to the Mission Control Center**

Ground Segment
Local User Terminals (LUTs)

58 LEOLUTs in 46 Locations

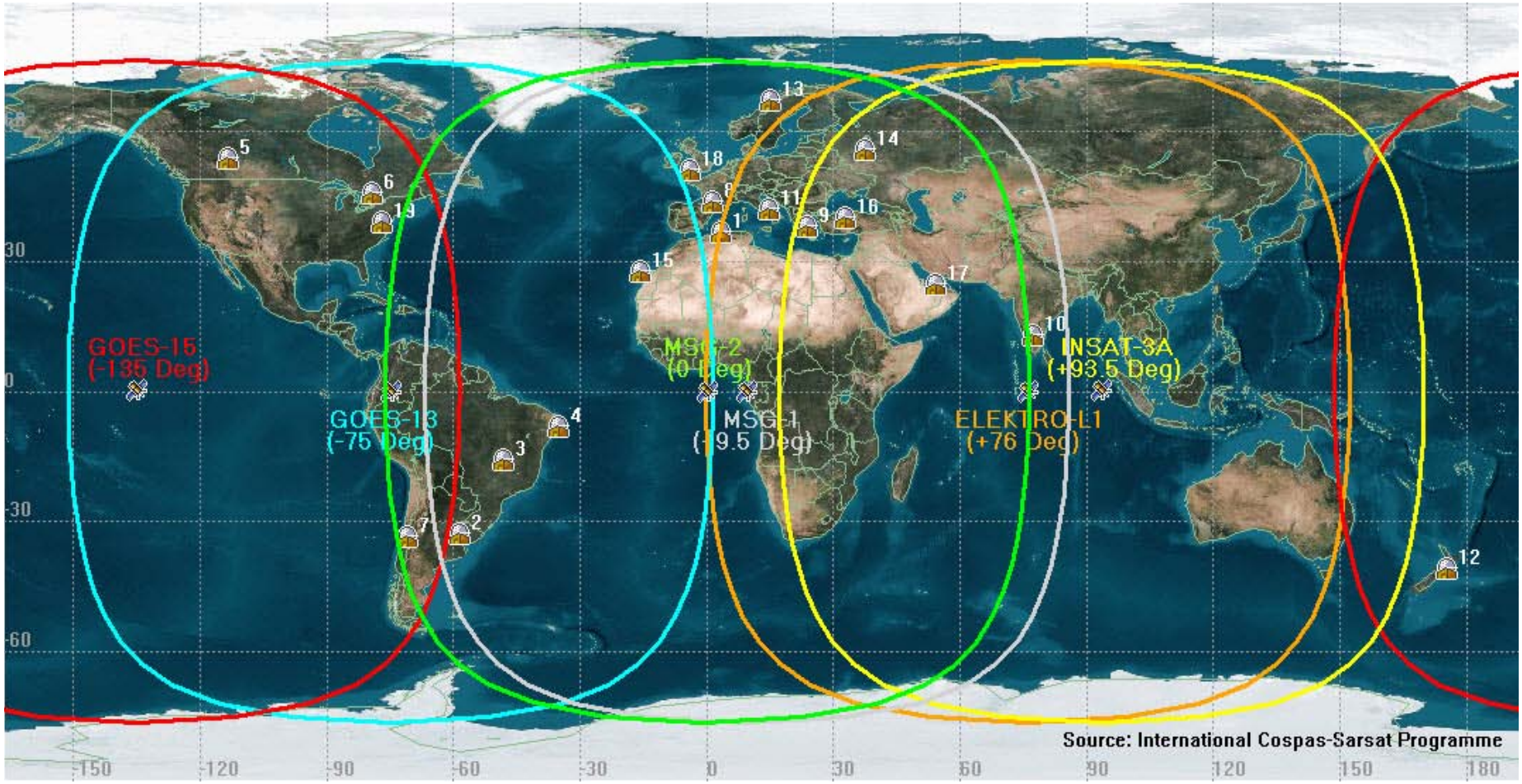


Ground Segment
Local User Terminals (LUTs)

- **GEOSAR Local User Terminals (GEOLUTs):**
  - **Receive and process data from Geostationary Earth Orbit (GEO) satellite search and rescue repeaters (SARR)**
  - **Provides beacon location information to MCC when it is included in the digital message of a 406 MHz beacon if the beacon has external or internal navigation device**
  - **Transmit collected data to the Mission Control Center**

Ground Segment
Local User Terminals (LUTs)

19 GEOLUT Locations



Ground Segment

United States Dual System LUTs

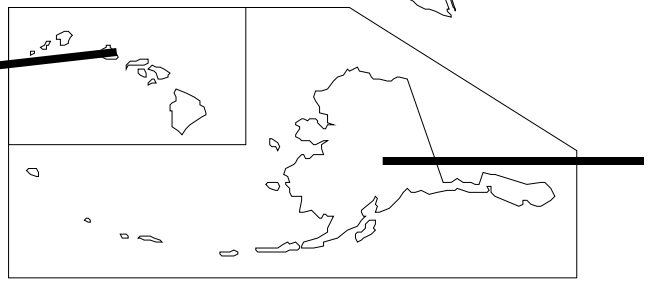
Guam

California

Maryland

Miami

Hawaii



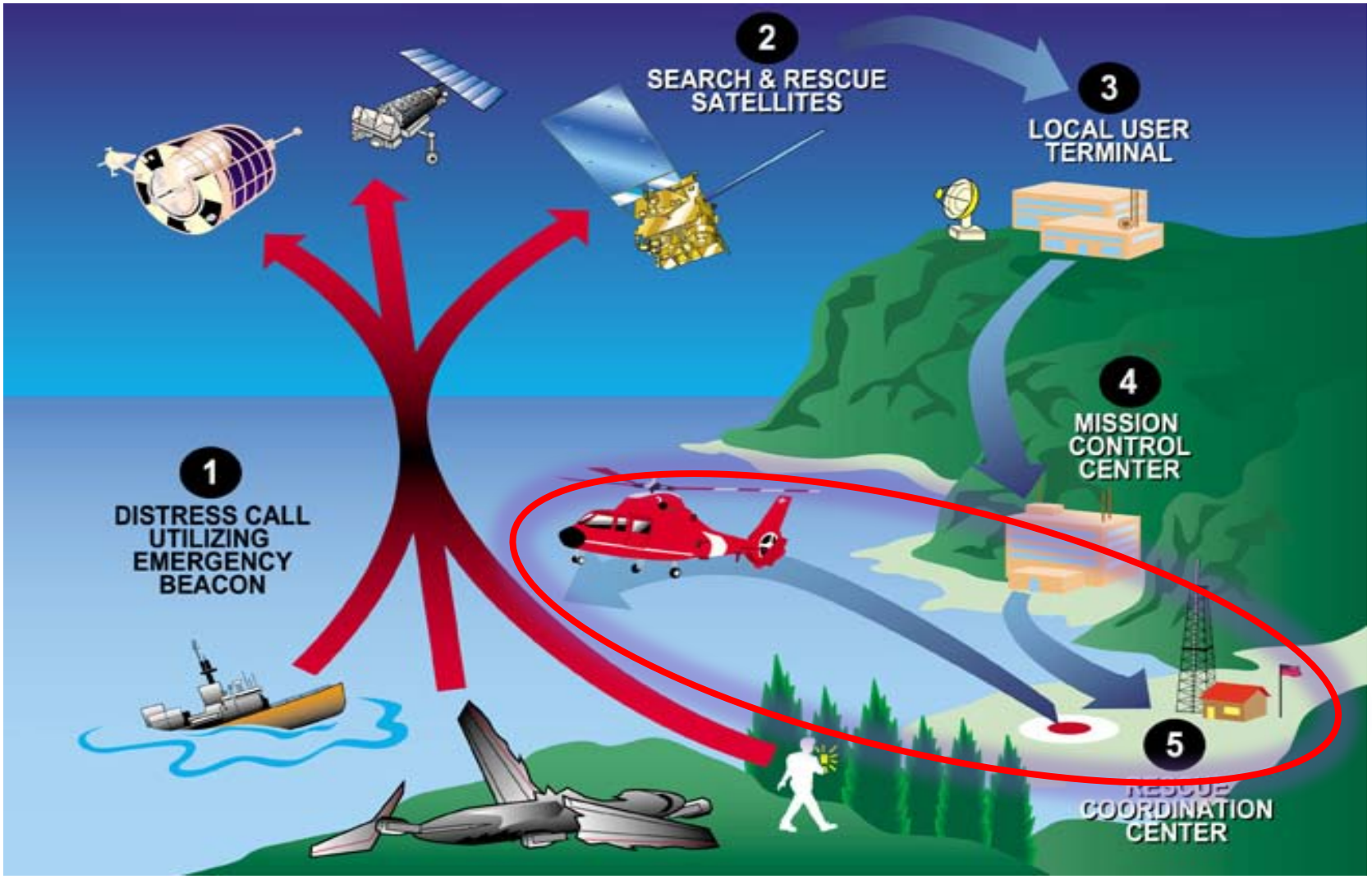
Alaska

Ground Segment

Mission Control Centers (MCCs)

- Receive alerts from national LUTs and foreign MCCs
- Validate, match, and merge alerts to improve location accuracy and determine the correct destination
- Correlate with registration database and append info to alert
- Geographically sort and then transmit alerts to appropriate Rescue Coordination Centers (RCCs) and SAR Points of Contact (SPOC).
- Filter redundant data
- Perform System support and monitoring functions

Cospas-Sarsat System Overview
Search and Rescue Segment

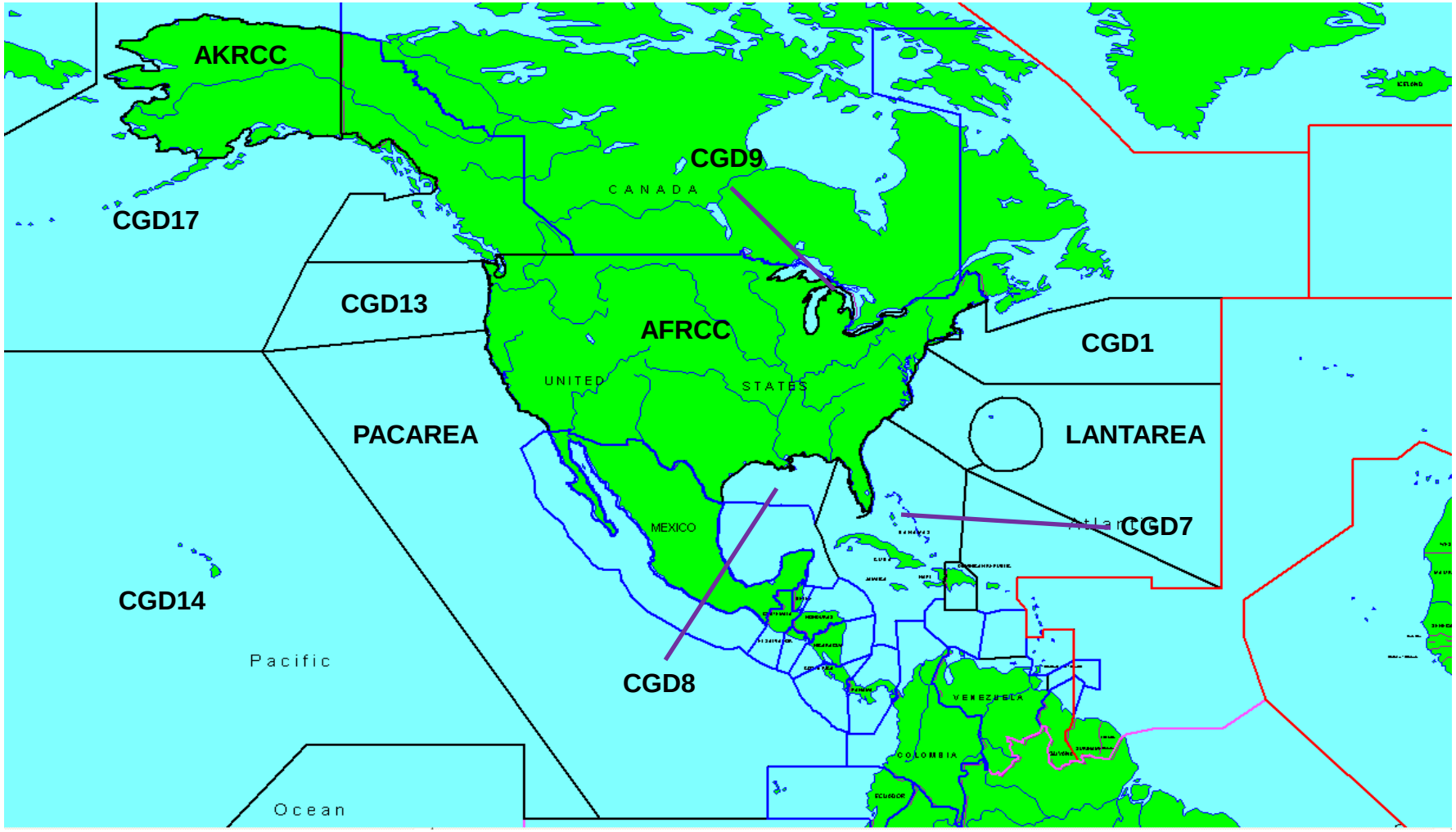


Rescue Coordination Centers

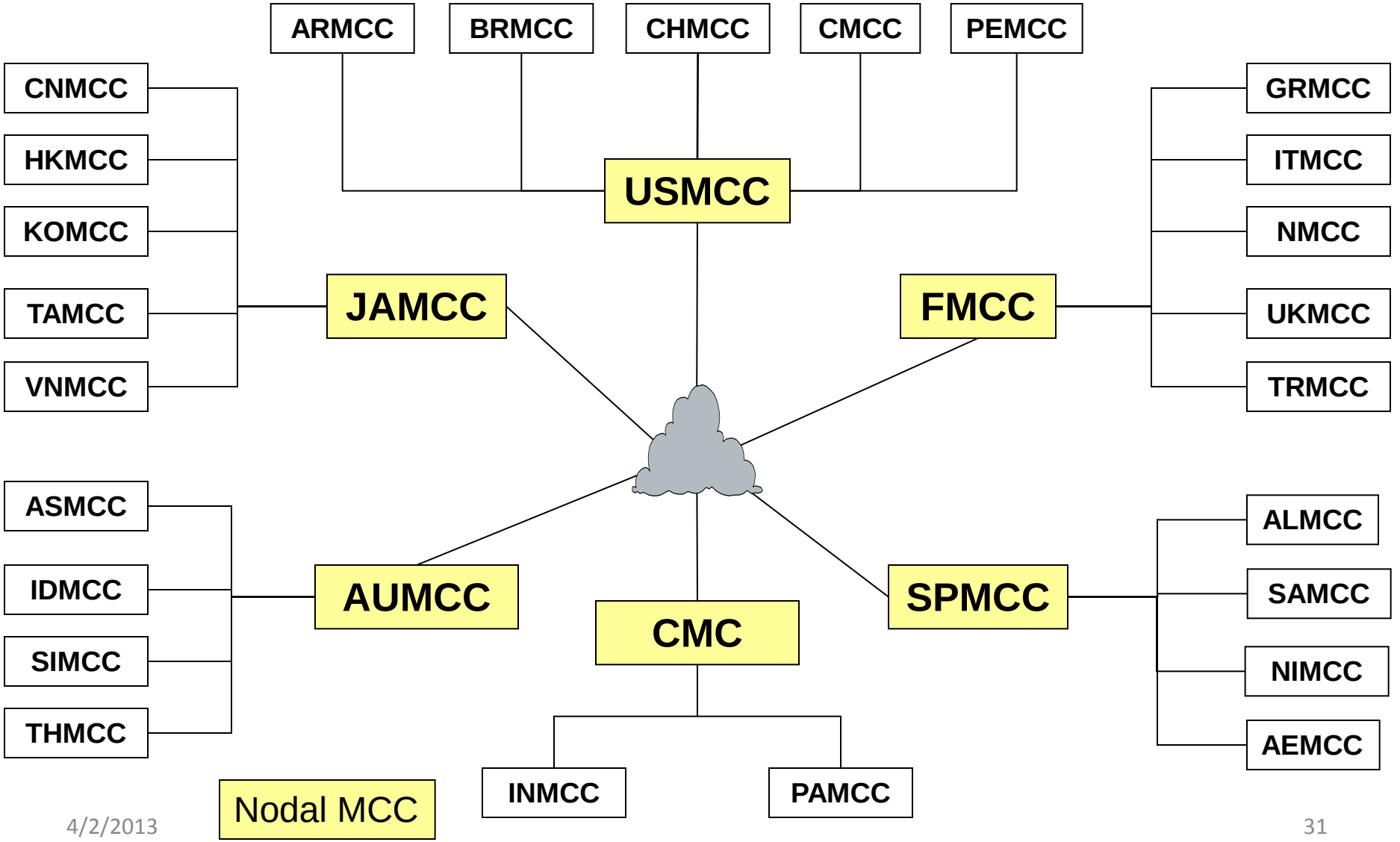
- Receive SARSAT Distress Alerts from MCCs
- Coordinate the Rescue Response

Rescue Coordination Centers

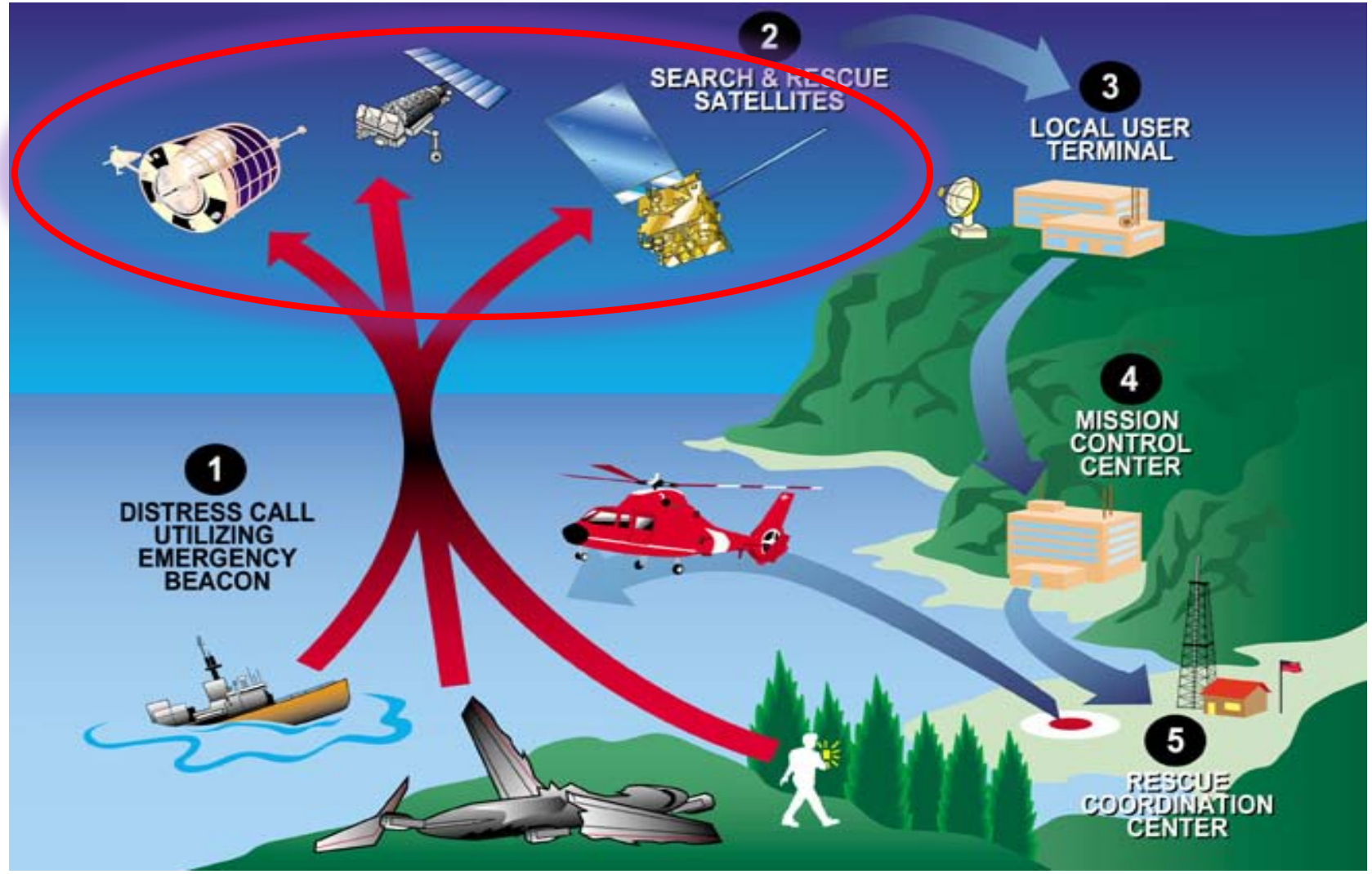
U.S. Rescue Coordination Center Coverage Areas



MCC to MCC Data Distribution



Cospas-Sarsat System Overview
Space Segment



Space Segment

Currently 2 Types of Satellites:

- **Low Earth Orbiting Search And Rescue (LEOSAR)- 5 on Orbit**

  Altitude: 500 miles in "Pole-Pole" orbit

  Performs Doppler locating function (primary means of locating…not GPS)

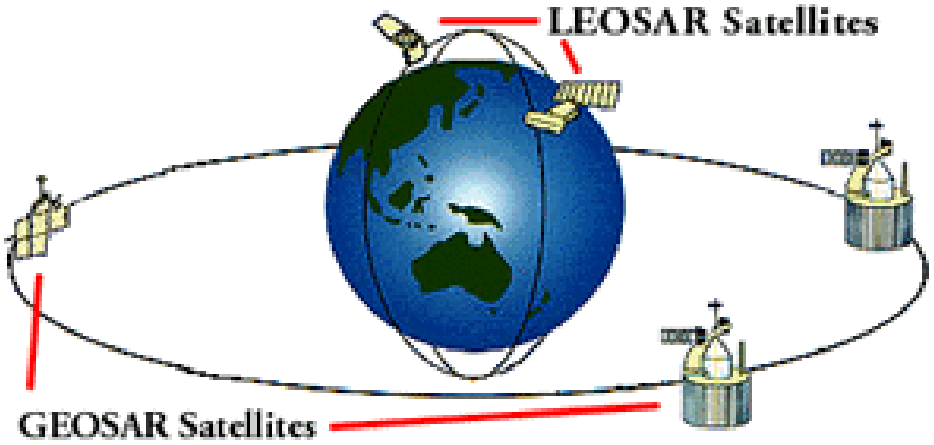
  Stores & Forwards alerts continuously for 48 hours (provides worldwide coverage and total system redundancy)

- **Geostationary Orbiting Search And Rescue (GEOSAR)- 4 on Orbit**

  Altitude: 23,000 miles in fixed orbit

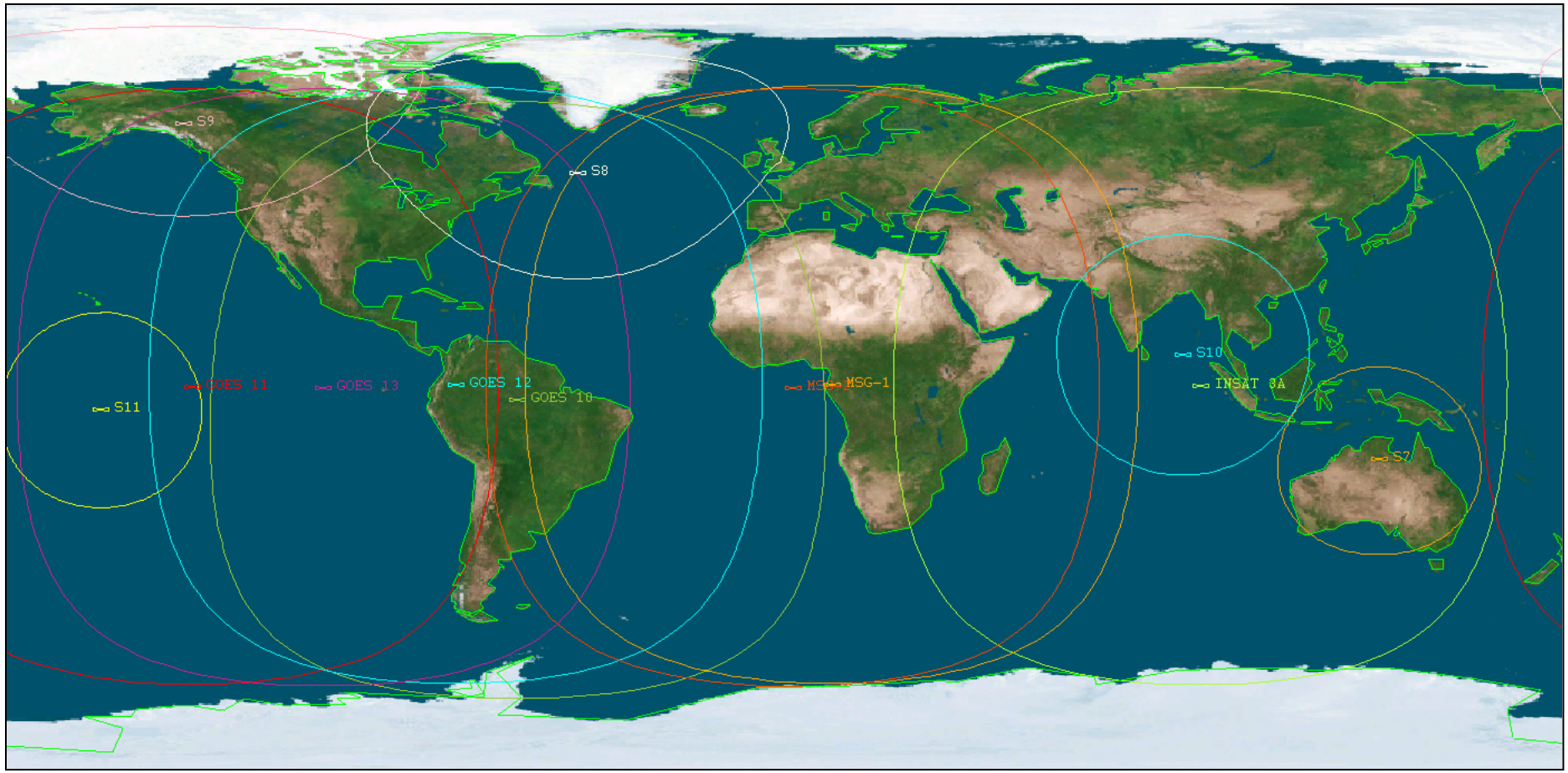
  Performs instantaneous alerting function. No locating capability unless beacon is equipped with GPS.

  Coverage from 70N – 70S



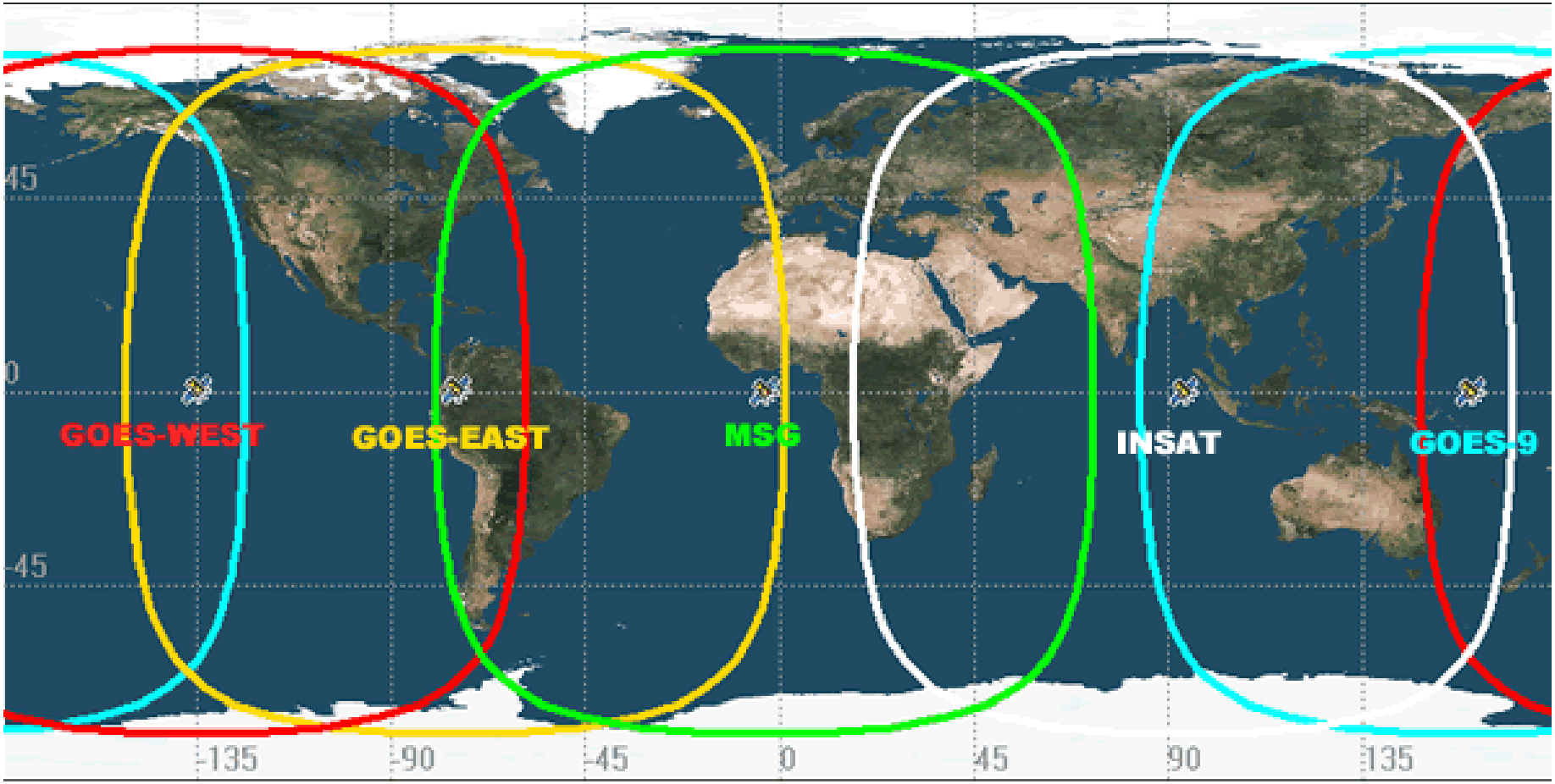
Space Segment

Typical Satellite Footprints



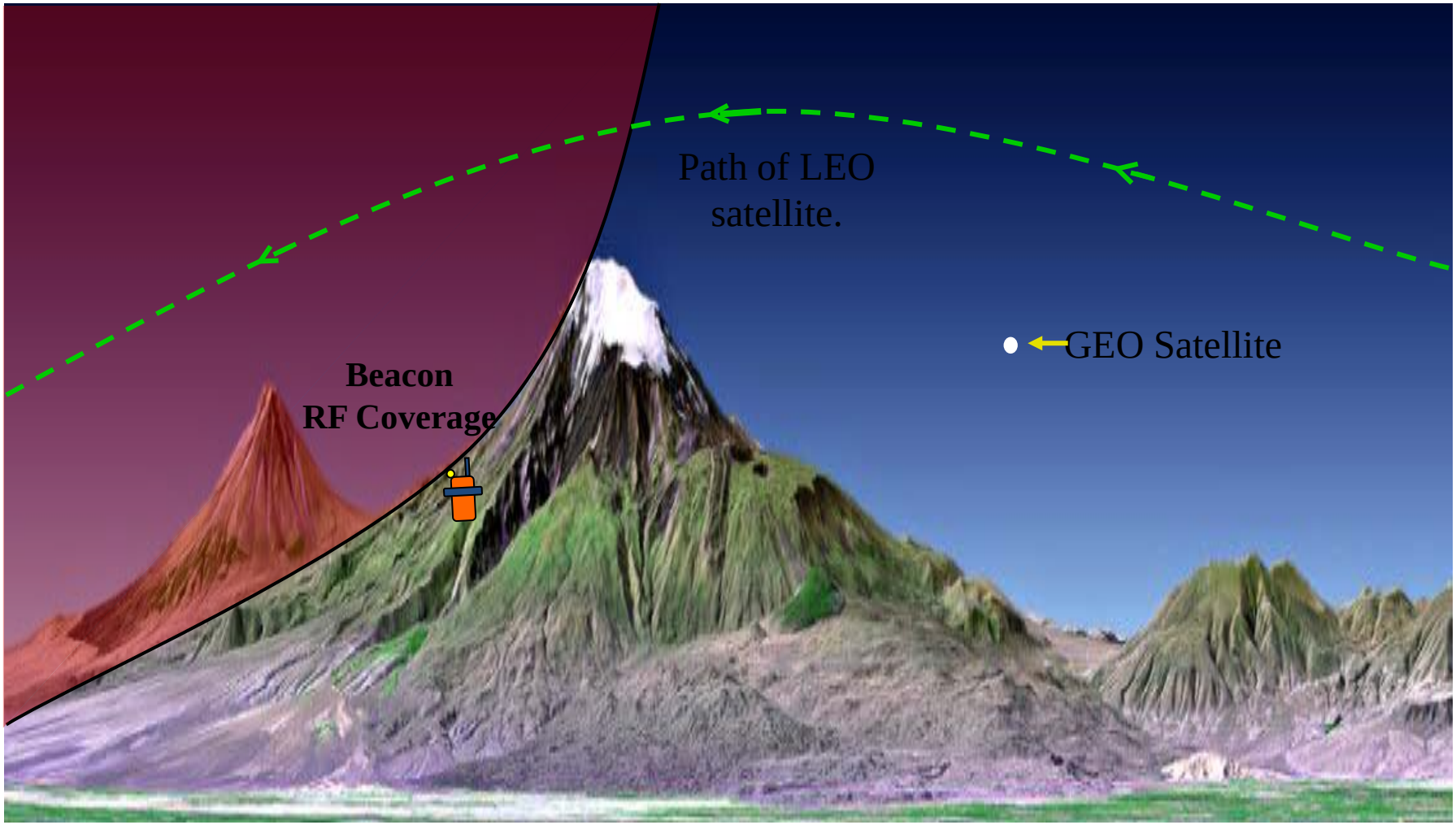
Space Segment

GEOSAR Coverage - Typical Satellite Footprint



Space Segment

Field of View



Future Enhancements

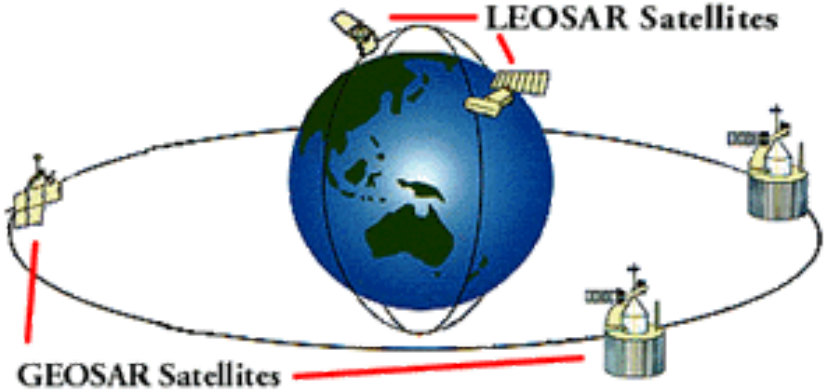
Current Limitations

GEOSAR:

- Coverage limited to 70N to 70S
- Fixed geometry to emergency beacon
- No Doppler or independent location capability

LEOSAR:

- Waiting time
- Payload configuration fixed



System:

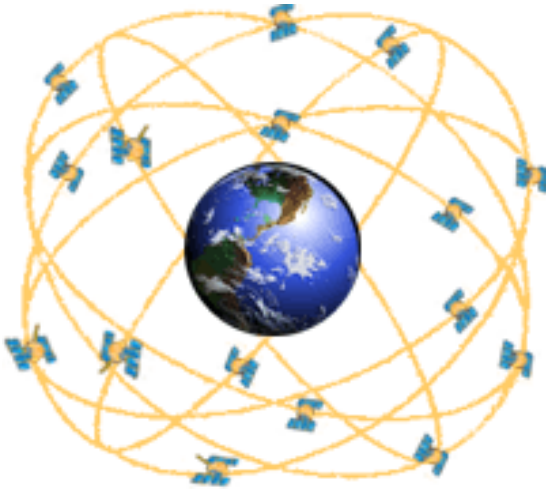
- Performance variations between SAR payloads
- System reliability

Future Enhancements

Future Capability

Medium Earth Orbit SAR System (MEOSAR)

- **Improved Position Accuracy**
  - ***Average accuracy decrease from 3.1 km to 500 meters***
- **Decrease in waiting time**
  - ***Improvement ranges from three minutes to eight hours depending on latitude and terrain.***
- **Robust Space Segment which operates even if some of the satellites fail**



Future Enhancements

International Cooperation

- **Similar systems being proposed for the European Galileo and Russian Glonass Global Navigation Satellite System (GNSS) systems.**
  - ***U.S. – European Union agreement on GPS/Galileo calls for cooperation on search and rescue within Cospas-Sarsat***
  - ***Cospas-Sarsat concluded a Declaration of Intent to Cooperate with the Galileo Joint Undertaking in December 2006.***
  - ***U.S. – Russia in middle of negotiating an agreement which will include search and rescue***
- **Cospas-Sarsat has developed MEOSAR Implementation Plan to help ensure interoperability**
- **Countries developing plans to deploy test and operational ground segment equipment to support the new space segment.**

Cospas-Sarsat Results

Cospas-Sarsat Results

Rescues in the United States

Calendar year 2011

Overall – 207 Rescues in 116 Events

EPIRB – 123 rescues in 41 events

PLB – 71 rescues in 42 events

ELT – 14 rescues 6 events

Cospas-Sarsat Results

Persons rescued world-wide since 1982

33,000+

Persons rescued in United States since 1982

(as of Feb 21, 2013)

7,019

Questions?