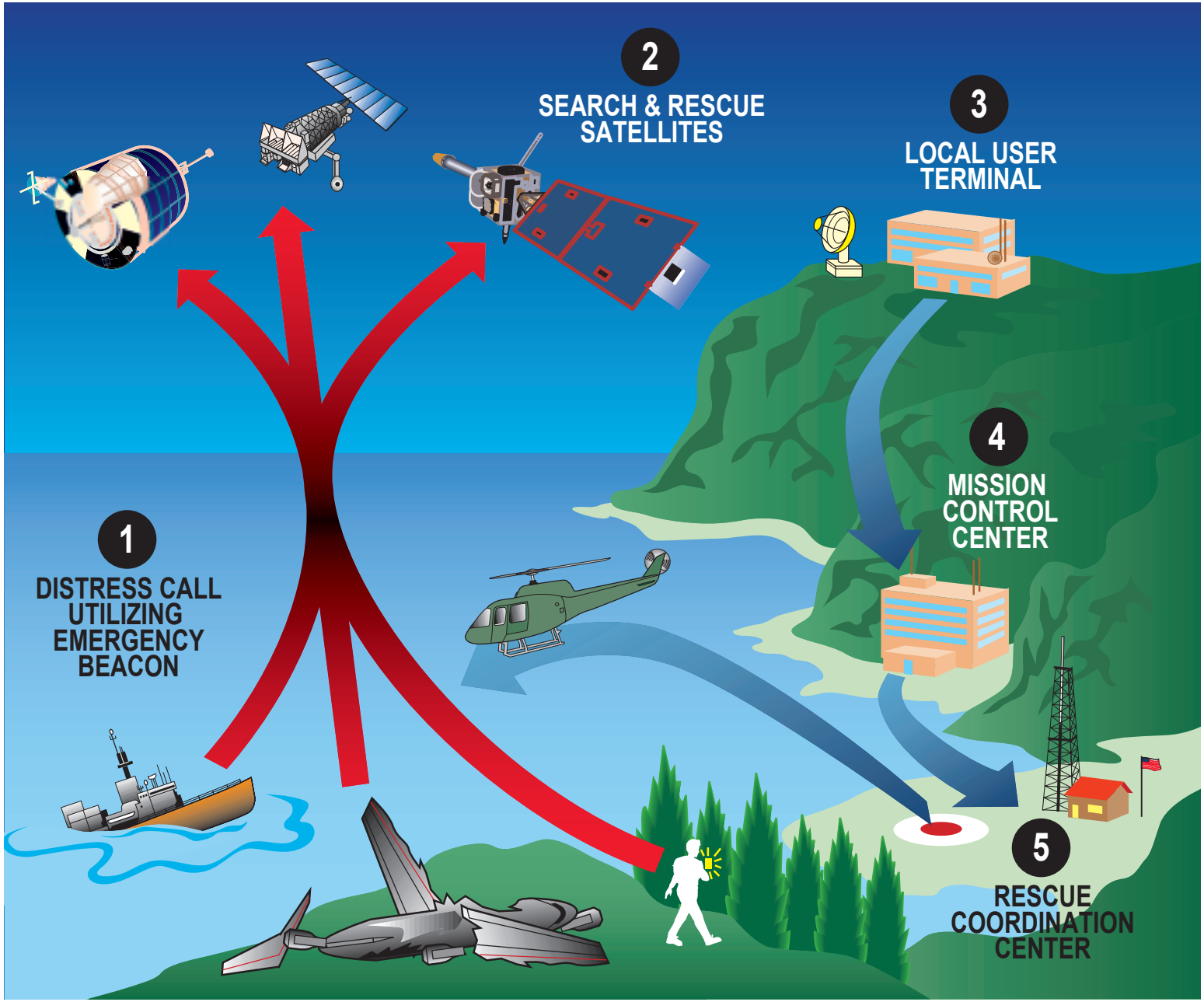
National Aeronautics and Space Administration
Goddard Space Flight Center

COSPAS-SARSAT Search and Rescue System

National Oceanic and Atmospheric Administration
National Environmental Satellite, Data, and Information Service



1. In situations of "grave and imminent danger" when lives are at risk, emergency beacons are activated.

2. Emergency alerts received by the satellites are retransmitted to 38 automatic (unstaffed) ground stations worldwide. These stations are called Local User Terminals (LUTs).

3. Alerts are routed to a Mission Control Center (MCC) in the country that operates the LUT. Routed messages include beacon location computed at the LUT if the message is received by one of the system's low-Earth-orbiting satellites. Alerts received by system satellites in geosynchronous orbit provide instantaneous alerting and can include location information if the beacon is a self-locating type.

4. After validation processing, alerts are relayed depending on beacon location or country of registration (406-MHz beacons only) to either another MCC or to the appropriate Rescue Coordination Center (RCC).

5. U.S. RCCs are operated by the Coast Guard and the Air Force. The Air Force Rescue Coordination Center (AFRCC) at Langley AFB, Virginia, coordinates all inland SAR activities in the lower 48 states. In most situations, the actual search and rescue is carried out by the Civil Air Patrol or local rescue services. The U.S. Coast Guard coordinates and conducts most maritime SAR missions from RCCs located in nine Command Districts around the United States and two Rescue Sub-Centers (RSCs) in San Juan, Puerto Rico, and in Guam.

5 (in Alaska). Alaskan inland rescues are handled differently. The Air Force operates an Alaskan Rescue Coordination Center (AKRCC) in Anchorage at Ft. Richardson. Alaskan SAR is carried out by Air National Guard units, the Alaska State Police, and local authorities.

The U.S. portion of the Cospas-Sarsat system is operated by the NOAA SARSAT Office in Suitland, Maryland. The U.S. Mission Control Center (USMCC) is located there. Additional information on the system including the latest U.S. and worldwide lives saved can be obtained from http://www.sarsat.noaa.gov and http://poes.gsfc.nasa.gov/sar/sar.htm.

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Cospas-Sarsat,* an international, humanitarian satellite-based search and rescue system, has helped save over 11,300 lives (as of May 2000) worldwide since its inception in 1982. The system, which operates 24 hours a day, 365 days a year, detects and locates transmissions from emergency beacons carried by ships, aircraft, and individuals.

Sponsored by Canada, France, Russia, and the United States, the system aims to reduce the time required to alert rescue authorities whenever a distress situation occurs. The rapid detection and location of a downed aircraft, a ship, or an individual in distress are of paramount importance to survivors and to rescue personnel.

The Cospas-Sarsat system consists of emergency radio beacons, equipment on satellites in low-Earth polar or in geosynchronous orbits, ground receiving stations also called Local User Terminals (LUTs), Mission Control Centers (MCCs), and Rescue Coordination Centers (RCCs).

There are three types of emergency beacons: 1) Emergency Position Indicating Radio Beacons (EPIRBs) for maritime applications, 2) Emergency Locator Transmitters (ELTs) for aviation applications, and 3) Personal Locator Beacons (PLBs) for individuals in distress. Rescue beacons transmit on 121.5, 243.0 and 406 MHz.

There are approximately 590,000 121.5-MHz beacons in use worldwide. The U.S. military and NATO forces use beacons that transmit at 243.0 MHz. Neither of these beacon types transmits encoded information.

Beacons that transmit between 406.0 and 406.1 MHz send digitally encoded information which includes a beacon ID for accessing a user registration database. This database can supply the beacon type, its country of origin, and the registration number of the maritime vessel or aircraft and can also include location data derived from the Global Positioning System (GPS). Encoded location is of great value when using a geostationary (GEO) satellite for relaying beacon signals because a GEO satellite provides immediate alerting. There are approximately 220,000 406-MHz beacons presently in use worldwide.

*Sarsat is an acronym for Search and Rescue Satellite-Aided Tracking. Cospas is an acronym for the Russian words "Cosmicheskaya Sistyema Poiska Avariynich Sudov," which mean "Space System for the Search of Vessels in Distress."

The system uses two different types of satellites: polar-orbiting satellites in low-Earth orbit (LEO) and satellites in geosynchronous orbit. Russia and the United States provide the LEO satellite platforms. Canada, France, Russia, and the United States contribute components. The Russian NADEZHDA navigation satellites carry the Cospas repeater packages, and NOAA weather satellites carry Sarsat packages. The NOAA LEO satellites orbit the Earth every 100 minutes. Cospas satellites complete an orbit every 105 minutes.

GEO satellites continually view large areas of the Earth and can provide immediate alerting and identification of 406-MHz beacons. Even though GEO satellites cannot determine a beacon's location using Doppler processing, the near instantaneous alerting, user ID, and detective work by the RCC often yield the location of the distress call. Based on this information alone, search planning can begin. Ideally, a Sarsat or Cospas LEO satellite will overfly the beacon within the next hour and calculate a Doppler-determined location.

The Cospas-Sarsat LEO system uses two modes of operation. In the **Bent-Pipe or repeater mode,** the Search and Rescue Repeater, or SARR, immediately retransmits received beacon signals to any LUT in the satellite's footprint. This mode is possible when the spacecraft is visible to both the beacon and the ground station simultaneously, an area approximately 2,500 miles (4,000 km) in diameter. In the **store and forward mode,** the on-board processor, or SARP, receives and records search and rescue beacon transmissions and repeatedly retransmits them to LUTs as the satellite orbits the Earth. This mode is possible only with 406-MHz beacons. It provides true global coverage.

The signals received by LEO satellites are relayed to a network of LUTs that locate the beacon by measuring the Doppler shift caused by the motion of the satellite with respect to the beacon. This process can locate beacons within an accuracy of 12.4 miles (20 km) for 121.5-MHz beacons and 3.1 miles (5 km) for 406-MHz beacons. A low-power 121.5-MHz homing signal included in most 406-MHz beacons helps rescuers determine the final location.

The location data is then relayed to an MCC that alerts the appropriate RCC or an MCC in another country. If the alert is in an area covered by a foreign MCC, that MCC is alerted, and in turn, notifies its own RCC. The RCC then begins the actual search and rescue operation.

NOAA, the U.S. Coast Guard, and the U.S. Air Force operate the Cospas-Sarsat system in the United States. NASA provides technical support by investigating system problems and developing technological improvements. More information may be found at: http://www.sarsat.noaa.gov/ and http://poes.gsfc.nasa.gov/sar/sar.htm.

For the Classroom

Go to the website that lists Recent Saves at www.sarsat.noaa.gov/saves.html. Select a group of saves for any period of time from the list and read the description of at least three of the saves that took place. Now put yourself in the place of someone who needs help and write a short story (1-2 pages) that describes your dilemma. Use your imagination, the description of a real save, and also the material on this page that explains how the Search and Rescue system works.

To help you:
ELT - Emergency Locator Transmitter
EPIRB - Emergency Position-Indicating Radio Beacon
MCC - Mission Control Center
PLB - Personal Locator Beacon
RCC - Rescue Coordination Center

In your story, be sure to include:
1. Where you were when you needed help. Use a map if necessary.
2. Whether you were on a plane, in a boat, or somewhere else on the ground.
3. Why you needed help.
4. After you sent your signal, what happened?
5. Where did the signal go that you sent?
6. How did the signal get to the people who rescued you?
7. How long did it take for you to be rescued?

Share your story with your classmates.

LG 2000-XX-XXX-GSFC