INTRODUCTION
TO THE
COSPAS-SARSAT SYSTEM

C/S G.003
Issue 8
November 2022

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COSPAS SARSAT

INTRODUCTION TO THE COSPAS-SARSAT SYSTEM

Revision History

Issue	Revision	Date	Comments
1		April 1986	Approved
2		April 1988	Approved
3		June 1989	Approved by CSC-2
4		December 1994	Approved by CSC-13
5		October 1998	Approved by CSC-21
6		October 2009	Approved by CSC-43
7		November 2019	Approved by CSC-62
8		November 2022	Approved by CSC-67

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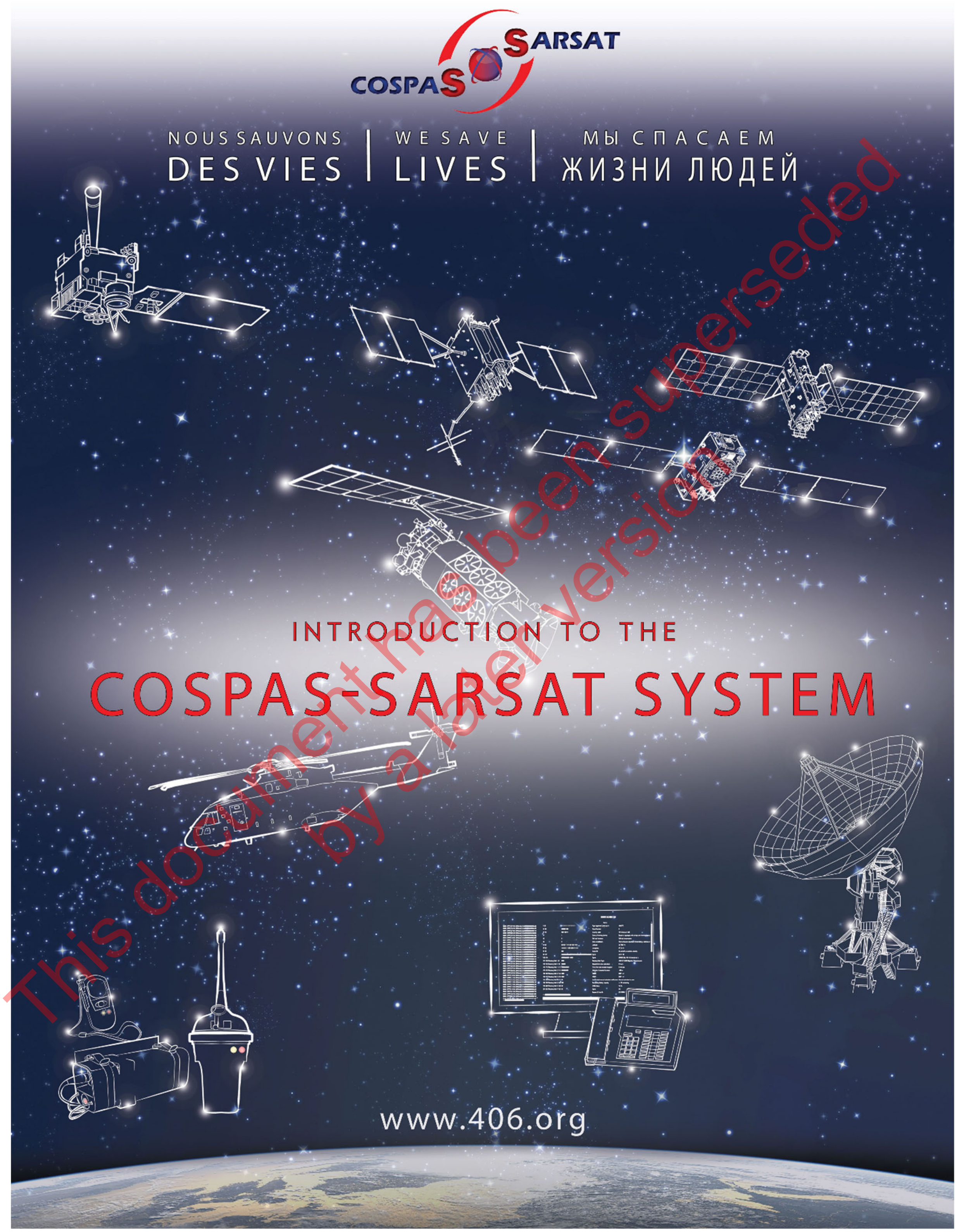

This document has been superseded by a later version

TABLE OF CONTENTS

Page

This document has been superseded by a later version

This document has been superseded by a later version

LIST OF FIGURES

LIST OF TABLES

This document has been superseded by a later version

1. INTRODUCTION

1.1 Purpose

This document introduces potential users to the Cospas-Sarsat[1] System (the System): a satellite-based beacon alert communication system for the support of Search and Rescue (SAR) operations around the world. The System uses spacecraft and ground facilities to detect and locate distress signals from emergency beacons carried on boats, on aircraft, and by individuals. The distress alert information, including the position of the distress beacon and other related information (such as the information provided when the beacon was registered), is sent by Cospas-Sarsat to the appropriate SAR authorities. Figure 1-1 shows an Emergency Technician and the man he rescued, holding the beacon that brought help to him.

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Figure 1-1: After the Rescue
This illustration shows the Emergency Technician and the rescued victim.
Note that the victim is holding the 406 MHz beacon that called the help for him.

Distress beacons include Emergency Locator Transmitters (ELTs, for use on aircraft), Emergency Position Indicating Radio Beacons (EPIRBs, for use on ships), Personal Locator Beacons (PLBs, for use in multiple environments by individuals) and Ship Security Alerting System (SSAS) beacons for use when an attempted piracy effort, terrorist act, or other incident acts as a threat to maritime security. As shown in Figure 1-2, these beacons transmit 406 MHz signals that are received by search

[1] The system name is made up of two acronyms:
- COSPAS: Acronym for "Cosmicheskaya Sistyema Poiska Avariynich Sudov", meaning "Space System for the Search of Vessels in Distress", as transliterated from the Cyrillic "Космическая система поиска аварийных судов".
- SARSAT: Acronym for "Search and Rescue Satellite-Aided Tracking".

and rescue instruments on the satellites used by the System. These signals are relayed to the receiving stations of the Cospas-Sarsat Ground Segment, called Local User Terminals (LUTs), which process the signals to extract the beacon identification data and to determine the location of the beacon. Each LUT is associated with a Mission Control Center (MCC), to which the alert data is forwarded and then relayed, through a data distribution network of MCCs, to the appropriate SAR point of contact (SPOC), Rescue Co-ordination Centre (RCC), or other authority, who is then responsible for the necessary search and rescue activities.

Figure 1-2: Flow of Information
This illustration shows the flow of information through the Cospas-Sarsat System after a 406 beacon is activated.

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1.2 Scope

This document is provided as a high-level introduction to the Cospas-Sarsat System for the use of the many stakeholders and consumers of the data that is provided by the System, such as:

- the International Maritime Organization (IMO)
- the International Civil Aviation Organization (ICAO)
- the International Telecommunications Union (ITU)
- Cospas-Sarsat Programme Participants
- Potential Cospas-Sarsat Programme Participants
- SAR Points of Contact (SPOCs)
- Rescue Coordination Centres (RCCs)
- Marine Fleet Owners and Operators
- Airline Operators
- Air Traffic Service Units
- Purchasers (and potential purchasers) of distress beacons
- Users of distress beacons

- Inspectors and Maintenance Facilities for ships and aircraft

More comprehensive and detailed specifications that describe the various parts of the Cospas-Sarsat System, as well as more detailed training materials, are available in other System documents, which are identified in this document and which are available on the Cospas-Sarsat professionals website under <DOCUMENTS>; alternately they can be obtained from the Cospas-Sarsat Secretariat.

1.3 Document Organization

The structure of this document is outlined in Table 1-1.

Table 1-1 Document Structure

Section 1	A general introduction to the document
Part I	**High-level information about the Cospas-Sarsat Programme**
Section 2	The International Cospas-Sarsat Programme
Section 3	The Cospas-Sarsat System
Part II	**The design and operation of the Cospas-Sarsat System**
Section 4	An overview of the System
Section 5	The operation of the System
Section 6	The performance that is required and expected of the System
Part III	**The international context of the Programme**
Section 7	The International Cospas-Sarsat Programme Agreement (the foundation document of the Cospas-Sarsat System)
Section 8	The organizational structure of the Programme
Section 9	The other international organizations to which Cospas-Sarsat must relate in its structure and operations
Section 10	Conclusion

1.4 References

The acronyms and other system-specific terminology that are used in this document are defined in document C/S S.011, "The Cospas-Sarsat Glossary".

All of the Cospas-Sarsat documents that are referenced in this "Introduction to the Cospas-Sarsat System" are available on the Cospas-Sarsat professionals website, at http://www.cospas-sarsat.int/en/pro (under the <DOCUMENTS> tab) or from the Cospas-Sarsat Secretariat.

To access the Cospas-Sarsat professionals website, go to the Cospas-Sarsat home page (at http://www.cospas-sarsat.int) and select the <COSPAS-SARSAT PROFESSIONALS> button.

- END OF SECTION 1 -

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Part I OVERVIEW OF THE COSPAS-SARSAT SYSTEM

2. THE INTERNATIONAL COSPAS-SARSAT PROGRAMME

2.1 History and Background

The Cospas-Sarsat satellite system for the support of Search and Rescue (SAR) operations was initially developed under a Memorandum of Understanding, signed in 1979 among Agencies of Canada, France, the USA, and the Union of Soviet Socialist Republics (USSR). Following the successful completion of a demonstration and evaluation phase that started in September 1982, a second Memorandum of Understanding was signed on 5 October 1984 by the Centre National d'Etudes Spatiales (CNES) of France, the Department of National Defence (DND) of Canada, the Ministry of Merchant Marine (MORFLOT) of the former USSR, and the National Oceanic and Atmospheric Administration (NOAA) of the USA. The System was declared operational in 1985.

Even during the Demonstration and Evaluation phase, the Cospas-Sarsat System had an immediate impact: the newspaper clippings in Figure 2-1 show the reactions after the first rescue that was guided by the System.

Figure 2-1: Newspaper Headlines
This collection of clippings from newspapers published after the first Cospas-Sarsat rescue shows some of the impact of the System on the world.

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On 1 July 1988, these same four States (who were providing the space segment for the System) signed the International Cospas-Sarsat Programme Agreement (the ICSPA, document C/S P.001). This document ensures the continuity of the System and guarantees its availability to all States on a non-discriminatory basis. In January 1992, the government of the Russian Federation assumed responsibility for the obligations of the former Soviet Union. As was foreseen in the Agreement, a number of States who are not Parties to the Agreement have also associated themselves with the Programme.

A comprehensive history of the Programme is available in the book, "The History and Experience of the International Cospas-Sarsat Programme for Satellite-Aided Search and Rescue", written by Daniel Lévesque (the first Head of the Cospas-Sarsat Secretariat) and published in 2017 by the International Astronautical Federation (IAF). A PDF version of this book is also available on the Cospas-Sarsat website.

2.2 The International Cospas-Sarsat Programme Agreement

The four States Party to the ICSPA and all of the States that have associated themselves with the Agreement pay a part of the common costs of the Programme. Each State may also, at its own discretion (and at its own cost), contribute some component to the operation of the system. In addition (and whether or not they provide any operational contribution to the System), all member States are able to participate in the management of the System.

Residents and citizens of all States are eligible to benefit from the distress alerts that are generated by the Cospas-Sarsat System and that are distributed to their Search and Rescue Point of Contact (SPOC) by the Ground Segment operated by the Cospas-Sarsat Participants.

2.3 Mission Statement

> "The International Cospas-Sarsat Programme provides accurate, timely and reliable distress alert and location data to help search and rescue authorities assist persons in distress."[2]

As stated in the dedication of the ICSPA, this data is provided on a non-discriminatory basis:

- It is generated in response to the detection of any beacon, regardless of the country of the person who owns or operates the distress beacon.
- It is distributed, based on the location and the country of registration of the beacon, to the SAR authorities of the appropriate State(s), regardless of whether they have associated themselves with the Programme.

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[2] This mission statement is quoted from document C/S P.016 (Cospas-Sarsat Strategic Plan).

2.4 Programme Objectives

The Cospas-Sarsat Strategic Plan also provides a list of strategic goals that have been identified for the System:

1. Continuous and effective System operation,
2. A comprehensive management structure to support System evolution and ensure Programme continuity,
3. Worldwide support for the Programme,
4. Participants, users and customers use and operate the System to its full potential, and
5. A robust industrial base to support System operations.

For each of these strategic goals, a set of objectives and action plans have been developed to ensure that the Programme continues to achieve these goals.

A Quality Management System (QMS)[3] has been developed to monitor the operation of the System and to ensure that it continues to achieve the goals that have been established. Refer to section 6.2 of this "Introduction to the Cospas-Sarsat System" for more information about the Cospas-Sarsat QMS.

- END OF SECTION 2 -

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[3] The QMS is described in the document C/S P.015 (*Cospas-Sarsat Quality Manual*) and in the document C/S A.003 (*Cospas-Sarsat System Monitoring and Reporting*).

3. THE COSPAS-SARSAT SYSTEM

3.1 Segments of the Cospas-Sarsat System

The Cospas-Sarsat System is comprised of several separate component segments:

- 406 MHz Distress Beacons,
- Space Segment,
- Ground Segment Local User Terminals,
- Ground Segment Mission Control Centres, and
- Communications links to the data recipients.

These components are specified in the Cospas-Sarsat System specification documents and are described more generally in the Cospas-Sarsat handbooks and training documents. All of these documents are listed in the appropriate parts of this "Introduction to the Cospas-Sarsat System".

3.2 Cospas-Sarsat Concept of Operation

Figure 3-1 illustrates the Concept of Operation of the Cospas-Sarsat System.

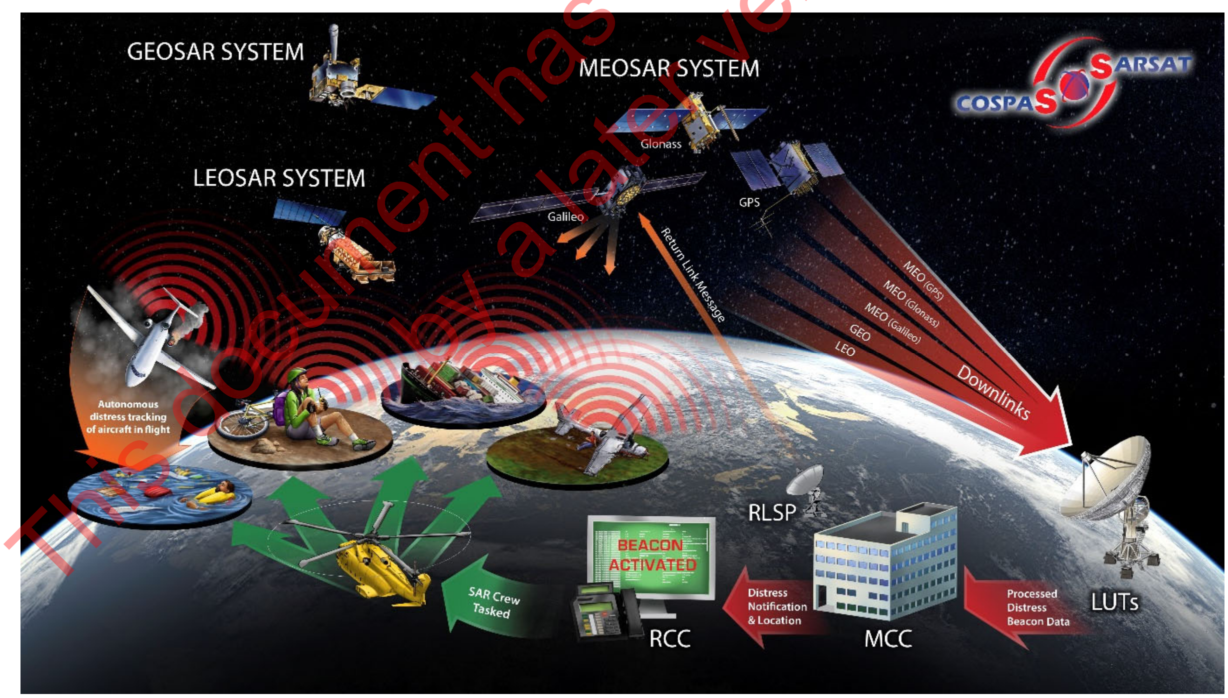

Figure 3-1: Cospas-Sarsat Concept of Operations
This diagram illustrates the Concept of Operations of the Cospas-Sarsat System, showing the different components of the System. The flow of data through the System is described in more detail in section 4.1 below

- END OF SECTION 3 -

- END OF PART I -

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Part II SYSTEM DESCRIPTION AND OPERATIONS

4. OVERVIEW

4.1 Cospas-Sarsat Data Flow

The data flow paths through the Cospas-Sarsat System are illustrated in the diagram in Figure 4-1, and are summarized in the following paragraphs. In this summary description of the data flow, the numbers in parentheses refer to the circled numbers in this diagram.

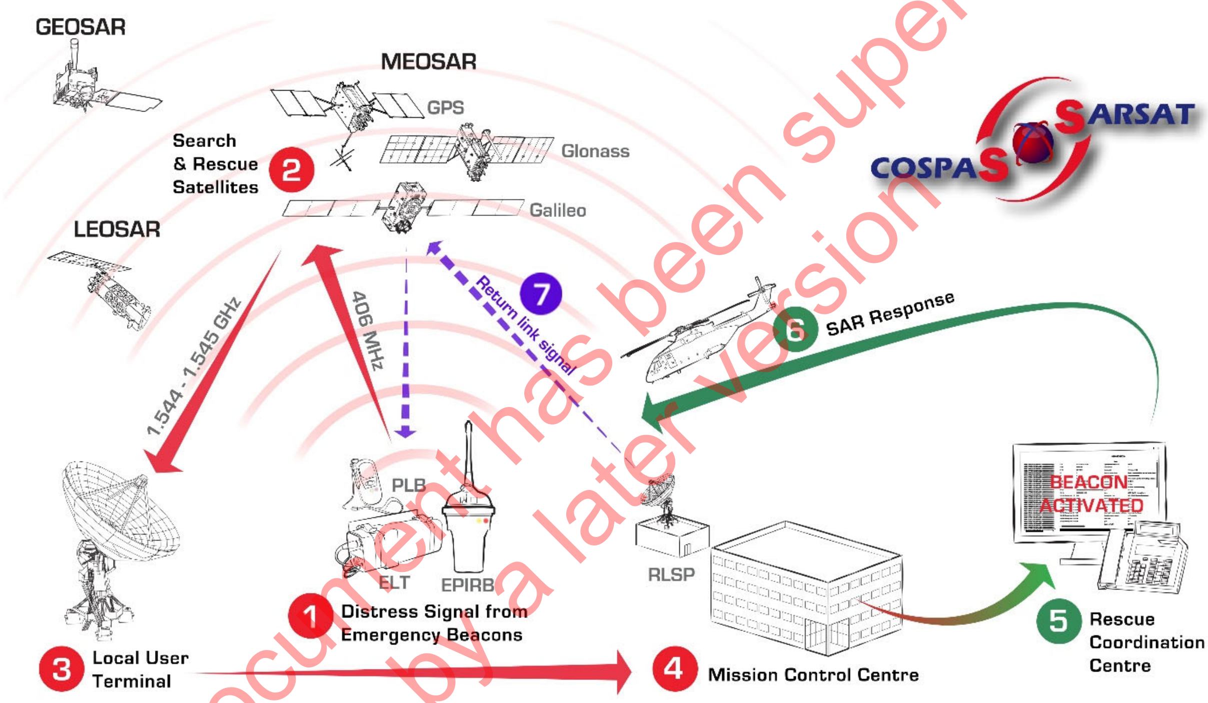

Figure 4-1: Flow of Data Through the Cospas-Sarsat System
The path of data that flows through the Cospas-Sarsat System is illustrated in this diagram and is explained in the accompanying text.

A more detailed explanation of each step in the operation of the Cospas-Sarsat System is provided in section 5.

The System is called upon when a 406 MHz distress beacon (1) is activated. The flow of information is as follows:

- The distress beacon (1) transmits a digital radio signal in the 406 MHz frequency band, which is received by the equipment on the spacecraft (2) that are a part of the Cospas-Sarsat Space Segment.
- The signal is re-transmitted (in the 1,544.5 MHz band) to one or more ground stations (3): the Local User Terminals (LUTs) of the Cospas-Sarsat Ground Segment.

- The LUT extracts the beacon message, measures the time and frequency of the signal received, and produces an independent determination of the location of the beacon.
- The LUT sends this incident alert data to its associated Mission Control Centre (MCC) (4).
- The MCC sends this incident alert data, either directly or through another MCC of the Cospas-Sarsat data distribution network, to the appropriate Search and Rescue (SAR) authority (5).
- The responsible authority that has been notified then takes action (6), according to its responsibilities and its authority, to respond to the incident alert message, to find and rescue the person(s) in distress.

The appropriate destination or authority to whom the Cospas-Sarsat distress alert is sent may be determined as any one or more of:

- The RCC that is responsible for the Search and Rescue Region (SRR) where the beacon is located.
- The SPOC that has been identified by the national authorities responsible for the 406 MHz beacons coded with their country code(s).
- The competent authority identified by the nation where a Ship Security Alert System (SSAS) beacon is registered, to address the security issue that caused the beacon to be activated
- The Return Link Service Provider (RLSP) associated with the Global Navigation Satellite System (GNSS) that provides support for an activated beacon with a Return Link Service (RLS) capability. In this case, the RLSP sends an acknowledgement through the satellite navigation links (7) and back to the beacon.
- The Location of an Aircraft in Distress Repository (LADR), under the responsibility of ICAO and operated by EUROCONTROL, for the storage of information received from ELT(DT) distress tracking beacons, and for further notification to the airline that operates the aircraft on which a distress tracking ELT has been activated.

- END OF SECTION 4 -

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5. SYSTEM OPERATION

The Cospas-Sarsat System is designed for automatic operation with a minimum of human intervention required. During the normal operation of the System, it is only when the incident alert data is received at an RCC that human intervention is required to plan and implement the appropriate SAR activities.

5.1 Distress Beacons

The types of Cospas-Sarsat 406 MHz distress beacons that are used by the Cospas-Sarsat System are illustrated in Figure 5-1. Many of these beacons are activated automatically in the event of an accident. Others are designed to be triggered manually; however, once they have been activated, they will transmit their distress messages with no further intervention.

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Figure 5-1: Types of Cospas-Sarsat Distress Beacons

Types of beacons are designed for use in different environments:

- **Aviation: Emergency Locator Transmitter (ELT) and Distress Tracking ELT(DT) (for tracking aircraft in-flight in potential distress situations),**
- **Maritime: Emergency Position-Indicating Radio Beacon (EPIRB) and Ship Security Alerting System (SSAS) beacon (for security situations on SOLAS vessels), and**
- **Individual: Personal Locator Beacon (PLB) (not necessarily linked to an aircraft or a ship).**

When activated, every 406 MHz distress beacon will transmit a signal that contains a digital encoded message, which includes:

- a country code to identify the nation in which the beacon is registered,
- a unique identifier to positively identify the beacon,
- an indication of the type of beacon from which it has been sent.

Many beacons include a receiver for a Global Navigation Satellite System (GNSS) or a link to a source (such as an aircraft navigation system) that is external to the beacon; these beacons will include the GNSS beacon location data in the transmitted message.

The characteristics that are necessary for the beacon signals to be compatible with the Cospas-Sarsat System are specified in various System documents[4,5,6,7]. Other characteristics are regulated by national Administrations, separately from the System specifications.

The legal requirements for the carriage of various types of beacons are established by the government of each country, based on their national requirements. The document C/S S.007 (Handbook of Beacon Regulations) is a summary of available information about the regulations in many countries. It should also be noted that many distress beacons are carried by individuals (and on vessels) on their own initiative, even in cases where there is no legal requirement mandating such carriage. However, the carriage and use of these beacons are still subject to the requirements and restrictions of the national laws on beacon carriage.

Every nation that authorizes the use of 406 MHz distress beacons is required either to maintain a beacon registry or to allow beacons with its country code to be registered in the International Beacon Registry Database (IBRD) operated by Cospas-Sarsat. For each beacon, the registry should contain the beacon identifier and the beacon message data, information about the vessel on which the beacon is carried, and contact information for the owner and operator of the beacon, as well as emergency contacts for someone who is unlikely to be with the beacon. This registry information will be made available, through the national MCC that is responsible for the region that includes the beacon's nation of registry, to the appropriate RCCs. For those nations that do not operate their own beacon registry, the Programme operates an International Beacon Registry Database (IBRD) that provides the necessary registration services and that can be made available to the appropriate authorities.[8]

5.2 Satellite Relay

The signals transmitted by the distress beacons are relayed through the satellites of the three unique Space Segments that are used by Cospas-Sarsat:

- The Low-altitude Earth Orbit Search and Rescue (LEOSAR)[9] system consists of satellites in relatively low (800 to 1,000 km) polar orbits.

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[4] The detailed specifications for the First-Generation Beacons (FGBs), which transmit a narrow-band (approximately 3 kHz) signal in a designated frequency channel, are contained in the document C/S T.001, "Specification for [First-Generation] Cospas-Sarsat 406 MHz Distress Beacons", and (for SSAS beacons) in document C/S T.015, "Cospas-Sarsat Specification and Type Approval Standard for 406 MHz Ship Security Alert System (SSAS) Beacons".

[5] The detailed specifications for the Second-Generation Beacons (SGBs), which transmit a Code-Division Multiple Access (CDMA) spread-spectrum signal (similar to those used by mobile telephones) that is distributed across the entire 406 MHz frequency band, are contained in the document C/S T.018, "Specification for Second-Generation Cospas-Sarsat 406-MHz Distress Beacons".

[6] Document C/S T.012, "Cospas-Sarsat 406 MHz Frequency Management Plan", describes the allocation of frequency channels, within the 406 MHz frequency band, for these beacons.

[7] Reference beacons are described in document C/S T.006, "Cospas-Sarsat Orbitography Network Specification", and in document C/S T.022, " Cospas-Sarsat System Beacon Specification and Design Guidelines".

[8] Document C/S D.004, "Operations Plan for the Cospas-Sarsat International 406 MHz Beacon Registration Database", describes this database and explains how it is to be used. Information about registering a beacon is also available on the Cospas-Sarsat web site: select <REGISTER YOUR BEACON>, or (on the Professional page) select <BEACONS> and then <BEACON REGISTRATION>.

[9] The LEOSAR spacecraft, and their SAR payloads, are described in the document C/S T.003, "Description of the 406-MHz Payloads Used in the Cospas-Sarsat LEOSAR System". The document C/S T.004, "Cospas-Sarsat LEOSAR Space Segment

- The Medium-altitude Earth Orbit Search and Rescue (MEOSAR)[10] system consists of satellites at altitudes around twenty thousand kilometres, in orbits that are inclined to the plane of the equator.
- The Geostationary Earth Orbit Search and Rescue (GEOSAR)[11] system consists of satellites in equatorial orbits at an altitude of approximately 36,000 kilometres.

The diagram in Figure 5-2 illustrates the relative altitudes of these different constellations. The onboard instruments are all designed to receive and to relay the beacon signals automatically as each signal arrives at the satellite.

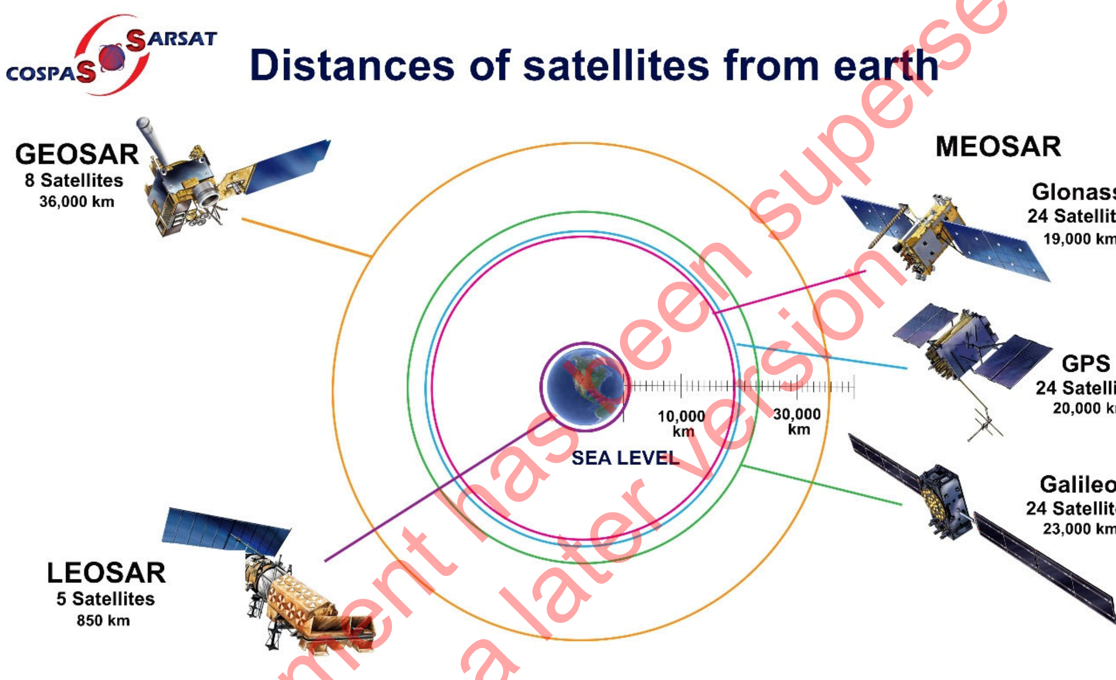

Figure 5-2: Space Segment

The satellites each have altitude-dependent areas of visibility on the surface of the Earth. Figure 5-3 shows the circles that are visible from each of the different types of satellite.

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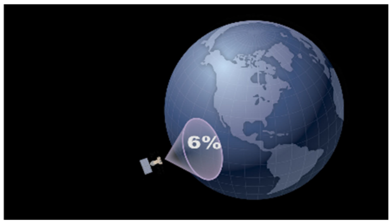
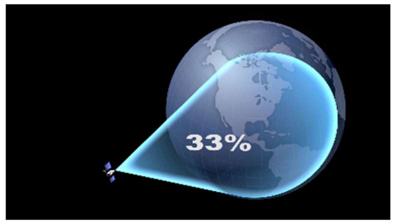
Commissioning Standard", describes the tests that are performed to characterize each spacecraft before it is approved for use in the Cospas-Sarsat system.

[10] The MEOSAR spacecraft, and their SAR payloads, are described in the document C/S T.016, "Description of the 406-MHz Payloads Used in the Cospas-Sarsat MEOSAR System". The document C/S T.017, "Cospas-Sarsat MEOSAR Space Segment Commissioning Standard" describes the tests that are performed to characterize each spacecraft before it is approved for use in the Cospas-Sarsat system.

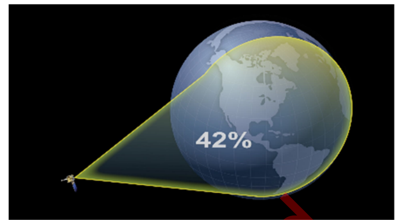
[11] The GEOSAR spacecraft, and their SAR payloads, are described in the document C/S T.011, "Description of the 406-MHz Payloads Used in the Cospas-Sarsat GEOSAR System". The document C/S T.013, "Cospas-Sarsat GEOSAR Space Segment Commissioning Standard", describes the tests that are performed to characterize each spacecraft before it is approved for use in the Cospas-Sarsat system.



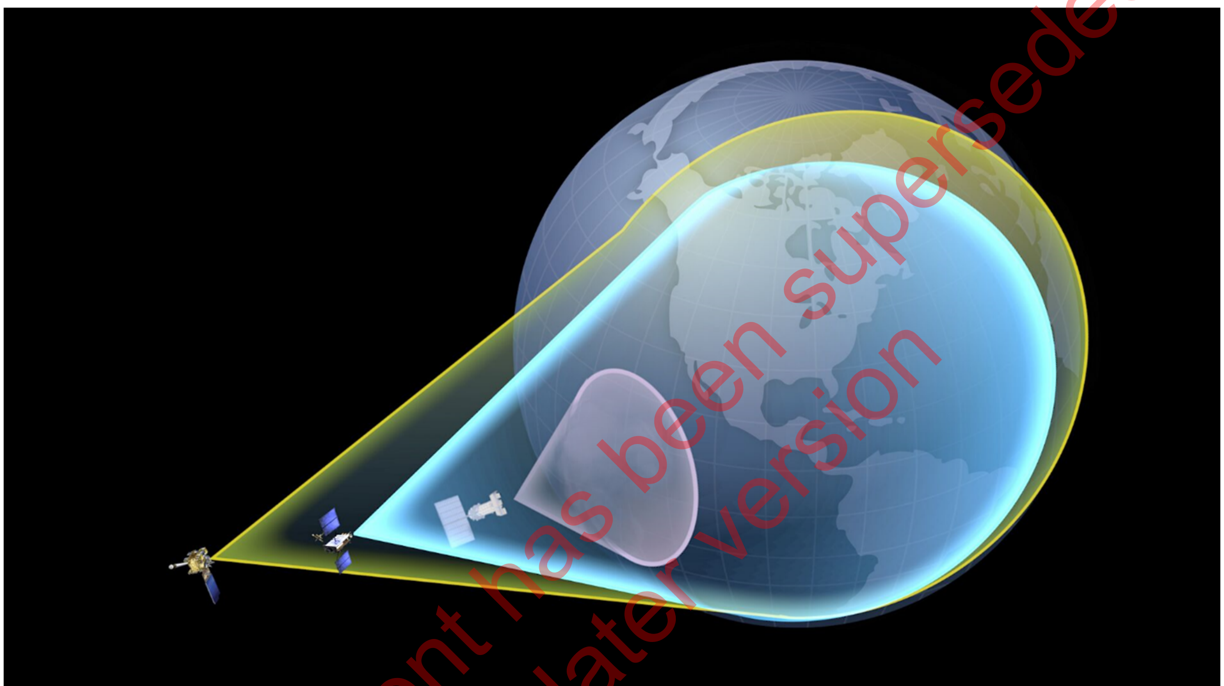
LEOSAR



MEOSAR



GEOSAR



Superimposed View

Figure 5-3: Satellite Visibility Areas

This illustration shows the visibility circles for the different types of satellites used in the Cospas-Sarsat System. The radius of a visibility circle is: about 3,000 km for a LEOSAR satellite, about 8,000 km for a MEOSAR satellite, and about 9,000 km for a GEOSAR satellite. The upper illustrations show the individual satellite visibility circles (with the percentage of the Earth's surface that each one covers). The final image shows the three different visibility circles superimposed on the same image of the Earth.

5.3 Beacon Signal Processing

The processing of the 406 MHz beacon signals in the Ground Segment is performed by the LUTs which receive the data through their antennas on the ground. The maps in Figure 5-4 show the locations of the LEOLUTs and GEOLUTs that are available to the Cospas-Sarsat System. The fully operational configuration of the MEOLUTs is still (in 2022) in the process of being established.

Each LUT has one or more antennas that track the appropriate satellites and receive the downlink signals that are transmitted by those satellites. The LUTs are normally capable of unmanned operation; the selection of a satellite to track and the tracking of the visible satellites is fully automated, as is the reception and processing of the data as it arrives from the satellite.

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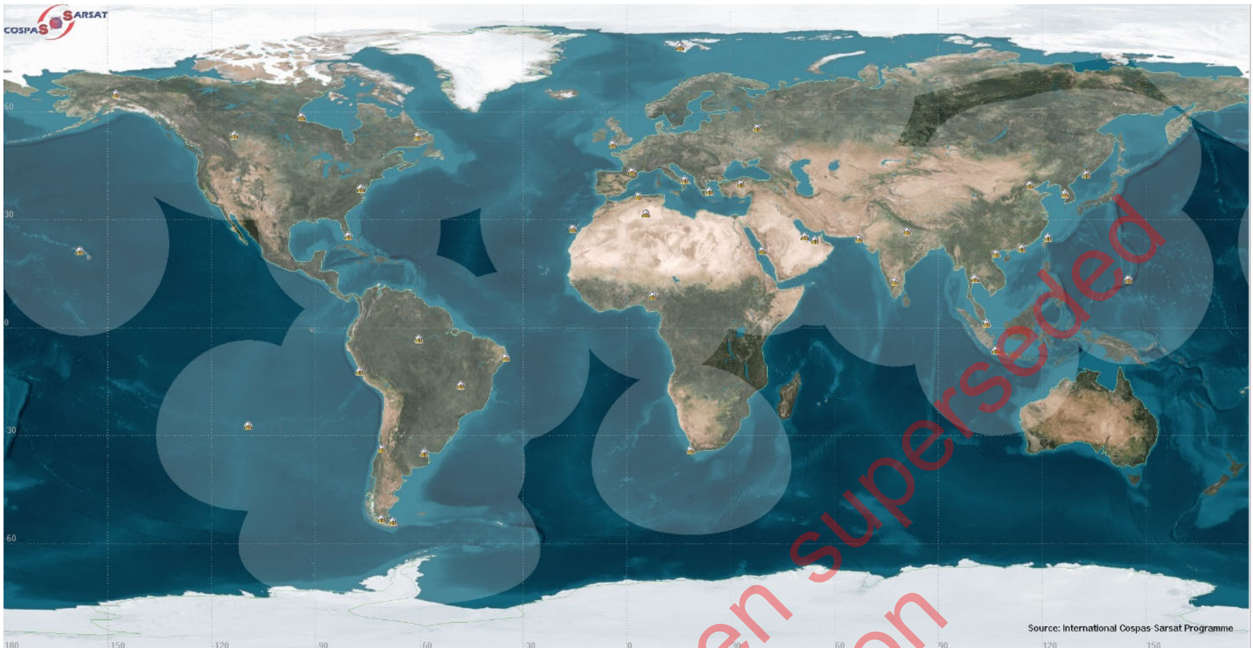
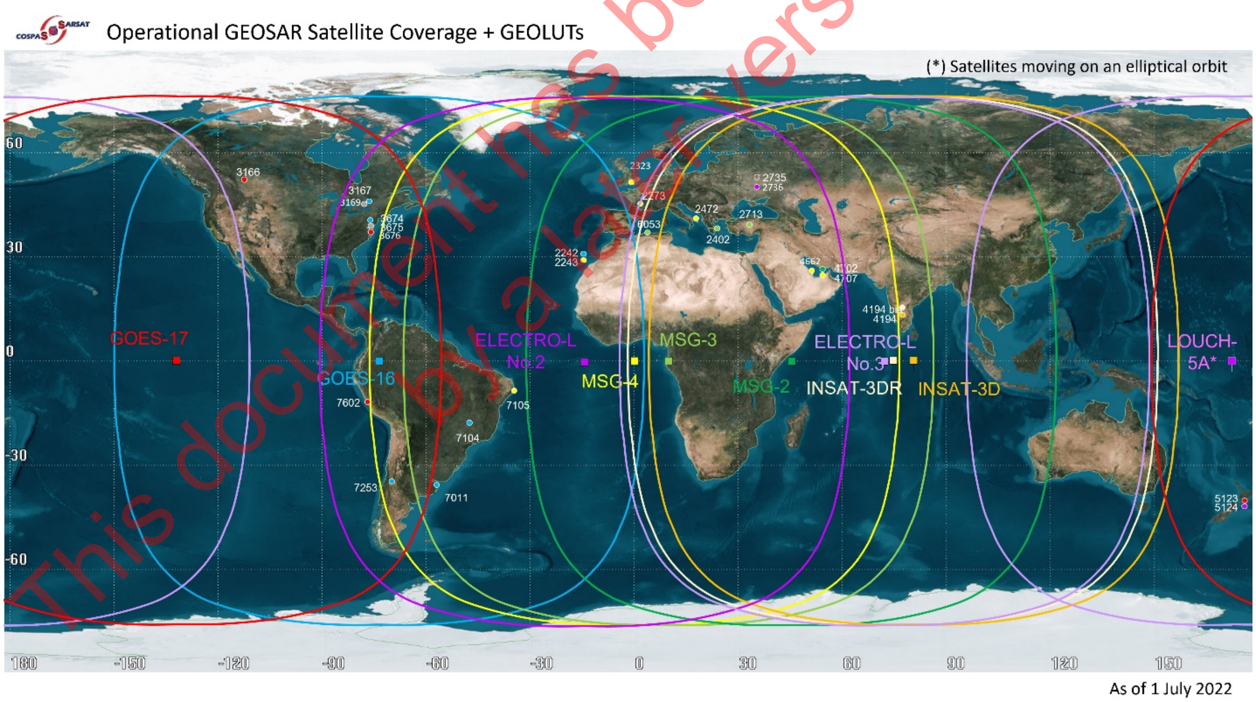


a. Typical LEOSAR Local Coverage Area



b. Typical GEOSAR Local Coverage Area

Figure 5-4: Local Coverage Area Maps

These illustrations show the typical local coverage areas for the Cospas-Sarsat LEOSAR and GEOSAR satellite constellations. The locations of the various LEOLUTs and GEOLUTs are marked on the maps. The light-grey areas on the LEOSAR map show areas where LEOSAR satellites and operational LEOLUTs have mutual visibility. When a satellite is outside a light-grey area and detects beacons, data are stored, and then sent down to a LEOLUT as soon as the satellite is tracked again entering a light-grey area. The outlines on the GEOSAR map indicate where each system can reliably expect to detect and locate a beacon.

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5.3.1 Beacon Detection

Each LUT continually monitors the Cospas-Sarsat downlink signals for the presence of any message from a 406 MHz distress beacon. As each such message is detected, the LUT extracts the message and decodes the binary data that it contains. The LUT also calculates and records the frequency and the time at which the message is received at the satellite.

Because each satellite system is at a different altitude, each one has a different ability to detect the beacon signals. For example, the GEOSAR satellites are much further away from the beacons than the LEOSAR or MEOSAR satellites, so the quality of the received signal is not as good. To enhance the quality of the received signal, the GEOLUT may integrate the data from two (or more) successive transmissions to extract the beacon message. When a LUT does not have enough data to determine a location for a detected beacon, it will generate an unlocated alert message for its associated MCC.

5.3.2 Independent Beacon Location

The Cospas-Sarsat Ground Segment includes a network of satellite ground stations, called Local User Terminals (LUTs), that are installed and operated by participating Ground Segment Provider States.

All the beacon messages that are received by a LEOLUT or a MEOLUT are sorted to identify the messages that are received from each distress beacon. The LUT then processes the time and frequency data and performs its location determination processing as follows:

- After each pass of the satellite over a LEOLUT[12], the LUT processes all the data collected during that pass. It analyzes the change of the received frequency as the satellite passes over each beacon and uses this data to compute a Doppler location estimate for the beacon.
- A MEOLUT[13] processes all the data received from each individual transmission from a beacon. It computes the time differences and frequency differences of these messages as they arrive at the LUT through each of the available satellite relay paths. It uses this information to compute a difference of arrival (DOA) location estimate for the beacon.

A GEOLUT[14] does not have any independent location capability; it can only produce unlocated alert detection messages unless the beacon itself provides an "encoded" GNSS location (derived from a navigation system such as the Global Positioning System (GPS)).

5.3.3 Local User Terminals

For each of the satellite constellations that are used by the Cospas-Sarsat System, there is a dedicated set of LUTs. The maps in Figure 5-4 illustrate the locations and the levels of coverage that are provided by the LEOLUTs and GEOLUTs. The MEOSAR system was declared at EOC (early operational capability) in 2016. At FOC (full operational capability), the MEOSAR system will also

[12] The requirements for a LEOLUT are defined in document C/S T.002, "Cospas-Sarsat LEOLUT Performance Specification and Design Guidelines". The LEOLUT commissioning tests are defined in document C/S T.005, "Cospas-Sarsat LEOLUT Commissioning Standard".
[13] The requirements for a MEOLUT are defined in document C/S T.019, "Cospas-Sarsat MEOLUT Performance Specification and Design Guidelines". The MEOLUT commissioning tests are defined in document C/S T.020, "Cospas-Sarsat MEOLUT Commissioning Standard".
[14] The requirements for a GEOLUT are defined in document C/S T.009, "Cospas-Sarsat GEOLUT Performance Specification and Design Guidelines". The GEOLUT commissioning tests are defined in document C/S T.010, "Cospas-Sarsat GEOLUT Commissioning Standard".

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have enough MEOLUTs, suitably distributed to provide full global coverage. Each operational LUT is an unmanned system that operates in a fully automatic mode.

A LEOLUT normally includes an antenna that tracks the LEOSAR satellites and receives the downlink signals from them, and a processing system to extract the beacon signals and to generate an independent position for each beacon.

Each MEOLUT includes several (at least four, and preferably six or more) antennas, so that it can track several satellites simultaneously, and a processing system that can extract the beacon signals and compute the location of the beacon.

A GEOLUT requires only a fixed antenna, pointed at the selected GEOSAR satellite. Because of the higher altitude of the GEOSAR satellites, the quality of the received signals is not as good as the LEOSAR or MEOSAR reception.

LEOLUTs collect data over the duration of each satellite pass (which is relatively short) and process the data collected from each beacon after the end of the pass. GEOLUTs and MEOLUTs, with a longer viewing time, continually process the data from satellites and can generate a solution from just one or a few beacon transmissions. After each LUT has completed its beacon message processing, it sends all the solutions that it has generated to its associated MCC for distribution.

The solution data produced by a LUT is automatically forwarded to its associated MCC, which then follows the procedures established by document C/S A.001, "Cospas-Sarsat Data Distribution Plan", to forward the incident alert to the appropriate destination(s).

5.4 Data Distribution Capabilities

The Cospas-Sarsat data distribution system is implemented in the network of MCCs[15], which are operated by the Ground Segment Providers of the Cospas-Sarsat System, and as illustrated in Figure 5-5. These MCCs receive, process and distribute the incident alert data automatically, with no requirement for operator intervention in most normal operating conditions. Each MCC is a critical part of the Cospas-Sarsat System and is required to always have qualified personnel available. The basic operational objectives of every MCC are to receive alert data from its associated LUT(s) or from other MCCs and to compute and distribute this information to the appropriate alert data recipients. Every MCC is also expected to have a suitable back-up plan in place, to ensure that the System can continue to operate even if an MCC fails in operation.

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[15] The functions of an MCC are identified and described in detail in document C/S A.005, "Cospas-Sarsat Mission Control Centre Performance Specification and Design Guidelines". The data distribution system that they implement is described in detail in document C/S A.001, "Cospas-Sarsat Data Distribution Plan". The formats of the messages that are exchanged among MCCs, and some guidance for the use of the networks that are used for communications among the MCCs, are specified in document C/S A.002, "Cospas-Sarsat Standard Interface Description".

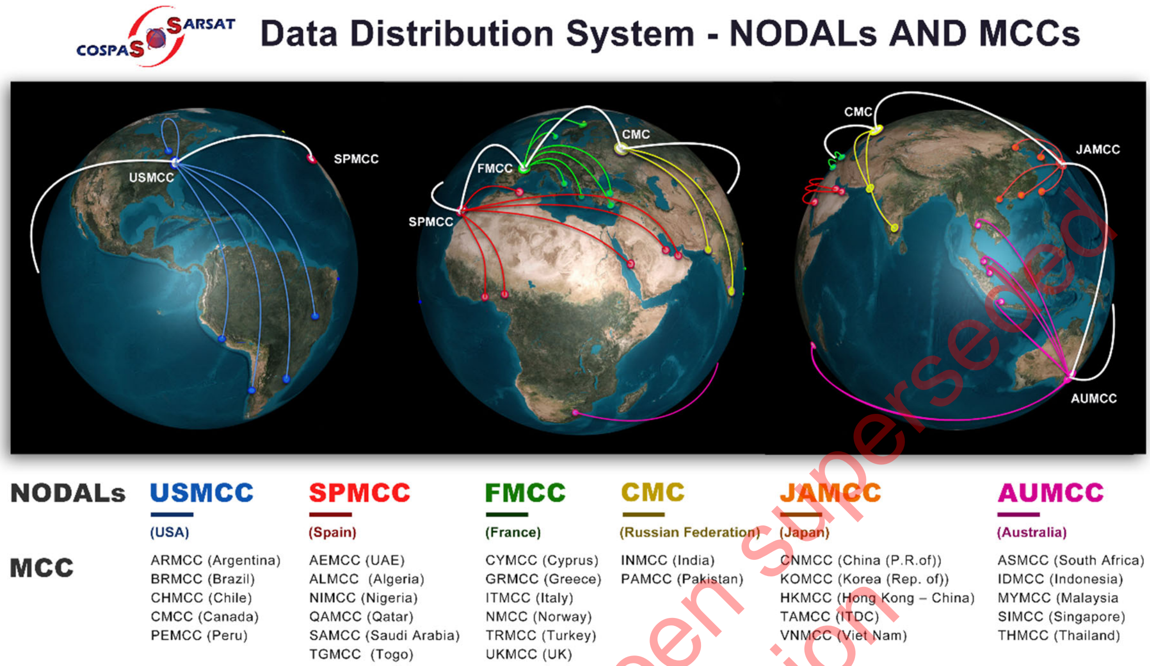

Figure 5-5: The Cospas-Sarsat Data Distribution Network

The network of Cospas-Sarsat Mission Control Centres (MCCs) shown in this diagram comprises the Cospas-Sarsat data distribution system, which controls the distribution of incident alert messages from the Cospas-Sarsat System to Search and Rescue authorities all over the world. This diagram also shows the links from each nodal MCC to the national MCCs in its Data Distribution Region (in distinctive colours) and the links among some of the nodal MCCs (in white). (Note that, for clarity, not all the inter-nodal MCC links are shown.)

A description of the Cospas-Sarsat data distribution system is contained in the document C/S G.010, "MCC Operator Handbook", in a format that is designed for use in training MCC operators and other personnel. The data distribution system is organized into:

- MCC Service Areas[16], which define the geographic area that is served by each MCC of the Cospas-Sarsat Ground Segment, and
- Data Distribution Regions (DDRs)[17], which are comprised of the Service Areas of several MCCs, and within which one MCC, called the nodal MCC, coordinates the Cospas-Sarsat activities (especially the data distribution).

The MCC Operators Handbook includes more comprehensive explanations of these terms and of the organization of the data distribution network.

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[16] The principles applicable to the definition of an MCC service area are provided in document C/S P.011, "Cospas-Sarsat Programme Management Policy", and the procedures for distributing data to the MCCs and RCCs in each region are explained in the operational documents, the A-series of documents listed under <SYSTEM DOCUMENTS> <C/S A.000 SERIES - OPERATIONAL> on the Cospas-Sarsat professionals website.

[17] A Data Distribution Region is the area for which the distribution of Cospas-Sarsat data is managed by a nodal MCC. Each DDR consists of the MCC Service Regions that are served by the MCCs within the DDR.

5.4.1 System Data Distribution

System data[18] is the information that is distributed through the System to enable the providers of the Space Segment and Ground Segment to maintain and operate their components of the Cospas-Sarsat System. System data is normally sent only to the affected Participant(s), although the orbit and calibration data, as well as some status data, are sent to all Ground Segment Providers.

5.4.2 Alert Data Distribution

Incident alert data[19] is the data that is received from or generated as a result of a 406 MHz distress beacon transmission. This data is sent through the MCCs of the data distribution network to the MCC that is responsible for the final destination of the alert according to the nature of the data:

- Incident alert data is always reported to the SAR authorities in the country identified in the beacon message.
- Distress alert data with an associated location (either an encoded GNSS location in the beacon message or an independent - Doppler or DOA - location estimate) is sent to the appropriate SAR authorities associated with that location.
- Ship Security alert data is sent only to the competent authority that has been designated by the nation identified in the beacon message.
- Distress alert data from a beacon that supports a Return Link Service (RLS) capability is also sent to the Return Link Service Provider (RLSP) of the GNSS that supports the RLS used by the beacon (as identified in the beacon message).
- Distress tracking alert data from aircraft which may still be in flight is sent to RCCs/SPOCs and the ICAO LADR (Location of Aircraft in Distress Repository).

The Cospas-Sarsat System is responsible for generating the distress alert data and for reporting it to the appropriate authority. The response to that alert, including the organization and conduct of the subsequent search and rescue activities, is the responsibility of the authority that has been notified of the event.

5.5 Data Communications

Cospas-Sarsat does not operate any communications networks; it makes use of commercial networks that are available. At the present time, the only networks that are used operationally among the MCCs in the Cospas-Sarsat System are:

- the Internet (File Transfer Protocol over Virtual Private Network – FTP/VPN), as the primary network for communications between MCCs, and
- the Aeronautical Fixed Telecommunications Network (AFTN)[20] or the newer Aeronautical Message Handling System (AMHS), used to communicate with some RCCs or SPOCs, and as a backup communications link between MCCs.

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[18] The different types of system data, and the rules for the distribution of that data, are defined in document C/S A.001, "Cospas-Sarsat Data Distribution Plan".

[19] The different types of incident alert data, and the rules for the distribution of that data, are defined in document C/S A.001, "Cospas-Sarsat Data Distribution Plan".

[20] The AFTN protocol is described in Annex 10 of the Chicago Convention. (See section 9.2 of this document.) ICAO is currently in the process of upgrading the AFTN for Air Traffic Services (ATS) to the ATS Message Handling System (AMHS or ATSMHS) (also known as Aeronautical Message Handling System). Cospas-Sarsat MCCs are converting to this new system as it becomes available in each country. However, since the AHMS is compatible with the AFTN, this is not expected to cause any significant issues during the conversion.

E-mail messaging is accepted as a back-up service that may be used; however, it is only to be used when the primary communications services are not available.

5.6 Message Formats

The formats for the messages that are sent between MCCs are defined in document C/S A.002, "Cospas-Sarsat Standard Interface Description". These message formats are designed for automated processing by the computer systems in each MCC.

The formats for the messages that are sent by an MCC to the SPOC of another country (which are also defined in document C/S A.002) are designed for the human readers for whom they are intended. These messages are further explained in document C/S G.007, "Handbook on Distress Alert Messages for Rescue Coordination Centres (RCCs), Search and Rescue Points of Contact (SPOCs) and IMO Ship Security Competent Authorities" and in document C/S G.010, "MCC Operator Handbook".

- END OF SECTION 5 -

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6. SYSTEM PERFORMANCE

The specifications for the Cospas-Sarsat System, as set out in the various System documents identified in the previous sections, include performance requirements for each component of the System. To ensure that the System continuously achieves the specified performance levels, Cospas-Sarsat has developed monitoring procedures and a Quality Management System (QMS)[21].

A System document[22] describes the details of how the QMS system monitoring operates. This document describes how to compute the key performance parameters[23] (see section 6.1 below), and it also identifies additional parameters that are recommended to Ground Segment Providers for internal self-monitoring, so that they will be aware of any problems that may arise before they reach the point of degrading the performance of the System.

6.1 Performance Parameters

The Performance Parameters, which are identified in Annex C of the Cospas-Sarsat Strategic Plan, and which are to be monitored under the Cospas-Sarsat QMS are:

- Global Coverage,
- Automatic Beacon Activation,
- Timely Alerting, and
- Beacon Location Accuracy.

Each of these parameters is described in more detail in the following sections. There are some additional performance parameters that are implemented by design, or that are the responsibility of the Administrations that regulate the distress beacons, which are not monitored by the Cospas-Sarsat QMS system on a recurring basis.

In addition, some new performance requirements for the support of RLS beacons and Distress Tracking beacons are addressed in the last sections of this section.

6.1.1 Global Coverage

Each of the satellite systems that is used by Cospas-Sarsat provides global coverage in a different manner.

The spacecraft of the LEOSAR system carry SAR Processor (SARP) instruments; these instruments collect the data received from distress beacons as they pass over each beacon. This data is stored in a memory on the spacecraft and is played back continuously for as long as it remains in the satellite memory. Based on current beacon population and activity levels, the existing LEOSAR satellites have enough memory to retain data for approximately 18 hours. This is sufficient to ensure that the satellite will be able to transmit the data from every beacon that it passes over to an active LEOLUT well before the data has been cycled out of the spacecraft memory.

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[21] The QMS is described in document C/S P.015, "Cospas-Sarsat Quality Manual".
[22] Document C/S A.003, "Cospas-Sarsat System Monitoring and Reporting".
[23] These key Performance Parameters are identified in document C/S P.016, "Cospas-Sarsat Strategic Plan".

The MEOSAR system is expected to achieve Full Operational Capability (FOC) in 2023. The network of MEOLUTs that was in operation during the MEOSAR Demonstration and Evaluation Phase demonstrated a capacity for almost complete global coverage, with only a few identified gaps. New MEOLUTs are planned that will provide coverage over these gaps; they will be operational before the declaration of MEOSAR FOC.

The GEOSAR system provides complete coverage for the detection of 406 MHz distress beacons over all parts of the Earth between 75˚ South latitude and 75˚ North latitude. The gaps around the poles are inherent to the nature of the geostationary orbits and cannot be eliminated. These gaps are addressed by the other (LEOSAR or MEOSAR) space systems.

It is expected that the LEOSAR system will eventually be phased out, and the future Cospas-Sarsat System will be a GEOSAR / MEOSAR system.

6.1.2 Automatic Beacon Activation

The beacon activation mechanism is specified regionally by national Administrations, and not by Cospas-Sarsat. Although most EPIRBs and ELTs (including ELT(DT)s) are designed to support activation without human intervention, they usually also support manual activation. SSAS beacons and Personal Locator Beacons (PLBs) are, by design, manually activated.

6.1.3 Timely Alerting

The criterion for alert timing is that the distress alert must be provided to the responsible RCC within fifteen minutes of the initial reception of the signal from the beacon. For the GEOSAR and MEOSAR systems, the alerts are normally computed within this time, and will be transmitted to the responsible RCC on time.

The nature of the LEOSAR system requires that the LUT collect the data for a complete satellite pass over the LUT before it can compute the independent solution and pass it to the MCC for distribution.

Once the solution has been sent to the associated MCC, the incident alert will normally be sent through the data distribution network to the destination RCC or SPOC in less than a minute.

6.1.4 Beacon Location Accuracy

The accuracy of the beacon location that is provided by the Cospas-Sarsat System is dependent upon the capabilities of the beacon, the information encoded in the beacon message, and the satellite system which detects and delivers that message.

The location accuracy of the position information that is encoded in the beacon message is based on the accuracy of the underlying GNSS or navigation system that produces this location data and how this information is encoded in the beacon message. If a beacon has a GNSS capability, the encoded location data is usually within sixty metres of the true beacon position.

The Doppler solutions that are produced by the LEOLUTs are normally (more than 95% of the time) accurate to better than five kilometres of the true beacon location.

The DOA solutions that are produced by the MEOLUTs for Second Generation Beacons (SGBs) are expected to be accurate, on a single transmission, to less than five kilometres from the true beacon location. After several transmissions, this accuracy significantly improves; the fully operational

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MEOSAR system processing data from SGBs is expected to achieve one hundred metre accuracy within ten minutes after the first transmission.

The accuracies quoted above are illustrated in the images in Figure 6-1.

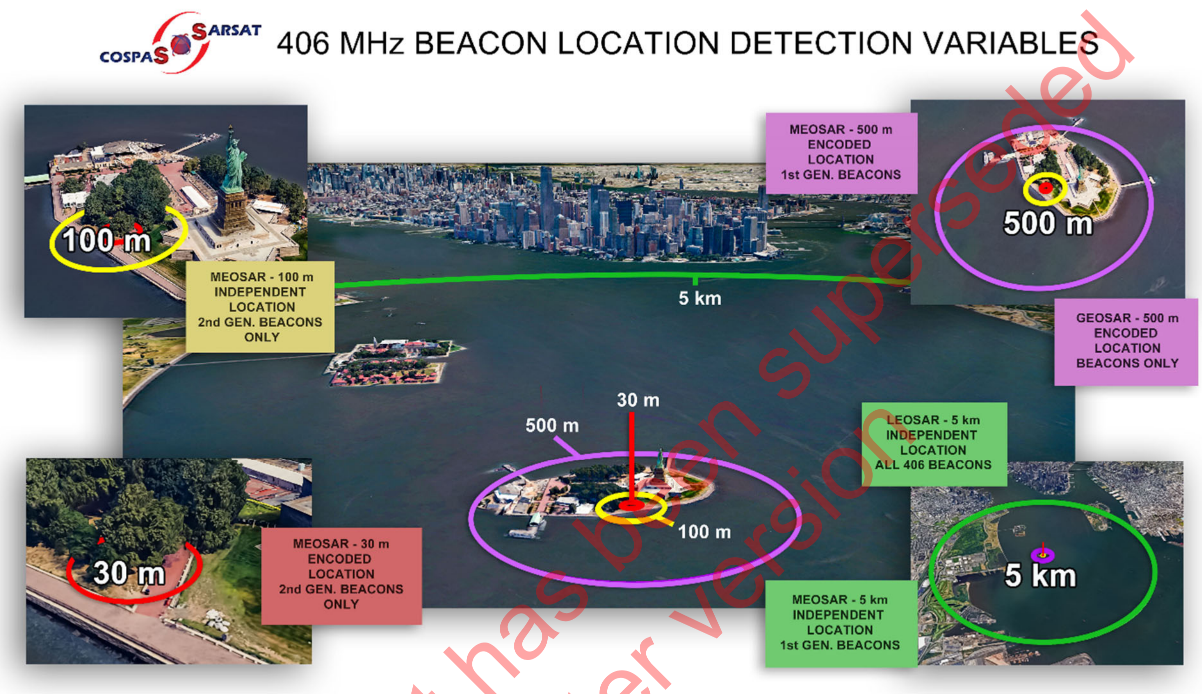

Figure 6-1: Cospas-Sarsat Solution Accuracy
This illustration shows the accuracy that is specified for the locations generated by the various sub-systems of the Cospas-Sarsat System.

6.1.5 Return Link Service Beacon Support

Some of the GNSS that are used by the MEOSAR system support a Return Link Service (RLS); this service uses the navigation downlink signals to transmit messages or commands to the beacon. In the initial implementation, the Galileo system is used to send an automatic acknowledgement message to the beacon after the alert has been received and the position confirmed by the MCC; this does not guarantee that the alert has been received and acted on by the RCC.

The performance requirements for the support of the return link message distribution are that the solution should be sent to the Return Link Service Provider (RLSP) within fifteen minutes after the beacon transmission. With a potential time of fifteen minutes for the RLSP to send the acknowledgement to the beacon, the total end-to-end capability is within thirty minutes. This requirement applies only to the MEOSAR and GEOSAR systems.

6.2 Quality Management System

The Cospas-Sarsat Quality Management System monitors the performance of the entire System. Every LUT transmits all the solution data for a designated set of reference beacons to its associated MCC, which forwards it to the nodal MCC (as defined in section 5.4) for analysis and processing. This process assures an independent evaluation of the quality of the data generated by the System.

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For the key performance parameters, the nodal MCC computes the performance statistics for each LUT and MCC in its Data Distribution Region. It reports the results on dedicated pages of the Cospas-Sarsat web site.

The MEOSAR QMS will provide a monitoring and reporting capability that is similar to the QMS that is in place for the LEOSAR and GEOSAR systems. Some of the performance indicators that are planned for MEOSAR are:

- Timely Alerting — The ability of the System to receive, process, and deliver a MEOSAR incident alert message within the required time (of five minutes)
- Beacon Location Accuracy (first alert) — The ability of the MEOSAR system to produce a single-burst location that is within the five-kilometre accuracy required by the MEOLUT specifications
- Beacon Location Accuracy (long term) — The ability of the MEOSAR system to produce a location with the accuracy required by the MEOLUT specifications: For an FGB, the solution after 30 minutes must be within five kilometres of the true location. For an SGB, the solution after ten minutes must be within one hundred metres of the true location
- RLS Support — The ability of the System to deliver the message from an RLS beacon to the Return Link Service Provider within the required 30-minute interval for the complete end-to-end performance
- Bit Error Rate — The rate of errors detected in the beacon messages received through the MEOSAR system

These performance parameters are being developed on the basis of the results observed during the MEOSAR Demonstration and Evaluation program, and they will be monitored (and updated as necessary) during the initial phases of MEOSAR system operations.

6.3 System Development

Since its implementation in 1984, the Cospas-Sarsat System has grown and improved. Figure 6-1 shows some of the improvements in performance in the detection of 406 MHz beacons. (The original performance of the System, to locate a 121.5 MHz beacon within 20 km, is not shown on these maps.)

Figure 6-2 illustrates the growth of the System over the first 30 years of operations.

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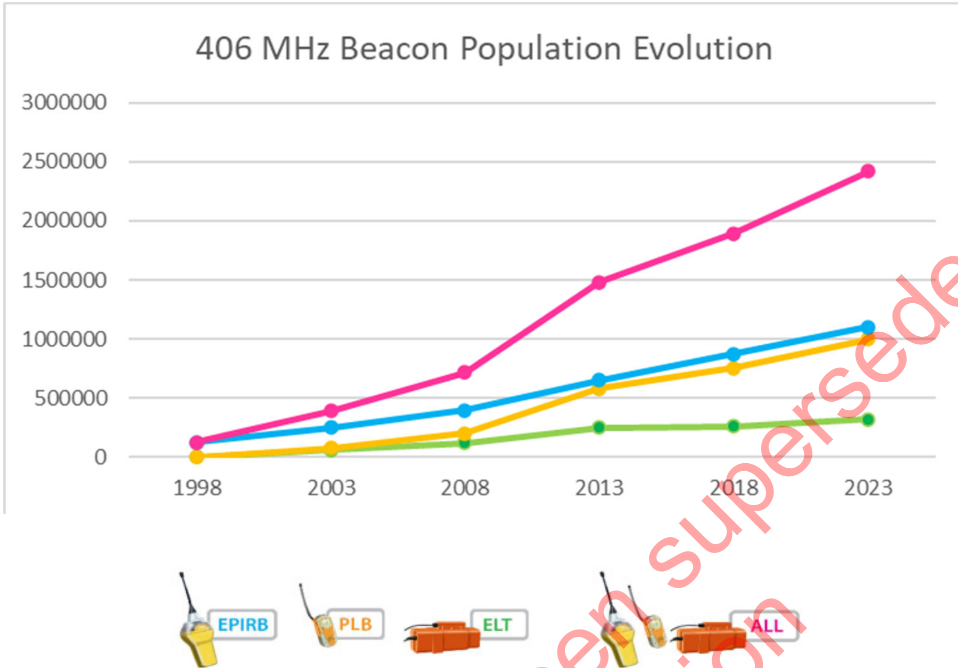

Figure 6-2: Cospas-Sarsat 406 MHz Distress Beacons
This illustration shows the growth of the number of 406 MHz Distress Beacons that have been operational during the first thirty years of the Cospas-Sarsat System.

- END OF SECTION 6 -

- END OF PART II -

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Part III INTERNATIONAL PROGRAMME MANAGEMENT

7. THE INTERNATIONAL COSPAS-SARSAT PROGRAMME

The International Cospas-Sarsat Programme ("the Programme") was formed when the International Cospas-Sarsat Programme Agreement ("the ICSPA", document C/S P.001) was signed and ratified. This formal Agreement among the Governments of Canada, France, the Russian Federation, and the United States of America (the States Party to the Agreement) allows the association of other States with the Programme.

Figure 7-1: A Cospas-Sarsat Joint Committee Meeting
The Cospas-Sarsat Joint Committee, which includes all of the Participants in the Cospas-Sarsat System, meets annually to discuss matters of importance to the operation of the System.

7.1 The Cospas-Sarsat Programme Structure

The ICSPA creates and assigns the roles of the Cospas-Sarsat Council and the Cospas-Sarsat Secretariat. The Council may create other subsidiary bodies, as necessary for the continuance and support of the Programme. (See section 8 for more information about subsidiary bodies created by the Cospas-Sarsat Council.)

7.1.1 The Cospas-Sarsat Council

The Cospas-Sarsat Council, consisting of one representative from each of the Parties to the ICSPA, is established by Articles 7, 8, and 9 of the Agreement. This Council is responsible for all aspects of the implementation of the Cospas-Sarsat System. While it may delegate various parts of this responsibility to other bodies (as described in section 8 below), the final decision on any matter of importance to the Programme must be made by the Council.

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7.1.2 The Cospas-Sarsat Secretariat

The Cospas-Sarsat Secretariat is established by Article 10 of the ICSPA, as the "permanent administrative organ for the Programme" to "assist the Council in the implementation of its functions".

The Secretariat is managed by a "Head of Secretariat", appointed by the Council. Other officers and employees are hired as necessary by the Head of Secretariat, as directed and authorized by the Council. In 2022, the Secretariat is staffed by a total of eleven persons.

- END OF SECTION 7 -

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8. THE COSPAS-SARSAT ORGANIZATION

8.1 The Cospas-Sarsat Council

The Cospas-Sarsat Council operates in the official languages of the Programme: English, French, and Russian. The Council meetings are conducted in these languages, with simultaneous translation provided.

The Council operates by consensus, and all decisions of the Council must be approved unanimously by the delegates from all four Parties to the ICSPA: Canada, France, the Russian Federation, and the United States of America.

8.1.1 Closed Meetings

The Cospas-Sarsat Council, as created by the ICSPA, consists only of the representatives of the Parties to the Agreement; this group normally meets twice a year: once in the spring and once in the fall.

8.1.2 Open Meetings

The ICSPA provides for other States to participate in the operation of the Cospas-Sarsat System, as Ground Segment Providers (Article 11 of the ICSPA) and as User States (Article 19 Of the ICSPA).

The Agreement explicitly states that they will "participate in appropriate meetings of the Programme, as defined by the Council". The Council, consisting exclusively of the Parties to the ICSPA, is the legal governing body of the Cospas-Sarsat System. However, since 1989, the Council has invited representatives of all States and organizations who have formally associated with the Programme ("the Participants") to join the open meetings of the Council sessions. The open meetings of the Council are normally conducted once a year, in the week following the fall closed meeting of the Council.

In 2022, there are 45 Participants[24] in the Cospas-Sarsat Programme, including:
- the four (4) Parties to the ICSPA
- thirty (30) Ground Segment Provider States
- two (2) Participating Ground Segment Provider Organizations
- nine (9) User States

These Participants are shown on the map in Figure 8-1.

There are also three Space Segment contributors (in addition to the Parties), who contribute to the Programme through special arrangement with the Cospas-Sarsat Parties. All of the Participants and contributors to the System are eligible to participate in the open meetings of the Council and of its other subsidiary bodies. The open meetings may also include Observers (who may be from non-Participating States or from supporting organizations) who have been invited by the Council to participate in the meetings.

[24] A complete list of the Participants and authorized observers to the Cospas-Sarsat Programme is contained in document C/S P.010, "List of States and Organizations Associated with or Contributing to the Cospas-Sarsat Programme". This document is reviewed and updated annually.

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Figure 8-1: The Cospas-Sarsat Participants
This map shows (in green) the States that are Participants in the Cospas-Sarsat System. These States are listed on the right side of the map.

8.2 The Cospas-Sarsat Joint Committee

At its first meeting, and acting under the authority granted by Article 9 of the ICSPA for "the establishment of mechanisms for exchange of appropriate technical and operational information", the Council established two working groups:

- the Operations Working Group (OWG), and
- the Technical Working Group (TWG).

In the first year, these two working groups met separately; however, since that time, they have met together, once a year, as the Cospas-Sarsat Joint Committee (JC).

The rules of procedure for the Joint Committee meetings are set out in the document C/S P.011, "Cospas-Sarsat Programme Management Policy". These rules are also used for the conduct of the meetings of the other bodies that have been created by the Cospas-Sarsat Council.

Although the Joint Committee includes participants who speak many languages, the meetings of the Joint Committee are conducted only in English.

The Joint Committee is an advisory group: it operates by consensus, and it makes recommendations to the Cospas-Sarsat Council. However, it does not have any authority to make decisions or commitments on behalf of the Programme.

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8.2.1 The Operations Working Group

The OWG addresses matters of operational importance to the Cospas-Sarsat System, including:

- the Data Distribution System;
- the Mission Control Centres (MCCs) that comprise the Data Distribution System, including:
  - Specifications for the MCCs of the Cospas-Sarsat System, and
  - Commissioning of the MCCs into the Cospas-Sarsat Ground Segment;
- issues associated with the registration of distress beacons; and
- relationships with the SAR organizations that are the customers of the data generated by the System.

8.2.2 The Technical Working Group

The TWG addresses technical matters associated with the operation of the Cospas-Sarsat System, including all matters that deal with:

- the 406 MHz radiobeacons that are the alerting mechanism for the System,
- the Space Segment components of the Cospas-Sarsat System, and
- the Local User Terminals (LUTs) of the Cospas-Sarsat Ground Segment.

8.3 Formal Working Groups

As it deems necessary, the Council may establish other working groups to address matters that may be too complex be dealt with in the large meetings of the Joint Committee.

8.3.1 Cospas-Sarsat Experts Working Groups

An Experts Working Group (EWG) consists of individuals who have specific expertise in the matters to be addressed. The Council defines the Terms of Reference for each EWG and invites subject matter experts to participate in the meetings of the EWG. The Council normally requests that the EWG report back at a specified time (or to a specific Cospas-Sarsat meeting). The EWG may report directly to the Council, or it may be asked to report through a subsidiary body (such as the Joint Committee).

8.3.2 Cospas-Sarsat Task Groups

A Task Group (TG) is open to the contributions of all individuals who are designated as delegates by the Participants in the Cospas-Sarsat Programme. The Council defines the Terms of Reference for each TG, and requests that the TG report to a specified meeting of the Joint Committee (or to another Cospas-Sarsat meeting). Any Participant in the Cospas-Sarsat Programme may send delegates to the meetings of a TG.

8.4 Unofficial Advisory Groups / Correspondence Working Groups

From time to time, to help manage the workload, interested participants work together intersessionally in correspondence working groups to address specific topics, usually in response to action items that have been identified by one of the formal working groups.

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8.5 Data Distribution Region Meetings

Within the nodal network of Data Distribution Regions (DDRs), each nodal MCC is responsible for the coordination of Programme activities over its DDR. Several nodal MCCs have taken the initiative to organize annual or biennial meetings of the MCCs (and, sometimes, the Search and Rescue Points of Contact – SPOCs) that comprise their DDR.

These regional meetings provide a valuable forum for the exchange of data among the neighbours within each region, and an extra level of support for the Cospas-Sarsat Programme and the Council. They make valuable contributions to the successful operation of the Programme.

- END OF SECTION 8 -

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9. RELATED ORGANIZATIONS AND SYSTEMS

The International Cospas-Sarsat Programme Agreement (ICSPA) clearly identifies[25] the other international organizations that are major stakeholders of the Programme:

The International Civil Aviation Organization

The International Maritime Organization

The International Telecommunications Union

Figure 9-1: Stakeholder Organizations

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The first two of these organizations have significant interest in and contributions to the areas of Search and Rescue, and they have jointly developed requirements that nations establish and operate Rescue Coordination Centres to provide response to accidents involving aircraft and ships at sea.

9.1 International Maritime Organization (IMO)

The International Maritime Organization (IMO) was established by the International Convention for the Safety of Life at Sea (the SOLAS Convention) in 1914 (in response to the sinking of the Titanic).

The following Annexes to the SOLAS Convention are of particular interest to Cospas-Sarsat:

- Chapter IV: Radiocommunications
  Among other things, this Annex mandates the carriage and use of the 406 MHz Emergency Position-Indicating Radio Beacons (EPIRBs) that are detected and located by the Cospas-Sarsat System.
- Chapter V: Safety of Navigation
  This Annex describes the obligations of various parties to provide assistance to any ship in distress.

In 1992, the SOLAS Convention was amended to establish the Global Maritime Distress and Safety System (GMDSS). The GMDSS includes the mandate that all ships subject to the SOLAS Convention (that is, all ships with a gross tonnage above a certain threshold that operate internationally) must carry an EPIRB and describes the use of and response to the EPIRB.

[25] In the ICSPA, IMO and ICAO are listed in Article 2(c), and the ITU is identified in Article 3.1(c). Article 9(e) clearly states that the Council is to ensure interaction and cooperation with all three of these organizations. Article 13 again emphasizes the need for Cospas-Sarsat to cooperate with these organizations.

9.2 International Civil Aviation Organization (ICAO)

The International Civil Aviation Organization (ICAO) was established by the Chicago Convention on International Civil Aviation (the Chicago Convention), which was originally ratified by the necessary 26 countries in 1947.

The following Annexes to the Chicago Convention are of particular interest to Cospas-Sarsat:

- Annex 6: Operation of Aircraft
  This Annex describes the regulations for the operation of vehicles that fly internationally, including commercial air transport, general aviation airplanes, and helicopters. It has been amended to include the mandate for the Global Aeronautical Distress and Safety System (GADSS) for all commercial aircraft from 2021 forward. This specifically includes the requirement that these aircraft must generate a tracking signal from which the position after a crash can be determined to within an accuracy of six nautical miles or better.
- Annex 10: Aeronautical Telecommunications
  Among other things, this Annex mandates the carriage and use of the 406 MHz Emergency Locator Transmitter beacons (ELTs) that are detected and located by the Cospas-Sarsat System. It also contains the specifications for the AFTN (and AHMS) communications network.
- Annex 11: Air Traffic Services – Air Traffic Control Service, Flight Information Service and Alerting Service
  This Annex describes the communications requirements associated with the flight of an aircraft, including specifically the alert communications that should be used in the event of a distress incident involving an aircraft.
- Annex 12: Search and Rescue
  This Annex describes the obligations of various parties to provide assistance to any aircraft in distress.

In 2015, in response to the disappearances of Air France flight 447 (over the Atlantic Ocean in June 2009) and of Malaysian Airlines flight MH370 (over the Indian Ocean in March 2014), ICAO formed a special Multidisciplinary Meeting on Global Flight Tracking (MMGFT); this meeting decided on the need to develop a Global Aeronautical Distress and Safety System (GADSS) to prevent the occurrence of similar disasters in the future.

The GADSS has been defined as a set of performance-based requirements documented by ICAO. In support of these requirements, the Cospas-Sarsat Programme has developed Distress Tracking ELTs: ELT(DT)s. An ELT(DT) may be coded as either a First-Generation Beacon (FGB), per document C/S T.001, or as a Second-Generation Beacon (SGB), per document C/S T.018. Unlike other ELTs, ELT(DT)s may be activated, either automatically or manually, while the aircraft is still in flight. Messages from ELT(DT)s will be distributed by MCCs directly to SAR authorities and indicate that an accident is likely to occur.

In addition to distributing ELT(DT) data to RCCs/SPOCs, Cospas-Sarsat will place data from each ELT(DT) transmission in a Location of an Aircraft in Distress Repository (LADR) as at Figure 9-2. The LADR is operated by EUROCONTROL and is under the responsibility of ICAO. The LADR will send notifications (not considered “alerts”) to registered users when data is present that matches their user profile.

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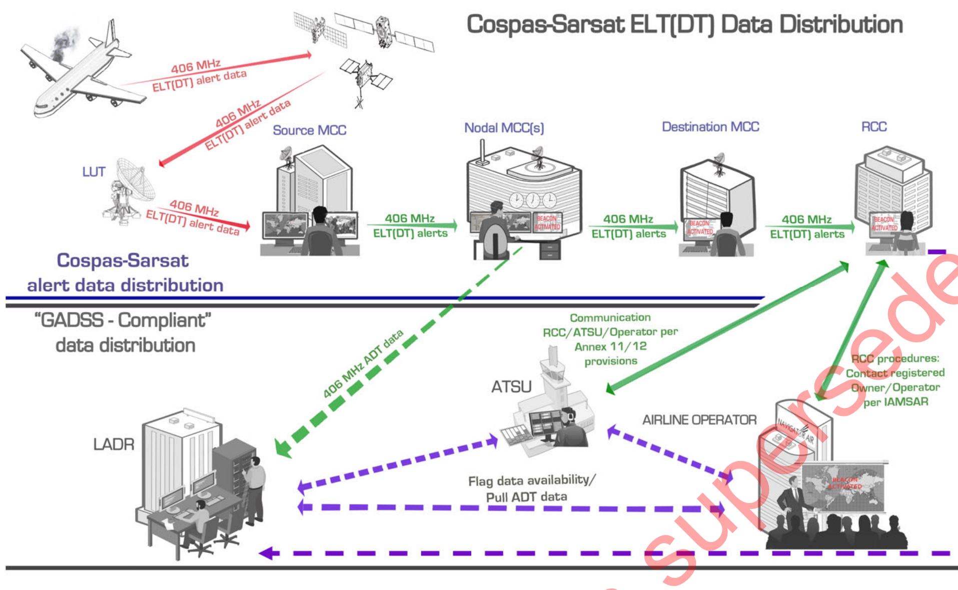

Figure 9-2: ELT(DT) Data Distribution

ELT(DT) data will be automatically distributed to designated SAR authorities (i.e., SPOCs), as well as placed in the ICAO LADR, where it will be made available to ATSUs, Airline Operators and RCCs that have subscribed to the LADR.

9.3 International Telecommunication Union (ITU): Radio Regulations

The International Telecommunication Union (ITU), originally the International Telegraph Union, was formed in 1865. It became a specialized agency of the United Nations (UN) in 1947; it is responsible for issues that concern information and communication technologies.

The ITU-R was established in 1927 (as the International Radio Consultative Committee or CCIR) to manage the international radio-frequency spectrum and satellite orbit resources. In 1992, the CCIR became the ITU-R. The ITU Radio Regulations define the spectrum allocations, limitations and requirements for radio transmissions, and, together with the recommendations from the ITU-R the restrictions on interference with allocated radio frequency bands.

Specifically, the ITU Radio Regulations include the allocation of the frequency bands:

- 406.0 to 406.1 MHz[26]: for transmissions from distress beacons to satellites in orbit. (This band is used by the Cospas-Sarsat distress beacons to send their distress messages.)
- 1544.0 to 1545.0 MHz[27]: for Cospas-Sarsat satellite emergency downlink transmissions. (This band is used by the Cospas-Sarsat spacecraft to relay the beacon signals back to the Local User Terminal ground stations.)

In support of these allocations, the ITU also assists with the monitoring and management of these frequency bands.

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[26] ITU Radio Regulations, Article 5, section IV, and notes 5.265, 5.266 and 5.267; and Recommendation ITU-R M.1478-3
[27] ITU Radio Regulations, Article 5, section IV, and note 5.356; and Recommendation ITU-R M.1731-2

Participants in the Cospas-Sarsat Programme, and especially the Ground Segment Providers and Organizations, monitor the frequency bands that are allocated for the use of the Cospas-Sarsat System, and report any interference[28] that they detect to the ITU. The ITU then works with the national authority responsible for the location where the interference has been reported to eliminate the offending transmissions.

In 2015, the ITU amended the Radio Regulations to explicitly identify the danger of interference to the Cospas-Sarsat uplink band from transmissions in adjacent frequency bands. States (and especially Cospas-Sarsat Participants) are invited to monitor these frequency bands and to report any transmissions that may affect the reliable operation of the Cospas-Sarsat System.

9.4 National Regulations and Legislation

Neither Cospas-Sarsat nor the other international organizations have the authority or the power to enforce their regulations. They are dependent on the individual States that comprise these organizations to make laws and to enforce these laws to give substance to the regulations that have been established by the international organizations. The overwhelming support for all these organizations results in the implementation of the necessary laws and regulations in virtually every country of the world. It is then incumbent on each government, at the national level, to enforce its laws and to ensure that everyone will follow the regulations that have been agreed at the international level.

For Cospas-Sarsat, the regulations that are adopted in the participating nations include standards that have been developed by various scientific, professional and educational organizations, such as the:

- International Electrotechnical Commission (IEC),
- Radio Technical Commission for Maritime Services (RTCM),
- RTCA (formerly the Radio Technical Commission for Aeronautics) in the USA,
- European Organisation for Civil Aviation Equipment (EUROCAE) in Europe.

These organizations develop the technical standards that then form the basis of regulations that are established under the laws of the participating States.

Document C/S S.007, the Cospas-Sarsat "Handbook of Beacon Regulations", is a compilation of the beacon carriage regulations of a large number of nations, including Participants and other (non-participating) nations. This document is based on contributions from representatives of the States that establish these regulations and is maintained by the Cospas-Sarsat Secretariat.

- END OF SECTION 9 -

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[28] Interference in a radio signal is any signal that is not within the authorized use of the frequency band. Such interfering signals may degrade the performance, increase the error rate, or completely stop the reception of authorized signals in the band. Interference may come from natural sources or from man-made signals.

10. CONCLUSION

The Cospas-Sarsat System is an important part of the international Search and Rescue infrastructure. As a SAR communications provider, it has delivered information and services in support of SAR operations for over 35 years. From September 1982 to December 2021, data from Cospas-Sarsat has contributed to the rescue of almost 60,000 persons in almost 18,000 SAR events. That works out to more than one rescue per day, with an average of 3.6 lives saved every day for more than 35 years. In 2022, the average number of lives saved in SAR events alerted by 406 beacons had increased to ten each day.

The System is continually being developed and enhanced, and it is expected to continue to contribute to the safety of people all over the world for the foreseeable future.

- END OF SECTION 10 -

- END OF PART III -

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