SATELLITE AIDED SEARCH & RESCUE SYSTEM

Indian Mission Control Centre

INDIAN MISSION CONTROL CENTRE (INMCC)
Satellite Aided Search and Rescue System (SASAR)
ISTRAC/ISRO

1. SEARCH & RESCUE (SAR)

Accidents in sea, air and even on land are part of our present day life. From the early days of history, with the man's unquenchable pursuit for adventure, there have been tragic incidents, involving loss of lives and property. With the increasing commercial interests in travel, the essentiality of safety has been well recognized and this has led to a number of innovations in the design of aircrafts and ships. Nevertheless, there is no way to completely eliminate accidents and hence, need for a foolproof search and rescue system.

In any emergency, time is precious; quicker the search areas are identified, more successful is the rescue. There are several ways that search and rescue authorities are alerted to a vessel or an aircraft in trouble, that includes marine radio distress calls, flares and overdue vessel or aircraft reports. But the space-age-technology elegantly handles the search and rescue operations using **Satellites and Radio beacons.** The radio beacon is a buoyant, self-contained radio transmitter and if activated, continuously emits a distinct distress signal for a period, not less than 24 hours.

SAVIOURS IN SPACE

2. COSPAS-SARSAT SYSTEM

The Cospas-Sarsat is an international satellite system for search and rescue, comprised of a constellation of satellites in polar and geostationary orbits and a network of ground stations. This system provides distress alert and location information to respective Search and Rescue (SAR) authorities globally for maritime, aviation and land users in distress.

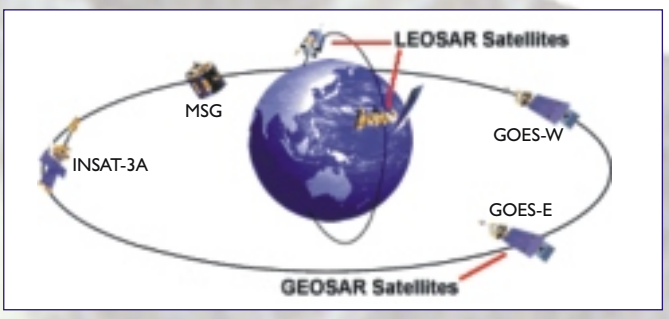
The Cospas-Sarsat Programme, as of February 2009, was comprised of 4 Parties to the Cospas-Sarsat Agreement, 25 Ground Segment Providers, 9 User States and 2 Participating Organisations. From Sept. 1982 to Dec. 2007, the Cospas-Sarsat system has supported the rescue of almost 25,000 persons in about 6800 SAR events globally.

3. SYSTEM COMPONENTS

The Cospas-Sarsat system consists of three main segments: Radio Beacons, Space Segment and Ground Segment.

a. Radio Beacons: A Cospas-Sarsat beacon operating on 406 MHz frequency is a powerful means of signaling to search and rescue forces that someone is in distress and is in need of immediate assistance. These emergency beacons are considered as the last resort for people in distress for saving their lives, when all other modes of emergency communications prove futile. There are three types of beacons viz. ELT (Emergency Locator Transmitter) for aviation use, EPIRB (Emergency Position Indicating Radio Beacon) for maritime use, and PLB (Personal Locator Beacon) for general outdoor use by an individual. The 406 MHz beacons are highly sophisticated because of the inclusion of digitally coded unique identification information in the beacon message, including location of the distress site based on GPS (for new generation beacon models). The global 406 MHz distress beacon population as of December 2007 was estimated at 600,000.

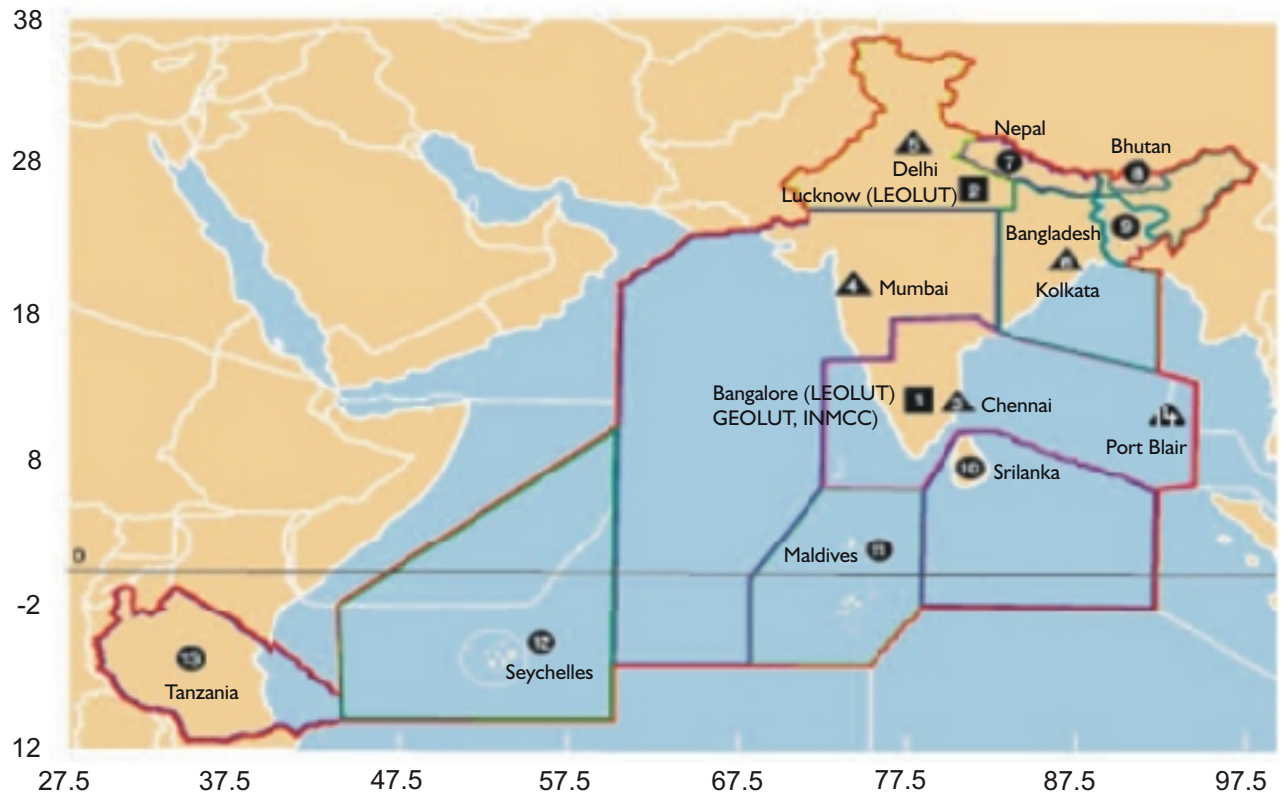
b. Space Segment: The Cospas-Sarsat satellite system consists of a number of different but complementary satellite constellations orbiting the earth. These include low earth orbiting (COSPAS and SARSAT) and geostationary satellites. Due to global coverage of the satellite system, distress signals can be picked up from anywhere on the earth.



Status of Space segment (as on February 2009) - LEOSAR: 5 SARSAT satellites (S7, S8, S9, S10, S11), GEOSAR: 5 Geostationary satellites [INSAT-3A (93.5° E), GOES-East (75° W), GOES-West (135° W), MSG1 (9.5° W), MSG2 (0°].

c. Ground Segment: The ground system, tracks, receives and processes distress signals from the Cospas-Sarsat beacons.

INMCC Service Area



Salient Features of the System

Feature	LEOSAR	GEOSAR
Coverage	Global	± 70 deg Latitudes
Location accuracy	Better than 5 km, 150 m (for GPS beacons)	100m (for GPS beacons only)
Wait time	90 mins. (Average at mid latitudes) with 4 satellites, and even better with 6 satellites	Nil (Immediate detection)
Processing time	20 minutes from the start of the satellite pass	5 minutes
Message delivery time	4 minutes (AFTN), Immediate (FTP)	Same as LEOSAR
Availability	LUTs > 95%, INMCC > 99% in a year	
Services offered	Distress alerting, Nodal agency for Indian beacon registration database, System exercise/beacon testing, Serial number allocation for coding and necessary guidance.	
Beacon Registration	Web-based online registration available to users at: http://inmcc.istrac.org	
System Operations	The INMCC System is fully automatic, manned only during office working hours (08:30 to 17:00 hrs, IST) Monday to Saturday, Outside the working hours, 24h services are provided on-call. 24h contacts: +91-80-2809-4534 (Shift Manager), Mobile/Res (Manager, INMCC): +91-93433-30354 / +91-80-4090-6656	

ISTRAC Quality Policy

To strive for continuous improvement in Space Operations
and provide fault-free services

The processed data containing distress location and identification of user/object in distress is sent to SAR agencies (RCCs/MRCCs) for further action.

The Indian ground system consists of 2 LEOLUTs (one each at Bangalore and Lucknow), 1 GEOLUT and an INMCC at Bangalore. The LEOSAR and GEOSAR systems were commissioned during 1989-90 and in 1992 respectively.

4. HOW DOES THE SYSTEM WORK?

The ship/aircraft/land users carry emergency transmitters (beacons: EPIRB/ELT/PLB), which can be activated either manually or automatically in case of a distress situation such as an accident, a crash, sinking, fire, explosion, etc. These units, when activated, transmit distress signals, which are picked-up by Cospas-Sarsat satellite system, and relayed to ground receiving stations known as Local User Terminals (LUTs). The LUTs track and receive the data, and provide user identification and location (Lat, Long) of the object/person in distress, precisely through Doppler principle using the relative motion between the source beacon and the satellite, or from the beacon data itself where the location is determined using GPS satellites. Alerts are then relayed, together with identification and location data, via a Mission Control Centre (MCC) to an appropriate Search and Rescue Point of Contact (RCC/MRCC) for further action.

RCC personnel use the beacon information to identify the user through the **"Online Beacon Registration Database"**, and then try to ascertain about the type of distress by contacting the owner prior to launching a SAR mission. If the beacon is not registered, and **if there is no collateral information available about the distress, the SAR operations can be adversely affected causing delay in rescue operation.**

5. DISTRESS MESSAGE DISTRIBUTION PROCEDURE

The Indian MCC is connected with 4 national Rescue Coordination Centres (RCCs) of the Airports Authority of India, 3 Maritime Rescue Coordination Centres (MRCCs) of Indian Coast Guard and 7 neighbouring countries known as Search and Rescue Points of Contact (SPOCs) through Aeronautical Fixed Telecommunication Network (AFTN) backed with email and manual FAX. The INMCC service area is shown in the diagram. The Indian MCC automatically detects any distress alert received within its coverage area and transmits to the respective designated points of contact. The alerts detected outside Indian service area are passed on to Russian and Australian Mission Control Centres for further distribution to respective SPOCs.

6. ONLINE REGISTRATION OF 406 MHZ BEACONS (ELTs/EPIRBs/PLBs)

"It is all about time…. The sooner we know you are in distress, where you are and who you are, the sooner help can get underway"

Registration of 406 MHz distress beacons with the recognized beacon registration databases is crucial as they are accessible to search and rescue authorities at all times. The information contained in these databases concerning the beacon, its owner, emergency contacts and the type of aircraft/vessel on which the beacon is mounted is vital for the effective utilization of Search and Rescue resources. The proper registration of a beacon could make the difference between success and failure of a search and rescue mission. During distress, "time" is a very critical factor and every minute spent directly affects the potential lives at risk. Hence, registration of radio beacons with INMCC is in the interest of the user and is very useful in the emergency situations, when you most need it. The registration of a beacon (EPIRB/ELT/PLB) helps to discriminate false alarms quickly, saving SAR resources and efforts by the SAR forces. The registration information is stored securely at the INMCC and is used only for search and rescue purposes. In India, about 5100 beacons are currently registered with INMCC.

Register your beacon online at http://inmcc.istrac.org

Important guidelines for the users for registration of the beacons:

- All beacon users to ensure that they are registered users of INMCC Online Beacon Registration System. If not, register immediately through the INMCC website link. It is free of cost
- Users should verify and confirm the correctness/accuracy of the information made available in the database
- Beacons are to be registered online only, no manual registration is accepted at INMCC

- The online registration permits to update the existing beacon registration data, new registration, deregistration, re-registrations, change of ownership, update user profile, get the certificate of registration/deregistration printed, search based on: 15 HEX ID, call sign, MMSI, aircraft reg. id, vehicle name etc.

7. DEREGISTRATION OF BEACONS [ELTs / EPIRBs / PLBs]

It is equally important to de-register the beacon when vessel/aircraft is sold or scrapped, in order to reach the real owner quickly without wasting critical time and SAR resources.

The new owner should re-register the beacon with appropriate changes in the beacon coding.

8. FALSE ALARMS

The majority of ELT and EPIRB emergency transmissions are false alarms (inadvertent activations). The study showed that approximately 92% are false alarms. **Additionally, about 80% false alarms are resolved with phone calls using beacon registration data.**

"False alerts have a negative impact on search and rescue resources worldwide. They tie up people and equipment/resources that would otherwise be available to respond to a real distress call…". The false alerts are costly to pursue and put search and rescue personnel/crews at possible risk in adverse environments. Following are some of the main causes of false alarms:

- **Beacon mishandling:** Improper installation, testing, maintenance, disposal, or shipping a beacon with the battery connected to it
- **Beacon malfunction:** Faulty activation switch / water ingress / transmitting distress signal while in test mode / electronics malfunction etc.
- **Mounting failure:** Strap or bracket failure / release mechanism failure / faulty mounting magnet for externally mounted ELT, removing a beacon from its bracket without properly disarming it
- **Environmental conditions:** Extreme weather conditions may sometimes trigger beacon activation

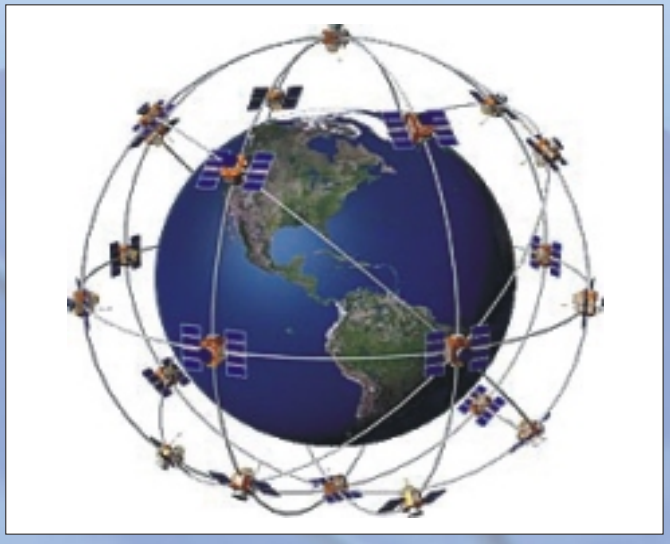
9. NEW DEVELOPMENTS

a. Development of Low Cost 406 MHz Radio Beacon by ISRO: Recognizing the vast user base in India for search and rescue applications, and keeping in mind affordability by Indian user community, ISRO took initiative to develop low cost 406 MHz radio beacon particularly for Indian fishermen community. The development has been completed and the technology is transferred to industry for mass production. The Indian make radio beacon will be shortly available in market.

b. Evolution of MEOSAR System: The USA, Russia and the European Commission / European Space Agency (EC/ESA) have agreed to include 406 MHz search and rescue repeater instruments on their respective constellations of Medium-altitude Earth Orbit (MEO) Global Navigation Satellite Systems namely GPS, GLONASS and Galileo.

A Cospas-Sarsat MEOSAR system based upon these constellations would provide near instantaneous global coverage, an accurate independent beacon locating capability (i.e. no reliance on a navigation receiver in the beacon to determine location), and a robust beacon-to-satellite communication link. Furthermore, due to the number of satellites planned and the characteristics of their medium altitude earth orbits, the MEOSAR system will provide high levels of redundancy and resistance against beacon-to-satellite blockages.

Preliminary testing using 9 prototype payloads on GPS satellites and MEOLUTs in Canada and the USA have already commenced in early 2006. ISRO plans to build ground system for upcoming Cospas-Sarsat MEOSAR System, which is expected to be demonstrated by 2012 and will be fully operational by 2016.



Most of the false alerts can be avoided by exercising operational discipline and following manufacturer's installation, operation and maintenance guidelines. Care must be taken not to activate the beacon, when checking the battery power or conducting beacon self-testing. While removing the beacon from the bracket for maintenance or shipping, one should switch off the beacon power. It is a violation of international regulations to intentionally transmit a false alert.

International 406 MHz Beacon Registration Database (IBRD), available online and free of charge at **www.406registration.com**.

IBRD is maintained by Cospas-Sarsat programme. Several Countries have opted to register their beacon with IBRD. National and International SAR authorities can have access to this database for search and rescue. The access is controlled by username and password, and is provided to authorized Indian SAR authorities on request to INMCC.

Important Guidelines to Users

i. Beacon Carriage Requirements:

- Always use ELT/PLB/EPIRB on aircraft/ships as per DGCA and DG Shipping guidelines
- It is recommended to use 406 MHz Beacons with internal GPS. New generation 406 MHz beacons with GPS technology are cost effective, and provide instantaneous and accurate location of distress within 500m
- Select the appropriate Cospas-Sarsat approved beacon model for specific application. List of approved manufacturers and beacon models are available on Cospas-Sarsat website

ii. Beacon Coding:

- Ensure that the beacon is coded with the Indian country code (419) by the beacon manufacturer at the time of purchase
- For leased aircraft/vessels beacon should be recoded with "India-419" as country code to ensure quick dissimilation of emergency information to Indian SAR authorities & owners
- Before purchase, ensure that the beacon is coded using a protocol approved by the Cospas-Sarsat for that beacon model. Approved coding protocols are listed on the beacon's type approval certificate, which can be found on the Cospas-Sarsat website
- In India, for maritime beacons (EPIRBs), DG Shipping made it mandatory to code the beacons using MMSI (Mobile Maritime Station identification)
- For aviation beacons (ELTs), any Cospas-Sarsat authorized coding protocol is allowed
- For PLBs, it is generally advised to code using serial protocol
- INMCC provides block of serial numbers on request for coding the beacons using serial protocol. The format for requesting block of serial numbers is made available on the INMCC website. It is recommended that the manufacturer provides the serial numbers for coding to maintain the unique beacon codes

iii. Beacon Registration:

- Registration of the beacons with INMCC is Mandatory, it is free of cost and available online **(http://inmcc.istrac.org)**. It is very helpful to get SAR assistance without delay during emergencies
- Ensure de-registration of beacon once vessel/aircraft is sold or scrapped

iv. Beacon Testing:

- Testing of the beacons with operational protocol is not permitted. One should use the self-test function of the beacon, which is not detected by the satellite system
- If there is any requirement for operational testing, the request has to be sent to INMCC in a prescribed format (available on INMCC website). Testing with operational protocol will be permitted only if it is found to be absolutely necessary

v. Switch over to 406 MHz Beacons:

- Beacon owners still using 121.5 MHz beacons should immediately switch over to 406 MHZ beacons
- Processing of distress alerts from 121.5 MHZ beacons has been terminated by Cospas-Sarsat system from **1st February 2009**

vi. Avoid False Alarms:

- Take extreme care to avoid false alarms. In case of inadvertent activation, immediately inform nearest RCC/MRCC/MCC and send false activation report by email to **india_sar@istrac.org**, giving specific reason for inadvertent activation
- Carryout periodic maintenance checks, and replace the beacon battery, prior to the expiry date
- Familiarize all the crew members with the importance of beacon operations and maintenance, which plays a vital role in saving life in most difficult emergency situations in any remote part of the world, where there is no one to hear or attend the emergency as all contacts with the rest of the world are cut off

vii. General:

- If the beacon has transmitted inadvertently for more than 6 hours, the battery needs to be replaced immediately to ensure its normal operation during real emergency
- In emergency, it is recommended to activate 406 MHZ beacon always, even if the vehicle or person in distress has voice or other communication with owner or SAR authorities
- The Cospas-Sarsat system has a well organized network of MCCs worldwide which ensures a swift distribution of alerts and a close cooperation with Rescue Coordination Centres (RCCs). Thus, it provides efficient support and ensures an efficient response of SAR services

Indian RCCs/MRCCs Contacts

RCCs (AAI) - Chennai : +91-44-22560700/22561365, Mumbai : +91-22-26828121/ 26829341
Delhi: +91-11- 25654061/ 25653284, Kolkata: +91-33-25119520/ 25130134
MRCCs (Coast Guard) - CGHQ : +91-11-23384934/ 23383196, Chennai : +91-44-25395017/25395018
Mumbai : +91-22-24316558/ 24316558, Port Blair: +91-3192-246081/ 242948
DG Comm.Centre (DG shipping, Mumbai): +91-22-22614646 / 22610606
Group Email id for all (RCCs/MRCCs/SPOCs/INMCC): **india_sar@istrac.org**

INMCC/ISTRAC/ISRO

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