HANDBOOK ON DISTRESS ALERT MESSAGES FOR RESCUE COORDINATION CENTRES (RCCs), SEARCH AND RESCUE POINTS OF CONTACT (SPOCs) AND IMO SHIP SECURITY COMPETENT AUTHORITIES

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COSPAS SARSAT

HANDBOOK ON DISTRESS ALERT MESSAGES FOR RESCUE COORDINATION CENTRES (RCCs), SEARCH AND RESCUE POINTS OF CONTACT (SPOCs) AND IMO SHIP SECURITY COMPETENT AUTHORITIES

HISTORY

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1. INTRODUCTION

1.1 Overview

Cospas-Sarsat is a satellite system designed to provide distress alert and location data to assist search and rescue (SAR) authorities, using spacecraft and ground facilities to detect and locate the signals of distress beacons operating on 406 megahertz (MHz). The position of the distress and related information is forwarded by the responsible Cospas-Sarsat Mission Control Centre (MCC) to the appropriate national SAR authorities. Cospas-Sarsat's objective is to support search and rescue authorities worldwide, whether at sea, in the air, or on land.

The purpose of this document is to provide Rescue Coordination Centre (RCC) personnel and SAR Point of Contact (SPOC) personnel with an overview of the Cospas-Sarsat System, its evolution and an understanding of the contents and types of Cospas-Sarsat distress alert messages. This will allow RCCs to prosecute SAR incidents involving Cospas-Sarsat distress alerts in an informed manner. Furthermore, the document also provides information on 406 MHz interference which can impact 406 MHz distress alerting.

1.2 Document Organisation

Section 1 provides information on the concept of the Cospas-Sarsat System and its vision. In addition, the section includes several topics of relevance to RCCs which are Doppler location processing procedures, 406 MHz interference, 406 MHz direction finding, future implementation of the medium-altitude earth orbit SAR system (MEOSAR), the International Beacon Registration Database (IBRD), etc.

Section 2 provides information on Cospas-Sarsat distress alert data distribution principles.

Section 3 gives a brief overview of Cospas-Sarsat beacon coding.

Section 4 provides detailed information on the content and types of Cospas-Sarsat 406 MHz distress alert messages.

Section 5 is a standard form for RCCs to provide reports on 406 MHz beacon SAR incidents.

Section 6 gives real world examples of 406 MHz distress alert messages.

Section 7 lists some frequently asked questions by RCC personnel.

Annexes A, B, C and D provide a Glossary, MCC address and contact numbers, data distribution regions and a suggested RCC personnel Cospas-Sarsat course.

1.3 Reference Documents

The Cospas-Sarsat documents listed below are available free-of-charge from the Cospas-Sarsat web site at **www.cospas-sarsat.org**:

C/S G.003 - Introduction to the Cospas-Sarsat System.
This document provides detailed information of the System history, Programme Management, concept of operation and a description of the various components. This is the ideal document to read to obtain a general understanding of the of the Cospas-Sarsat System.

C/S G.005 – Cospas-Sarsat Guidelines on 406 MHz Beacon Coding, Registration and Type Approval.

This document was developed as an aide to help in understanding beacon coding, registration and type approval. It also assists in the understanding of the more complex beacon technical specification document, C/S T.001 and complements it.

C/S P.011 – Cospas-Sarsat Programme Management Policy.

As the name suggests this is a high level document that provides information on all aspects of the System and its management and, in the main, is intended for senior Managers.

C/S A.001- Cospas-Sarsat Data Distribution Plan (DDP)

This document provides operational guidance to MCCs for the exchange of alert and system data between MCCs and to RCCs.

C/S A.002 – Cospas-Sarsat Mission Control Centre Standard Interface Description (SID)

This document provides information on message content and formats for the automatic exchange of data between MCCs and to RCCs.

C/S T.001 – Specifications for Cospas-Sarsat 406 MHz Distress Beacons

This document defines the specifications for the development and manufacture of 406 MHz distress beacons and the beacon message content.

C/S S.007 – Handbook of Regulations on 406 MHz Beacons

This document provides a summary of regulations issued by Cospas-Sarsat participants regarding the carriage of 406 MHz beacons and includes information on the coding and registration of 406 MHz beacons in each country.

The document listed below is available from the International Maritime Organization (www.imo.org) or the International Civil Aviation Organization (www.icao.int) for a fee:

Doc 9731 –AN/958 – IAMSAR Manual (International Aeronautical and Maritime Search and Rescue Manual).

1.4 Cospas-Sarsat Mission and Vision

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.

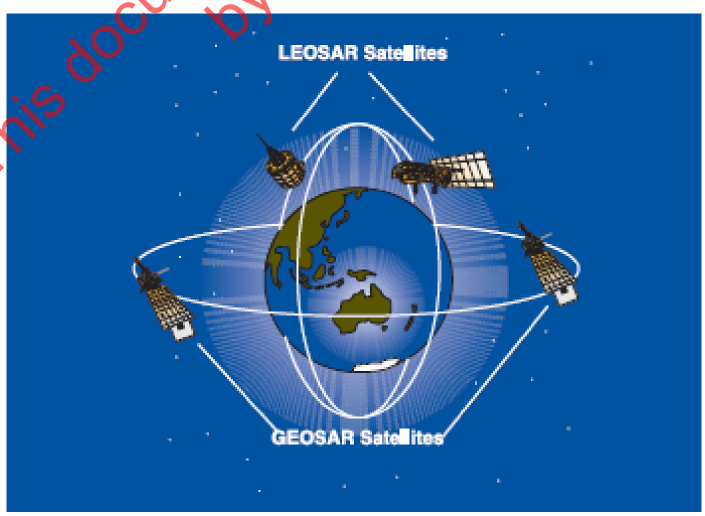
Objective:
The objective of the Cospas-Sarsat System is to reduce as far as possible, delays in the provision of distress alerts to SAR services, and the time required to locate a distress and provide assistance, which have a direct impact on the probability of survival of the person in distress at sea or on land.

1.5 Basic Concept of the Cospas-Sarsat System

The System is comprised of:

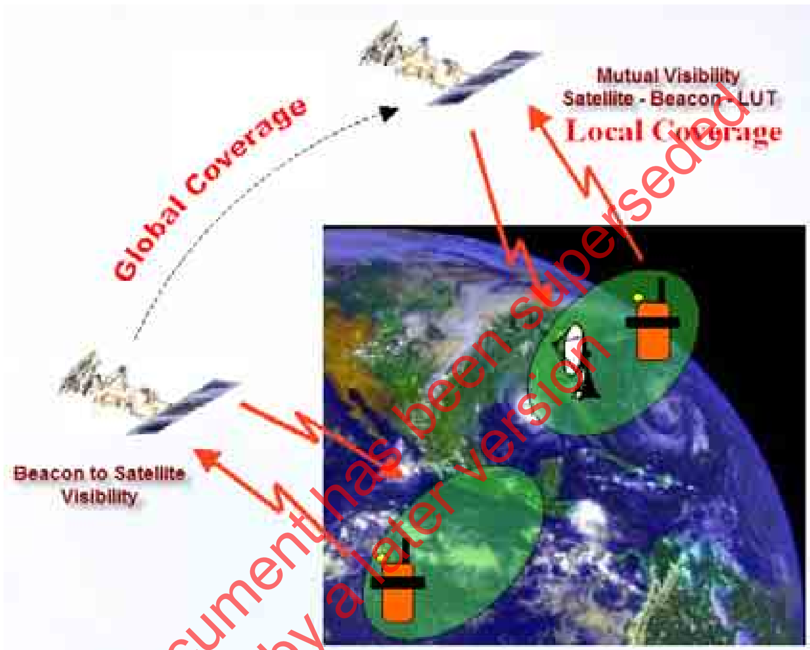
- satellites in low-altitude Earth orbit (LEOSAR) and geostationary orbit (GEOSAR) that process and / or relay signals transmitted by distress beacons;
- ground receiving stations called local user terminals (LUTs) which process the satellite signals to locate the beacon; and
- MCCs that provide the distress alert information to SAR services.

Figure 1.1: Cospas-Sarsat Space Segment



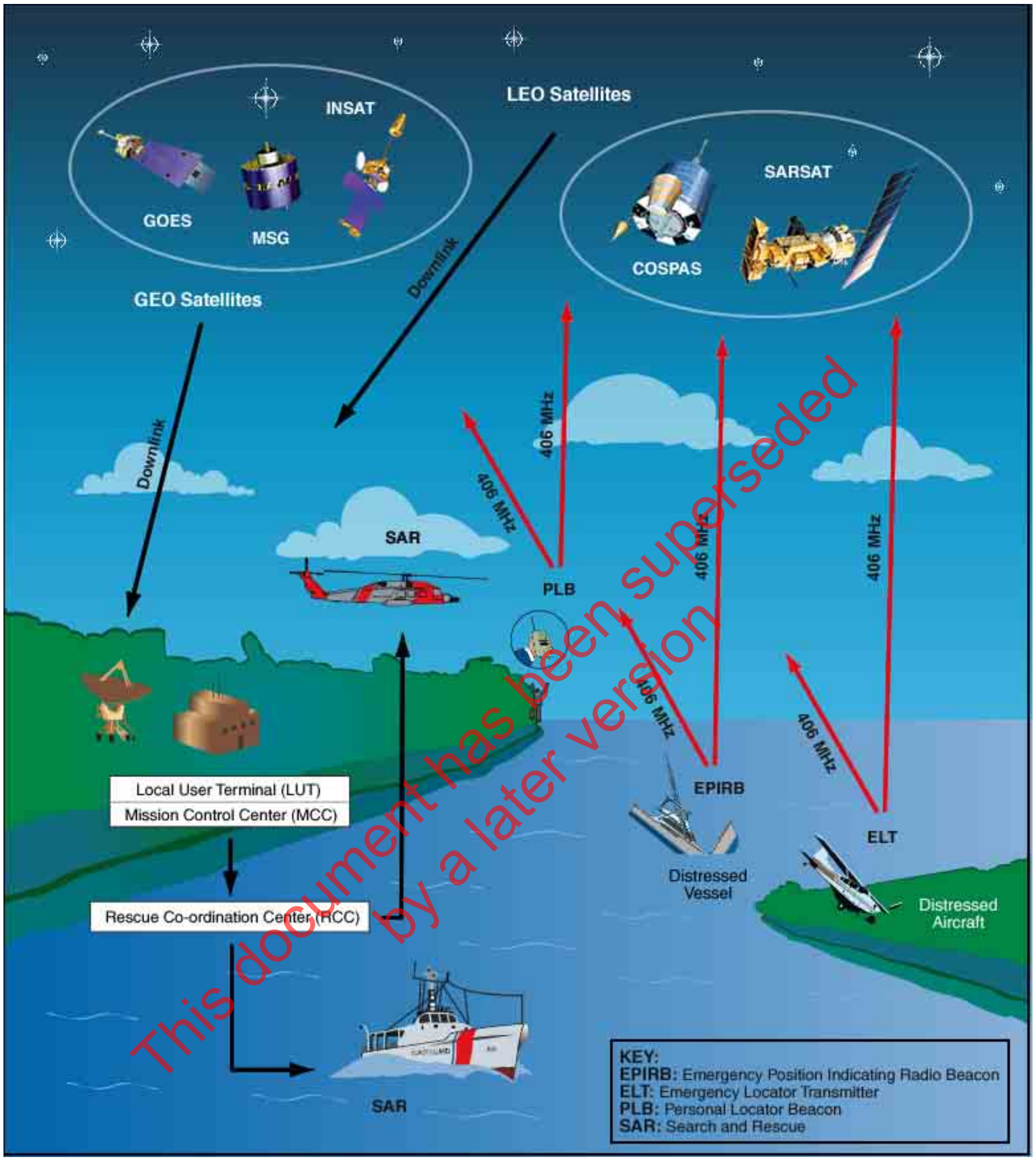
In contrast to older generation 121.5 MHz analogue beacons, both LEOSAR and GEOSAR satellites support 406 MHz digital beacons. Additionally, each LEOSAR satellite includes a 406 MHz processor/memory module that stores the digital messages received from 406 MHz beacons. The contents of the satellite memory are continually transmitted to Earth, thereby eliminating the need for the satellite to have simultaneous visibility of the beacon and a LUT for detecting and locating the beacon. In effect, after a satellite has received the 406 MHz beacon transmissions, the signals stored in the satellite memory are made available to every LUT in the Cospas-Sarsat System, thereby providing complete global coverage. Local mode coverage is when there is mutual visibility between the LUT, satellite and beacon.

Figure 1.2: Local and Global Mode Coverage



Users in distress may have to wait for a LEOSAR satellite to pass into view of their location. To address this limitation, in 1998 Cospas-Sarsat incorporated GEOSAR satellites to complement the service already provided by LEOSAR satellites. GEOSAR satellites are at a fixed position relative to the earth, and provide continuous coverage of a specific geographic region. Since geostationary satellites do not move with respect to the earth, the GEOSAR system cannot determine beacon location unless this information is transmitted in the beacon's digital message. Many 406 MHz beacon models incorporate a satellite navigation receiver to determine their own position and transmit this information in the distress message.

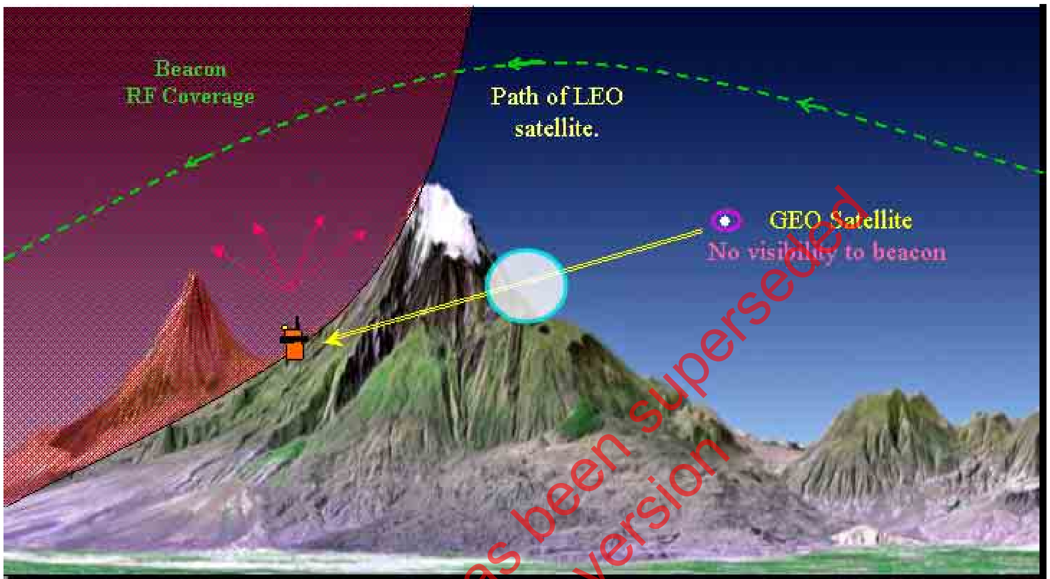
Figure 1.3: Basic Concept of the Cospas-Sarsat System



Notes:
COSPAS - Space system for the search of vessels in distress (Russia)
SARSAT - Search and rescue satellite-aided tracking system (USA)
MSG - Meteosat second generation satellite (EUMETSAT)
GOES - Geostationary operational environmental satellite
INSAT - Indian geostationary satellite
GEOLUT - Local user terminal in a GEOSAR system
GEOSAR - Geostationary satellite system for SAR
LEOLUT - Local user terminal in a LEOSAR system
LEOSAR - Low Earth Orbit satellite system for SAR

There are occasions when the beacon may be blocked from view of the stationary GEOSAR satellite but is visible to a polar orbiting LEOSAR satellite. This is depicted in Figure 1.4 below.

Figure 1.4: GEOSAR and LEOSAR Complementary Service



1.6 Doppler Location Processing

The Cospas–Sarsat System employs Doppler principles, using the relative motion between a satellite and an activated beacon to calculate the location of that beacon. This technique produces a position line, upon which are two positions, one either side of the satellite's track over the ground. One is the actual position, and the other is the "mirror image" on the other side of the satellite's track (see Figures 6.3 and 6.4). This ambiguity is resolved when a subsequent satellite pass detects the same beacon.

The frequency time plot in Figure 1.5 is representative of a 406 MHz signal heard by a LEO satellite passing over a stationary transmitter on the surface of the Earth. Each dot represents one digital burst from the beacon. The point of inflection of the curve represents the point in time where the satellite was closest to the transmitter (TCA – Time of Closest Approach). The actual shape of the curve can be used to determine the distance the transmitter was from the satellite track. A minimum of three bursts is required to calculate a Doppler location. However, under some circumstances a combination of LEO and GEO processing can provide a location from very limited beacon bursts.

Using this information, and by knowing where the satellite was at all times during the pass, it is possible to plot two lines which represent the distance from the satellite track to the transmitter. Then, knowing the time of closest approach of the satellite, it is a simple matter of drawing perpendicular lines from the point on the satellite track at TCA to the lines representing the distance between the transmitter and the satellite track. The intersection of these lines represents two possible locations for the transmitter, one the actual location and the other its mirror image.

RCCs should be aware that each location has a probability of error associated with it and this is processed as an error ellipse around each position with a 50% probability that the beacon is within the error ellipse. Error ellipse information is not provided to RCCs in the normal course of events however RCCs should be aware that the Doppler location provided is not flawless.

An error ellipse analogy can be considered to a wise navigator who thinks of a dead reckoning position as a circle, with a radial error appropriate to the situation. If his estimate of speed is believed to be less reliable than his estimate of direction of travel, he may think of the area of uncertainty as being an ellipse, with the long axis along his course line. If the speed is more accurate, the long axis is perpendicular to the course line.

Ambiguity resolution is the process of determining which of the two computed Doppler solutions of the transmitting beacon is the real position and which is the image , or "mirror" position. A subsequent satellite pass can be used to resolve the ambiguity between the actual location and its mirror (see Figure 6.4).

An estimate of the true and image location can also be calculated by taking into account the Doppler frequency change caused by the earth's rotation when computing the Doppler solutions. This ambiguity resolution technique is dependent upon the stability of the transmitted frequency of 406 MHz distress beacons.

If the LUT cannot calculate a Doppler location then the beacon identity information contained within the signal will be processed and transmitted to an RCC. With location protocol beacons an encoded position may also be included.

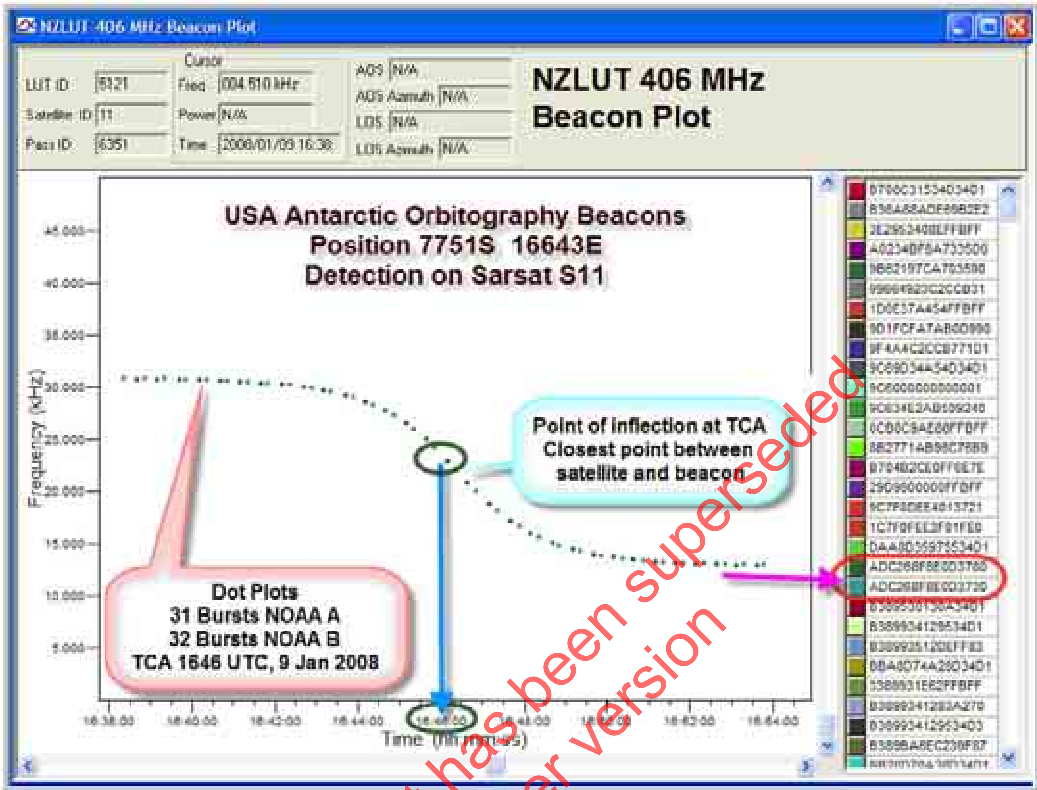
Figure 1.5 depicts a real world detection by the New Zealand Wellington LEOLUT and Sarsat-11 satellite of two USA Antarctic orbitography beacons. These special beacons transmit a burst every 30 seconds and are used to update the satellite orbit parameters in a LEOLUT. Note the Doppler curve from which the location of the beacon is determined.

The location obtained from the Wellington LEOLUT for this detection was:

HEX ID: ADC268F8E0D3730 - USA/ORB NOAA00B
TCA 9 Jan 2008 16:46:24.16 UTC, Bursts - 32
Position A - 77.8468S 166.7149E, Probability 98%
Position B - 84.3815S 173.2486E

HEX ID: ADC268F8E0D3780 - USA/ORB NOAA00A
TCA 9 Jan 2008 16:46:24.16 UTC, Bursts – 31
Position A - 77.8479S 166.7159E, Probability 99%
Position B - 84.3851S 173.2607E

Figure 1.5: Representative Doppler Curve



1.7 Interference on 406 MHz

The International Telecommunication Union (ITU) has allocated the 406 MHz band for low distress power beacons. Nevertheless there are unauthorised signal sources in various areas of the world radiating in the 406.0 – 406.1 MHz band. Interferers degrade the performance of the Cospas-Sarsat System and reduce the probability of detecting real beacon messages. The Cospas-Sarsat System itself can be used to detect and locate the source of some of these interferers from suitably equipped LUTs. Unlike the processing of 406 MHz digital beacon signals, no identification code is available from an interferer. An interfering source can only be identified by determining its location.

Persistent interferers are reported by MCCs to ITU through the Cospas-Sarsat Secretariat or their national spectrum management agencies. In addition, some MCCs also transmit 406 MHz interferer alerts to RCCs using the SIT 185 sixteen paragraph message format which is discussed in section 4.

Figures 1.6 and 1.7 provide graphical information on a typical 406 MHz interferer detection.

Figure 1.6: 406 MHz Interferer Time and Frequency Plot

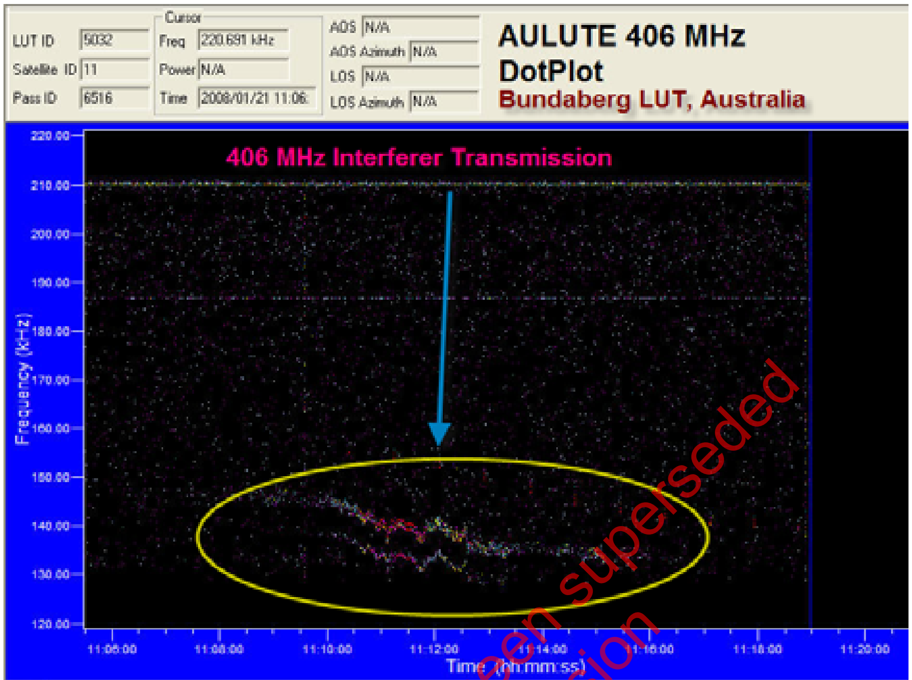
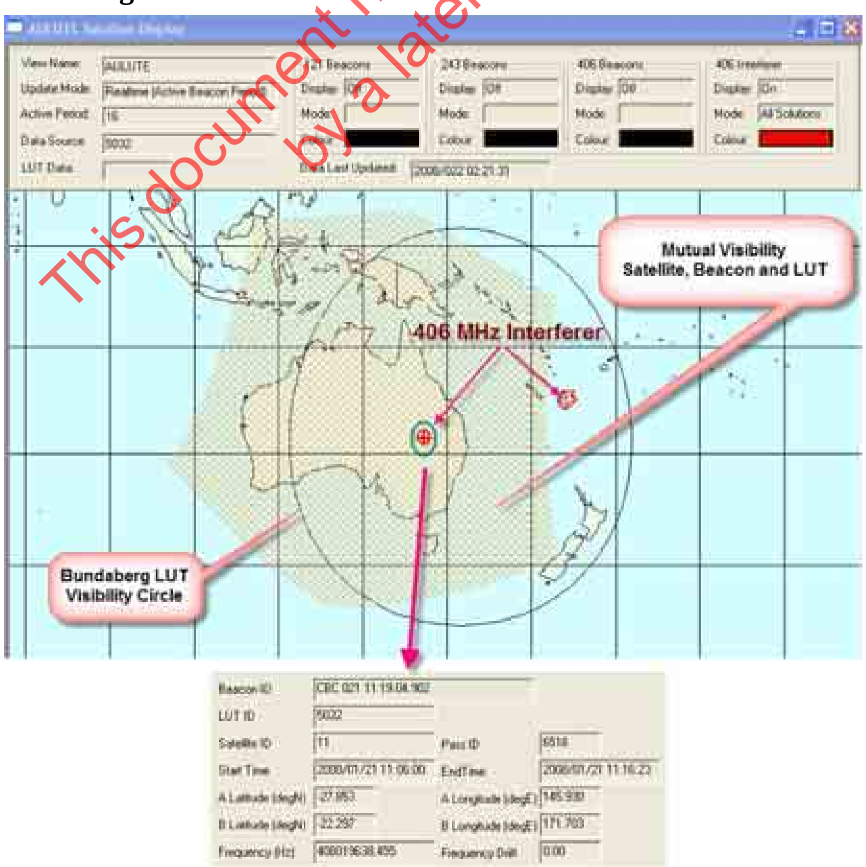


Figure 1.7: 406 MHz Interferer Location Information



1.8 Direction Finding on 406 MHz Beacons

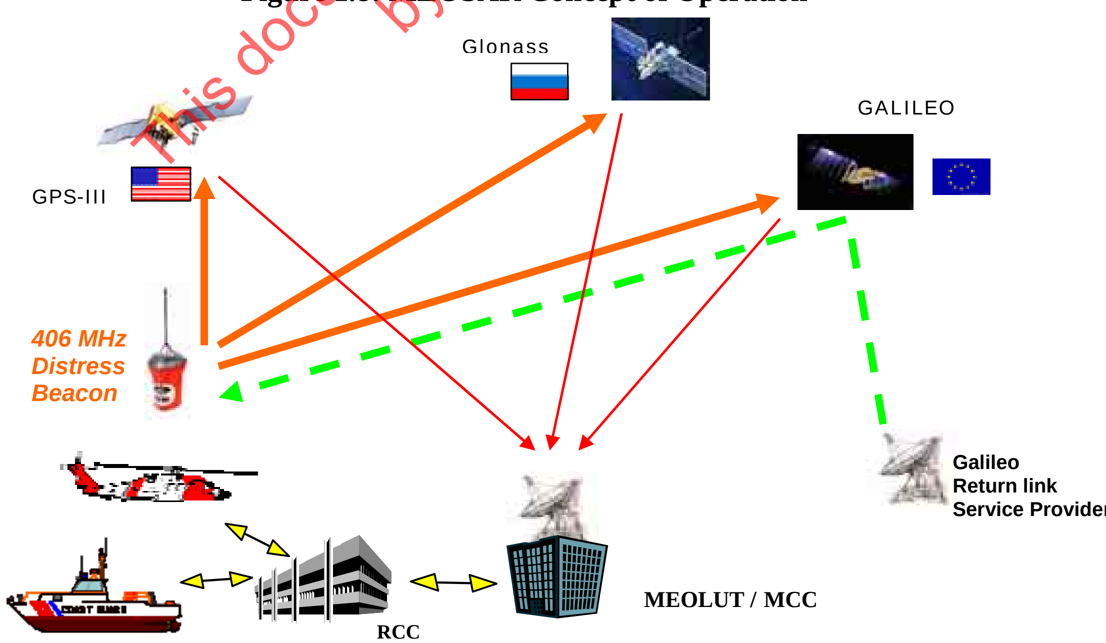
Most 406 MHz beacons transmit on 121.5 MHz for direction finding (DF) purposes by SAR aircraft. However, homing on the 406 MHz burst is also being undertaken by some SAR authorities. The 406 MHz burst transmission on 5 watts is 200 time stronger than the 25 milliwatt sweeping tone transmission on 121.5 MHz. Direction finding on 406 MHz allows the SAR aircraft to accurately track the course to the 406 MHz beacon. The US Coast Guard has reported locking on to 406 MHz beacons by SAR aircraft from 150 nm away at an altitude of 25,000 feet.

1.9 System Development - MEOSAR

The USA, Russia and the European Commission / European Space Agency (EC/ESA) have confirmed their plans to include 406 MHz search and rescue repeater instruments on their respective constellations of medium-altitude Earth orbit (MEO) global navigation satellites (GPS, Glonass and Galileo).

The Cospas-Sarsat MEOSAR system, based upon these constellations will 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 robust beacon-to-satellite communication links. Furthermore, because of 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 to beacon-to-satellite blockages. The system is expected to be operational in the 2016-2017 time-frame.

Figure 1.8: MEOSAR Concept of Operation



1.10 International Beacon Registration Database (IBRD)

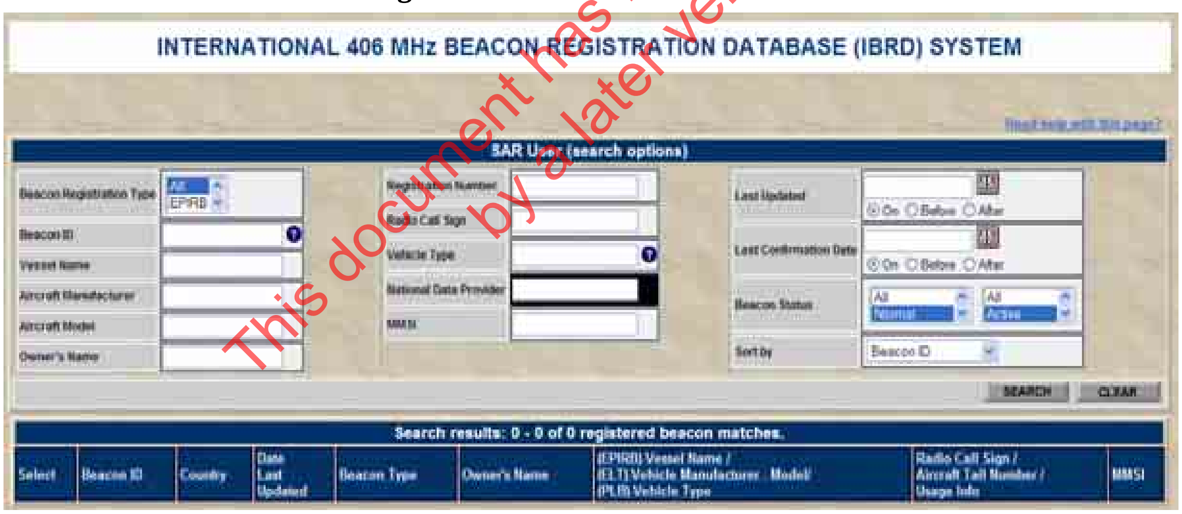
Cospas-Sarsat provides an online facility (www.406registration.com) to allow users to register their beacons and provide information that can be of great use to SAR services in the event of beacon activation. This includes beacon owner contact information, emergency points of contact details, specific aircraft or vessel identification data, the make/model of aircraft or vessel in distress, communication equipment available, and the maximum number of persons that might be onboard.

The IBRD is particularly useful when no established national database is available, or when Administrations cannot provide 24-hour per day, 7-day per week access to their national database. SAR services are able to query the IBRD directly over the Internet, using a password that has been requested by their Administration from the Cospas-Sarsat Secretariat.

More detailed descriptions of various aspects of the IBRD are available in other documents which can be obtained from the Cospas-Sarsat Secretariat or from www.cospas-sarsat.org.

The RCC user interface to search for beacons in the IBRD is provided below:

Figure 1.9: IBRD SAR User Interface



1.11 Non-responsive SPOCs and RCCs

RCCs should be aware that the IMO COMSAR (communications and search and rescue) sub-committee has noted that there are known and documented problems in regards to RCCs initiating SAR action in response to Cospas-Sarsat distress alerts. It was further noted that the Cospas-Sarsat System successfully delivered distress alerts but the RCC did not respond. It was recognised that the fault lay in the SAR response system and not with the delivery of alerts by Cospas-Sarsat MCCs. Given the foregoing the sub-committee indicated that if an RCC was unable to respond then an associated/backup RCC should undertake coordination of the SAR response. The

IMO/ICAO Joint Working Group is considering this matter further. RCCs should advise their support MCC of their associated backup RCC along with the address and contact numbers and if they are operational on a 24/7 basis.

1.12 MCC Communications with RCCs

Cospas-Sarsat MCCs, in the main, deliver distress alerts to RCCs via AFTN (aeronautical fixed telecommunications network) and facsimile. Each message has a unique message number and is sequential. RCCs should ensure that they are no missing messages by checking the sequential numbers and if there are any, then the RCC should request a repeat of the MCC for the message be retransmitted.

Cospas-Sarsat MCCs undertake regular communication checks with the RCCs they support. An MCC might also consider the transmission of regular operational alerts to an RCC to not warrant a communications check. The IMO COMSAR sub-committee indicated that RCCs should positively acknowledge receipt of distress alerts. This is in addition to any integral communications system acknowledgement in place like the AFTN distress priority SS message acknowledgement.

1.13 Conduct of Beacon Tests

On occasions the RCC may wish to conduct 406 MHz beacon tests for SAR training purposes or on behalf of others, e.g. a beacon owner or supplier.

Activating a beacon for reasons other than to indicate a distress situation or without the prior authorisation from a Cospas-Sarsat MCC is considered an offence in many countries of the world, and could result in prosecution.

406 MHz beacons are designed with a self-test capability for evaluating key performance characteristics. Initiating the beacon self-test function will not generate a distress alert in the Cospas-Sarsat System. However, it will use some of the beacon's limited battery power, and should only be used in accordance with the beacon manufacturer's guidance.

If a beacon is inadvertently activated in its operational mode the RCC should contact its associated Cospas-Sarsat MCC as soon as possible. The contact details for Cospas-Sarsat MCCs throughout the world are provided in Annex B.

In rare circumstances there may be a need to activate a 406 MHz beacon in its operational mode for test or training purposes. Regardless of the beacon's location or the duration of activation, a 406 MHz beacon would be detected by at least one GEOLUT and it might also be detected by every LEOLUT in the System. The resulting distress alert message would be routed to every MCC in the Cospas-Sarsat System. Consequently, a great deal of coordination is required to ensure that all MCCs throughout the world are aware of test transmissions from beacons in their operational mode and that they have programmed their equipment to respond accordingly.

Requests to conduct a live beacon test should be directed to the Cospas-Sarsat Mission Control Centre that services the location in which the test is planned. When making a request the following information should be provided:

- Objective of the test;
- Description of the test;
- Location of the test;
- Date, time and duration of the test;
- Beacon HEX ID (15 hexadecimal characters); and
- Point of contact for the test.

Some countries provide specific guidance on the conduct of beacon testing and make the information available on web sites. One such web site is at: http://beacons.amsa.gov.au/Maintenance/Testing.asp

1.14 RCC Course on Cospas-Sarsat

Cospas-Sarsat has developed a model course for MCC operators and this course can be adapted for RCC personnel. Typically such a course will include Cospas-Sarsat data distribution procedures, message formats, beacon coding and communications. More information is provided in Annex D.

Under the auspices of the United Nations Programme on Space Applications, the Office for Outer Space Affairs (UN/OOSA), some MCCs have jointly organised five-day training courses on "Satellite-Aided Search and Rescue for RCCs and SPOCs" within the MCC service area. These courses have been held in Australia, India, South Africa, Spain and the USA in recent years.

- END OF SECTION 1 -

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2. COSPAS-SARSAT DATA DISTRIBUTION PRINCIPLES

2.1 The Cospas-Sarsat Data Distribution Plan

Cospas-Sarsat alert data generated by LEOLUTs, (which can detect beacons locally in near real-time, or globally, from recorded data) or by GEOLUTs (which detect beacons in real-time) have to be distributed to the appropriate RCC, according to the position of the distress or the country code. Due to the high degree of redundancy in the Cospas-Sarsat Ground Segment (each operational LEOLUT is capable of providing essentially the same data in the global mode of operation, likewise each operational GEOLUT pointing to a geostationary satellite provides the same alert data), such distribution must be co-ordinated and redundant data filtered out of the ground communication network.

Each LUT is linked to an associated MCC and alert messages are forwarded to the appropriate RCC through the MCC communication network, in accordance with the procedures described in the Cospas-Sarsat Data Distribution Plan (document C/S A.001).

2.2 MCC Data Distribution Regions and MCC Service Areas

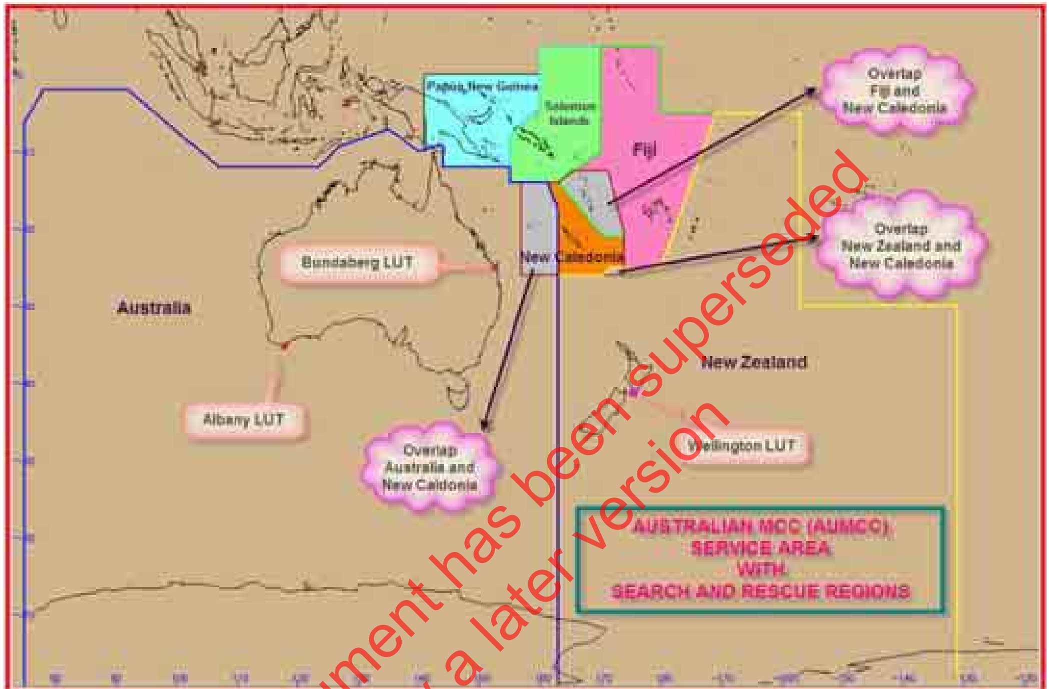
An MCC service area is that part of the world within which a Cospas-Sarsat alert data distribution service is provided by that MCC. An MCC service area is defined by the list of SAR Point of Contacts. SPOCs are RCCs or other recognised national points of contact that will use the distress alert data to enable fast and effective rescue of persons in distress. The MCC service area will usually include the search and rescue regions (SRRs) of the RCCs. SRRs are defined and coordinated internationally by ICAO and IMO and assigned to the aeronautical, maritime or Joint RCCs established by Administrations.

Each Cospas-Sarsat MCC will establish appropriate arrangements with all the countries/SPOCs in their service area on communication links to be used for the distribution of alert data. If such arrangements have not been made for a particular country in the MCC service area, the MCC will notify its own national SAR authority of any Cospas-Sarsat alert in that country's SRR, for handling in accordance with national SAR procedures.

MCC Service Areas, in the form of a list of SPOCs associated with each MCC, are described in the Cospas-Sarsat Data Distribution Plan, document C/S A.001. When a Cospas-Sarsat beacon transmission is located outside the Service Area of the MCC which receives the alert, the alert message is either forwarded to the MCC serving the area where the distress has been located, or is filtered out (if the alert data has already been received through another LUT/MCC).

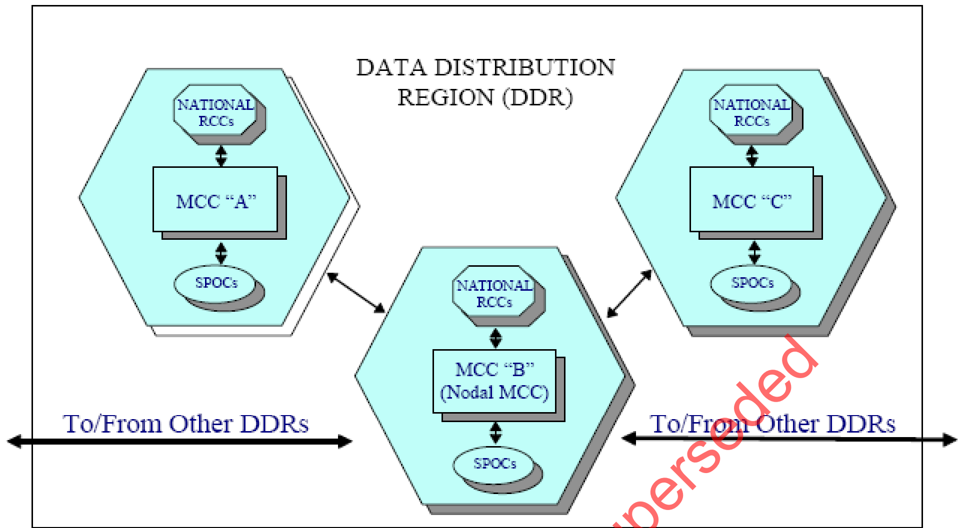
As an example, the Australian MCC (AUMCC) service area supports 20 SPOCs within six SRRs, Australia, Fiji, New Caledonia, New Zealand, Papua New Guinea and Solomon Islands and this is depicted in Figure 2.1 below.

Figure 2.1: Australian MCC Service Area and Search and Rescue Regions



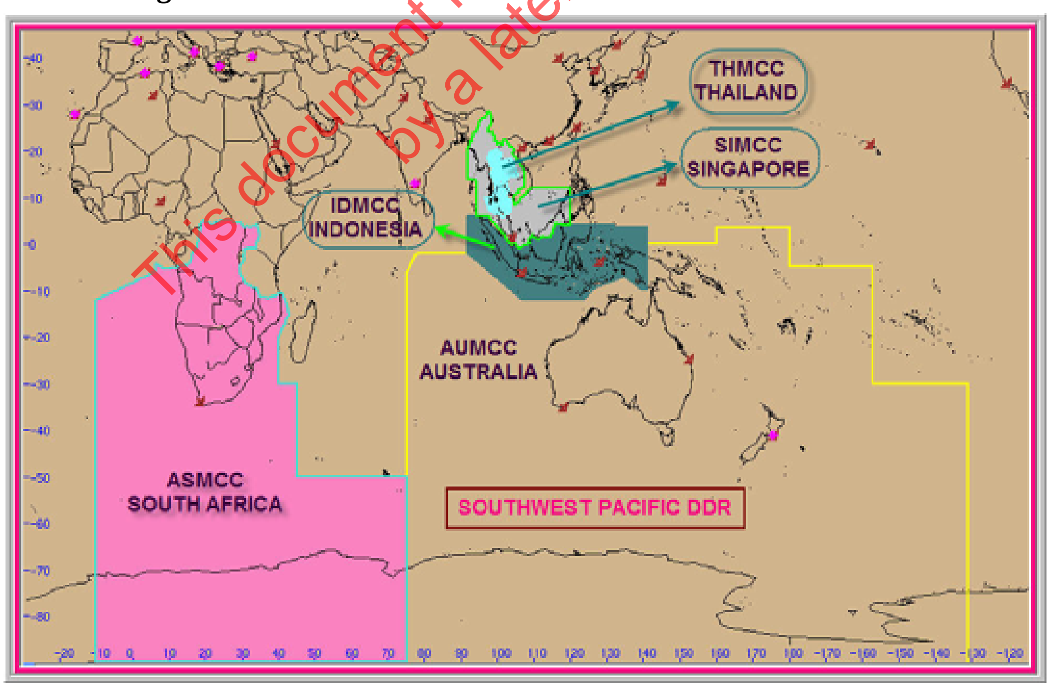
To further improve the distribution of operational information amongst a growing number of Cospas-Sarsat MCCs, MCC service areas have been regrouped to a small number of data distribution regions (DDRs). One MCC in each region, acting as a node in the communication network, takes responsibility for the exchange of data between the DDRs. Figure 2.2 illustrates the flow of alert messages in the Cospas-Sarsat MCC network.

Figure 2.2: Simplified Flow Diagram of Cospas-Sarsat Distress Alert Data



The world is divided into six DDRs and an example of the South West Pacific DDR is depicted below.

Figure 2.3: South West Pacific DDR with MCC Service Areas



Annex C provides a complete list of the six DDRs and identifies all the countries supported by each MCC. An RCC should approach the MCC that supports that country in the first instance to seek assistance on any Cospas-Sarsat distress alert or to establish further information.

- END OF SECTION 2 -

3. COSPAS-SARSAT BEACON CODING

3.1 Characteristics of a 406 MHz Beacon

The basic characteristics of 406 MHz beacons are:

- Transmission of a 5 watt radio frequency burst of approximately 0.5 seconds duration, every 50 seconds;
- stable carrier frequency;
- high peak power to increase probability of detection;
- frequency stability to assure accurate location;
- phase-modulated pulse with a digital message;
- low duty cycle to provide a multiple-access capability of more than 90 beacons simultaneously operating in view of a polar orbiting satellite; and
- low mean power consumption with at least a 24 hour operating lifetime at minimum temperature.

An important feature of 406 MHz emergency beacons is that the digitally encoded message provides such information as the country of beacon registration and the identification of the vessel or aircraft in distress, and optionally, position data derived from internal or external navigation receivers.

An auxiliary transmitter (homing transmitter) operating at 121.5 MHz can be included in the 406 MHz beacon to enable suitably-equipped SAR forces to home on the distress beacon. Alternatively, some SAR services have the capability to home on the 406 MHz signal.

Beacons can be activated either manually or automatically by immersion or shock.

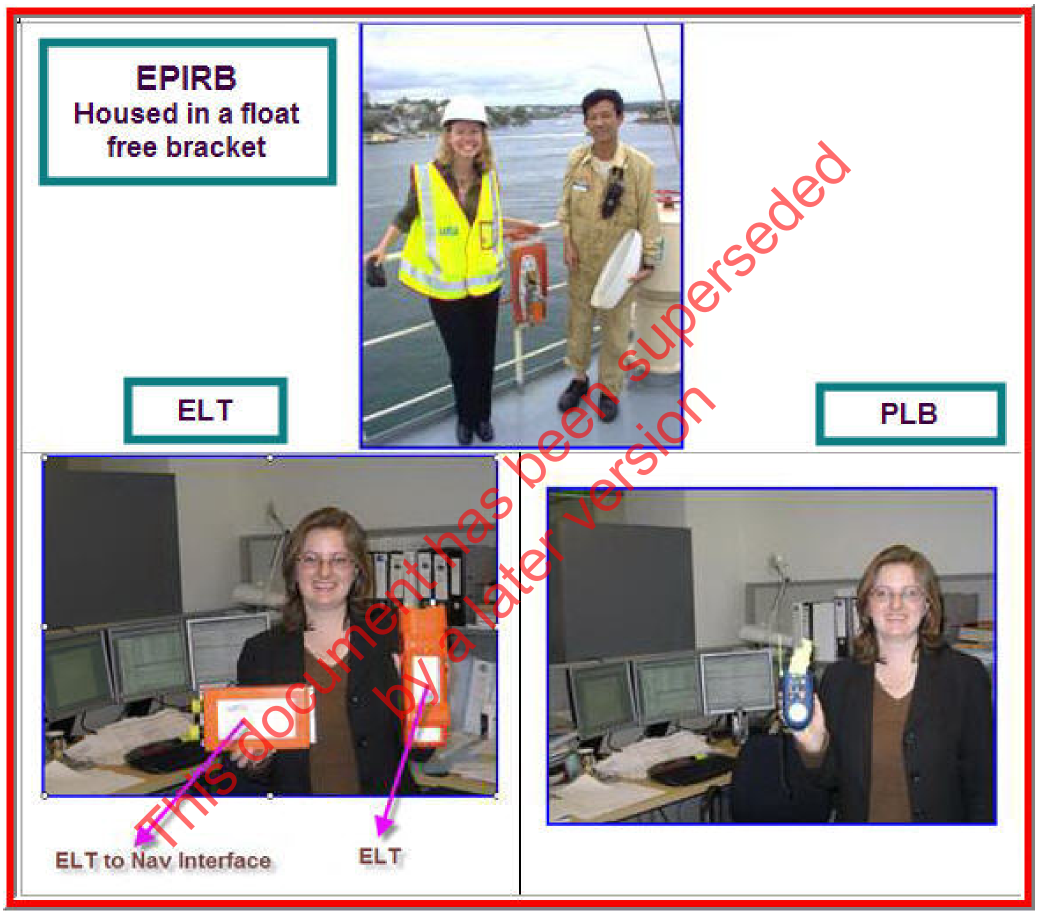
International regulations applicable to 406 MHz beacons are documented in section 6 of document C/S S.007 and include performance standards for 406 MHz beacons, guidelines to avoid false alerts, maintenance and testing, etc.

3.2 Beacon Types

The Cospas-Sarsat System provides alerting services for the following types of beacons:

- Emergency Locator Transmitters (ELTs) for aviation use;
- Emergency Position-Indicating Radio Beacon (EPIRBs) for maritime use; and
- Personal Locator Beacons (PLBs) for applications which are neither aviation or maritime.

Figure 3.1: Beacon Types



Cospas-Sarsat also provides alerting services for Ship Security Alert System (SSAS) and EPIRBs associated with Simplified Voyage Data Recorders (S-VDRs). These beacon types are carried under the IMO's Safety of Life at Sea (SOLAS) Convention. Distress alerts from EPIRBs associated with an S-VDR are distributed as normal distress alerts and can only be identified through a beacon registration database.

The distribution of SSAS alerts within the Cospas-Sarsat Ground Segment uses a modified version of the standard data distribution procedure and distributes the SSAS alert only to the MCC which services the flag of the vessel. The ship security alert is then distributed to a single point of contact identified by the Flag State as its "competent authority", per the SOLAS Convention, Chapter XI-2, Regulation 6.2.1.

Figure 3.2: Other Beacon Types

3.3 Beacon Coding

Beacon coding is best explained in a classroom environment and as indicated in section 1.14, courses can be provided by MCCs for the RCCs that they support. Knowledge of beacon coding will facilitate a comprehensive understanding of the Cospas-Sarsat distress alert message.

Beacon messages are comprised of a message preamble which is the combination of the 160 ms of unmodulated carrier, the bit synchronization pattern and the frame synchronization pattern. In addition, various other data fields which provide unique beacon identification and, depending upon the protocol used, other information that would be useful to search and rescue authorities can be included in the digital beacon message.

Beacons are coded using specialised computer PC software and a light pen. A typical coding implementation scheme is provided in Figure 3.3 below.

Figure 3.3: Coding the Beacon

Cospas-Sarsat has developed two major categories of beacon message protocols, User protocols, and Location protocols. User protocols, are short messages and consist of 112 bits of data and include the beacon identification and other important SAR information, but do not allow for encoding beacon position data. Location protocols are long messages and consist of 144 bits of data and include encoded beacon position data as well as beacon identification data.

LUTs are capable of error detection and correction of the beacon digital transmission using some special bits in the digital message set aside for this purpose in the beacon transmission. These special bits are referred to as the BCH code. BCH codes were invented in 1959 by Hocquenghem, and independently in 1960 by Bose and Ray-Chaudhuri. The acronym BCH comprises the initials of these inventors' names.

However, there are some bits which are not protected and are dependant upon the protocol used. Figure 3.4, Fields of the Short Message Format, shows that bits 107 – 112 are not protected. LUTs have a finite capability to detect and correct errors in the beacon digital transmission. If residual errors are detected in the beacon message then all coded information is treated as invalid and the message will be distributed solely based on Doppler location.

Figure 3.4: Fields of the Short Message Format

	Bit Synch	Frame Synch	First Protected Data Field				BCH-1	Non-Protected Data Field
Unmodulated Carrier (160ms)	Bit Synch Pattern	Frame Synch Pattern	Format Flag	Protocol Flag	Country Code	Identification or Identification plus Position Data	21-BIT BCH Code	Emergency Code or National Use
	Bits 1 - 15	Bits 16 - 24	Bit 25	Bit 26	Bits 27 - 36	Bits 37 - 85	Bits 86 - 106	Bits 107 - 112
	15 Bits	9 Bits	1 Bit	1 Bit	10 Bits	49 Bits	21 Bits	6 Bits

Note: Bits 107 to 112 are not protected and the information contained within these bits should be treated with caution as error detection and correction will not be applied to these bits. This information includes the emergency code, activation type and nature of distress as provided in an alert message.

Figure 3.5: Fields of the Long Message Format

	Bit Synch	Frame Synch	First Protected Data Field				BCH-1	Second Protected Data Field	BCH-2
Unmodulated Carrier (160ms)	Bit Synch Pattern	Frame Synch Pattern	Format Flag	Protocol Flag	Country Code	Identification or Identification plus Position Data	21-BIT BCH Code	Supplementary and Position or National Use Data	12-BIT BCH Code
	Bits 1 - 15	Bits 16 - 24	Bit 25	Bit 26	Bits 27 - 36	Bits 37 - 85	Bits 86 - 106	Bits 107 - 132	Bits 133 - 144
	15 Bits	9 Bits	1 Bit	1 Bit	10 Bits	49 Bits	21 Bits	26 Bits	12 Bits

Note: On occasion, due a number of factors, including the processing capability of the LUTs, long beacon message will be truncated at bit 112, i.e. bits 113 to 144 will be set to default values. As a consequence, the information provided in bits 107 to112 will need to be treated with caution as error detection and correction will not be applied to these bits. This information includes the encoded position data source and homing as provided in an alert message.

More detailed information on beacon coding can be obtained from Cospas-Sarsat document C/S T.001 "Specification for Cospas-Sarsat 406 MHz Distress Beacons" available from the Cospas-Sarsat website at http://www.cospas-sarsat.org.

3.3.1 User Protocols

User protocols (short message) support the following user types:

- EPIRB Maritime User Protocol (Radio Callsign or MMSI)
- EPIRB Radio Callsign User Protocol
- Aviation User Protocol (Aircraft Registration Marking)
- Serial User Protocols which include:
    - ELT with beacon serial number
    - ELT with aircraft operator and a serial number
    - ELT with aircraft 24-bit address
    - EPIRB (float free or non-float free) with serial identification
    - PLB with serial identification

3.3.2 Location Protocols

- User Location (long message) Protocol
    - EPIRB Maritime User Protocol (Radio Callsign or MMSI)
    - EPIRB Radio Callsign User Protocol
    - Aviation User Protocol (Aircraft Registration Marking)
    - Serial User Protocols which include –
        - ELT with beacon serial number
        - ELT with aircraft operator and a serial number
        - ELT with aircraft 24-bit address
        - EPIRB (float free or non-float free) with serial identification
        - PLB with serial identification

- Standard Location (long message) Protocol
    - Ship Security with MMSI
    - ELT with aircraft 24-bit address
    - EPIRB with MMSI
    - Serial Protocols which include
        - ELT with aircraft operator designator and a serial number
        - ELT with beacon serial number
        - EPIRB with serial identification
        - PLB with serial identification

- National Location (long message) Protocol
    - ELT with beacon serial number
    - EPIRB with serial identification
    - PLB with serial identification

The ICAO 24-bit aircraft address is allocated to States to uniquely identify aircraft worldwide. The Appendix to Chapter 9 of the ICAO Annex 10, Aeronautical Communications document provides the worldwide scheme for the allocation, assignment and application of aircraft addresses. The 24-bit address is presented as six hexadecimal characters in the Cospas-Sarsat distress alert message.

Aircraft operator designators are provided in the ICAO airline designators document published as ICAO document 8585 – Designators for Aircraft Operating Agencies, Aeronautical Authorities and Services. These designators are 3-letter codes like BAW for British Airways or QFA for QANTAS.

The maritime mobile service identity (MMSI) consists of a 9-digit code as follows:

$M_1I_2D_3X_4X_5X_6X_7X_8X_9$ wherein the $M_1I_2D_3$ represents the maritime identification digits (MID) and X is any integer from 0 to 9. The MID can be obtained from the International Telecommunication Union (ITU) web site: http://www.itu.int/cgi-bin/htsh/glad/cga_mids.sh?lng=E

In a Cospas-Sarsat alert the MMSI is provided in two parts, the MID and the last six digits of the MMSI.

The Radio callsign allocations can be obtained from the ITU website: http://www.itu.int/cgi-bin/htsh/glad/cga_callsign.sh?lng=E

3.4 Hexadecimal Identity of a 406 MHz Beacon

406 MHz beacons are identified by the content of the message that they transmit. Within the Cospas-Sarsat System beacon message content is identified using the hexadecimal representation of the binary bits encoded in the beacon, and presented in a 15 hexadecimal character representation.

All 406 MHz beacons, regardless of message format (i.e. long or short) or protocol, should be coded so that the combination of bits 26 through 85 is unique. For beacons coded with the Standard Location or National Location protocols, the 15 hexadecimal identification is calculated assuming the position bits in the first protected field of the message are set to their default values as specified in the Cospas-Sarsat 406 MHz beacon specification.

The 15 hexadecimal character representation is the beacon identification commonly used in referring to a beacon, and is used operationally as the identification in Cospas-Sarsat distress alert messages sent to SAR services.

An example of the HEX ID ADCD0228C500401 is provided below:

Figure 3.6: Hexadecimal Identification of a Beacon

A	D	C	D	0	2	2	8	C	5	0	0	4	0	1
1010	1101	1100	1101	0000	0010	0010	1000	1100	0101	0000	0000	0100	0000	0001

15 Hex identifier decode for : ADCD0228C500401

FIELD: Description	BITS	VALUE
Protocol : User	26	1
Country code : 366 <USA>	27-36	0101101110
Protocol type : Serial	37-39	011
Serial beacon type : Float Free EPIRB	40-42	010
Certificate flag: No	43	0
Serial number : 0035377	44-63	00001000101000110001
First national use field : 100	64-73	0100000000
Second national use field : 100	74-83	0100000000
Auxiliary radio device : 121.5 MHz	84-85	01

- END OF SECTION 3 -

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4. COSPAS-SARSAT DISTRESS MESSAGES

Cospas-Sarsat messages are categorized into Subject Indicator Types (SITs). The SIT specifies the format and category of content within the message. SIT messages exchanged between MCCs are processed automatically with little or no operator involvement. However, SIT messages transmitted to RCCs/SPOCs by MCCs may have some operator involvement, which can include a human check or value added information input by an operator. Messages transmitted to RCCs and SPOCs are termed SIT 185 messages and all have a standard 16 paragraph format.

The set of International Alphabet No. 5 characters that have an equivalent ITA2 character is the set of allowable characters in a Cospas-Sarsat distress alert message. RCCs should be aware that there are limitations on the use of characters and only uppercase alpha characters, figures and some other characters, like the hyphen [-], question mark [?], colon [:], octothorpe [#], parentheses [( )], period [.], comma [,], equal [=] and plus [+] signs, are allowed. Further limitations are also imposed by the communications mode used, e.g. AFTN (Aeronautical Fixed Telecommunications Network).

A SIT 185 supports many message types and is discussed further in section 4.2.

A 406 MHz initial alert with Doppler location, exchanged between two MCCs, would typically be in the form:

```
/12590 00000/5030/08 008 0401
/125/5030/010/01
/5121/-9/+02983.9 002.3 +00.00/08 008 0354 56.60/0
/9/13.803/0000/09
/6007A14ABC00160E90824000000000
/+503/-41.234/+172.516/337 000.7 000.6/79/08 008 0409/3/002.5 000.6
/+503/-48.334/+135.857/325 002.8 001.4/21/08 008 0547/1/008.1 004.6
/LASSIT
/ENDMSG
```

The equivalent SIT 185 in a plain text format will be of the form:

080401Z JAN 08
FROM AUMCC
TO RCC WELLINGTON
BT
1. DISTRESS COSPAS-SARSAT INITIAL ALERT
2. MSG NO: 12590 AUMCC REF: C00F429578002C1
3. DETECTED AT: 08 JAN 08 0354 UTC BY SARSAT S10
4. DETECTION FREQUENCY: 406.0280 MHZ
5. COUNTRY OF BEACON REGISTRATION: 512/ NEWZEALAND
6. USER CLASS:
SERIAL USER
PLB - SERIAL NO: 0042334
7. EMERGENCY CODE: NIL
8. POSITIONS:
RESOLVED - NIL
DOPPLER A - 41 14 S 172 31 E PROBABILITY 79 PERCENT
DOPPLER B - 48 20 S 135 51 E PROBABILITY 21 PERCENT
ENCODED - NIL
9. ENCODED POSITION PROVIDED BY: NIL
10. NEXT PASS TIMES:
RESOLVED - NIL
DOPPLER A - 08 JAN 08 0409 UTC WELLINGTON LUT NEW ZEALAND
DOPPLER B - 08 JAN 08 0547 UTC ALBANY LUT AUSTRALIA
ENCODED - NIL
11. HEX ID: C00F429578002C1 HOMING SIGNAL: 121.5 MHZ
12. ACTIVATION TYPE: MANUAL
13. BEACON NUMBER ON AIRCRAFT OR VESSEL NO: NIL
14. OTHER ENCODED INFORMATION:
CSTA CERTIFICATE NO: 0176
BEACON MODEL - STANDARD COMMS, AUSTRALIA: MT410, MT410G
15. OPERATIONAL INFORMATION:
LUT ID: WELLINGTON, NEW ZEALAND
16. REMARKS: NIL
END OF MESSAGE

4.1 Message Fields

A Cospas-Sarsat distress alert message consists of 16 paragraphs made up of various message fields (MFs). Each distress alert message will include a preamble that includes the time of transmission in UTC, originating MCC and recipient (RCC/SPOC). When information with respect to a message field is not available, or is unknown or irrelevant, dependant upon the message type and beacon protocol, the distress message will indicate “NIL” against that paragraph.

The message fields and their location within the 16 paragraph are provided in Table 4.1 below. This information is provided to inform RCCs of the basis on which the Cospas-Sarsat distress alert messages were developed. RCCs may wish to quote the specific message field number to an MCC when undertaking any enquiries on a distress alert message.

Table 4.1: Message Content for SIT 185 Messages

Cospas-Sarsat MF#	PARAGRAPH #	TITLE
45	1.	MESSAGE TYPE
46	2.	CURRENT MESSAGE NUMBER
47	2.	MCC REFERENCE
48	3.	DETECTION TIME & SPACECRAFT ID
49	4.	DETECTION FREQUENCY
50	5.	COUNTRY OF BEACON REGISTRATION
51	6.	USER CLASS OF BEACON
52	6.	IDENTIFICATION
53	7.	EMERGENCY CODE
54	8.	POSITIONS
54a	8.	RESOLVED POSITION
54b	8.	A POSITION & PROBABILITY
54c	8.	B POSITION & PROBABILITY
54d	8.	ENCODED POSITION AND TIME OF UPDATE
55	9	SOURCE OF ENCODED POSITION DATA
56	10.	NEXT PASS TIMES
56a	10.	NEXT TIME OF VISIBILITY OF RESOLVED POSITION
56b	10.	NEXT TIME OF VISIBILITY A POSITION
56c	10.	NEXT TIME OF VISIBILITY B POSITION
56d	10.	NEXT TIME OF VISIBILITY OF ENCODED POSITION
57	11.	BEACON HEX ID & HOMING SIGNAL
58	12.	ACTIVATION TYPE
59	13.	BEACON NUMBER
60	14.	OTHER ENCODED INFORMATION
61	15.	OPERATIONAL INFORMATION
62	16.	REMARKS
63	END OF MESSAGE	

Figure 4.1: Distress Alert Message and Corresponding Message Fields

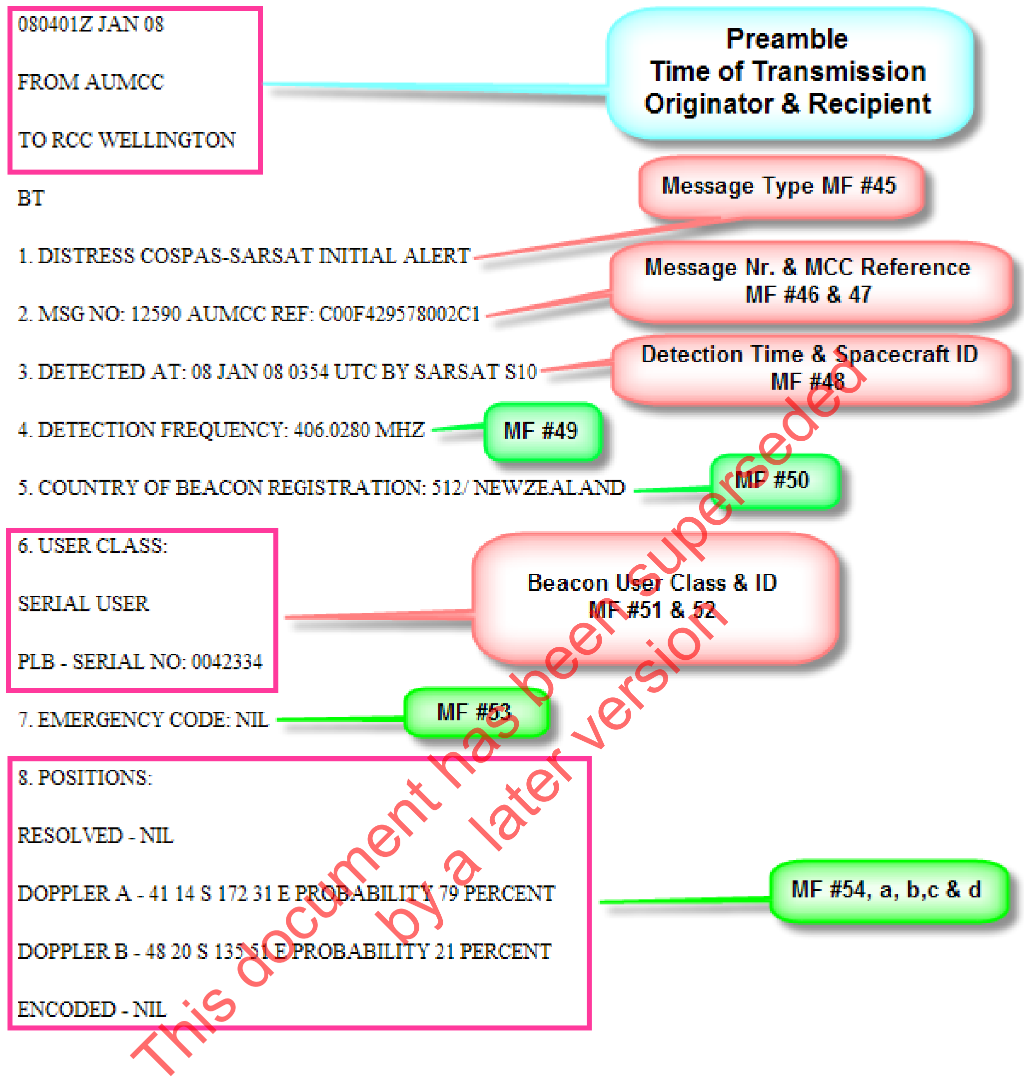

Figure 4.1: Distress Alert Message and Corresponding Message Fields (cont.)

4.2 Message Field Definitions

MF #45 Message Type (Paragraph 1)

Each message type begins with “DISTRESS COSPAS-SARSAT …”. However for a ship security alert, the message type begins with “SHIP SECURITY COSPAS-SARSAT …”

Types of distress alert message include the following and the titles are intended to be self explanatory:

- DISTRESS COSPAS-SARSAT INITIAL ALERT
- DISTRESS COSPAS-SARSAT POSITION CONFLICT ALERT
- DISTRESS COSPAS-SARSAT POSITION RESOLVED ALERT
- DISTRESS COSPAS-SARSAT POSITION RESOLVED UPDATE ALERT
- DISTRESS COSPAS-SARSAT INVALID ALERT
- DISTRESS COSPAS-SARSAT NOTIFICATION OF COUNTRY OF BEACON REGISTRATION ALERT
- SHIP SECURITY COSPAS-SARSAT INITIAL ALERT
- SHIP SECURITY COSPAS-SARSAT POSITION CONFLICT ALERT
- SHIP SECURITY COSPAS-SARSAT POSITION RESOLVED ALERT
- SHIP SECURITY COSPAS-SARSAT POSITION RESOLVED UPDATE ALERT

Real world examples are provided in section 6.

Position Resolved Alert (See example 6.a (iv))

A resolved Doppler position alert is possible after two detections of the same beacon with different TCAs and/or satellites provide locations within 50 km of each other. The resolved position is biased to the Doppler position with the smaller error.

A resolved distress alert is also possible when one of the Doppler locations is within 50 km of an encoded location provided by an internal or external GNSS device.

Position Conflict Alert (See example 6.b (ii))

If the matched positions (Doppler to Doppler or Doppler to encoded) are greater than 50 km apart a conflict alert will be transmitted. If two encoded positions are matched and are greater than 3 km apart, a conflict encoded position alert will be transmitted. Conflict alerts are only applicable prior to ambiguity in Doppler locations being resolved.

A conflict alert will also be transmitted for the same beacon event (SBE), that is when the same beacon has been detected by the same satellite with the same detection time (± 20 minutes) and the Doppler positions are more than 50 km apart. However, for this detection to be transmitted, the second alert must be of better quality as identified by some technical parameters. RCCs should not be confused when receiving conflict alerts for the same beacon event as the most recent alert is evaluated as being of better quality.

Invalid Alerts (See example 6.e)

When the LUT is unable to detect and correct all the errors in the beacon message the Doppler locations are the only information that can be used in the alert. When using decoding tools on the 15 HEX ID of an invalid alert the output will give erroneous results. The 15 HEX ID from example 6.e is decoded below and the decode program will indicate a valid country (Sweden) and other information. However in the alert transmitted to the RCC/SPOC it will indicate "NIL" for these fields.

```
xxxMCC $ decode 2148D00801490AE

15 Hex identifier decode for : 2148D00801490AE

FIELD: Description                        |  BITS   | VALUE
--------------------------------------------------------------------
Protocol : Location                       | 26      | 0
Country code : 266 <SWEDEN>               | 27-36   | 0100001010
Standard protocol : ELT - serial          | 37-40   | 0100
Certificate number : 0416                 | 41-50   | 0110100000
Serial number : 01024                     | 51-64   | 00010000000000
North/South Flag : S                      | 65      | 1
Latitude degrees : 36                     | 66-74   | 010010010
         minutes : 30                     | 66-74   |
East/West Flag : E                        | 75      | 0
Longitude degrees : 43                    | 76-85   | 0010101110
          minutes : 30                    | 76-85   |
```

Notification of Country of Beacon Registration (Example 6.g)

A notification of country of beacon registration (NOCR) alert is transmitted by an MCC in whose service area the beacon is located. For example, a Swedish country code beacon is located in the Australian MCC service area. The Australian MCC will send an alert message to the French MCC for forwarding to the Norwegian MCC and then to the Swedish RCC in accordance with standard Cospas-Sarsat message distribution procedures documented in the DDP (C/S A.001).

MF #46 Current Message Number (Paragraph 2)

This is a sequential message number assigned to each message by the transmitting MCC. RCCs should ensure that they have no missing message numbers.

MF #47 MCC Reference (Paragraph 2)

This reference is a unique designator supplied by the MCC to identify all messages sent for that beacon. Some MCCs use an integer and other MCCs use the beacon 15 HEX ID for this message field.

RCCs wishing to discuss a particular alert with an MCC can assist the MCC by quoting the message number and the MCC reference designator of the alert.

MF #48 Detection Time & Spacecraft ID (Paragraph 3)

The detection time is the time of closest approach (TCA) of the satellite to the beacon. The time is followed on the same line by the identity of the satellite which provided the alert data. The LEO satellites are identified as Sarsat and Cospas and the GEO satellites as GOES, MSG and INSAT.

MF #49 Detection Frequency (Paragraph 4)

The frequency is the actual beacon transmit frequency as determined by the LUT and can be in the vicinity of 406.025 MHz, 406.028 MHz and 406.037 MHz. Channel 406.040 MHz is expected to be opened in 2012. Knowledge of the individual frequencies may assist RCCs when tasking aircraft with a 406 MHz direction finding capability.

MF #50 Country of Beacon Registration (Paragraph 5)

The three digit country code as provided by the International telecommunication Union (ITU) followed by the name of the country where the **beacon is registered**.

The three digit country code can be obtained from the ITU web site at:
http://www.itu.int/cgi-bin/htsh/glad/cga_mids.sh?lng=E

If the beacon message is invalid the MCC will indicate "NIL" for this field.

MF #51 User Class of Beacon (Paragraph 6)

User class information is provided as per the coding protocols given in sub-sections 3.2.1 and 3.2.2. It should be noted that some beacons are coded inappropriately for the environment in which they are used. There have been real world examples of EPIRBs being used like a PLB in the Himalayan Mountains and some PLBs are being coded with an ELT protocol for use on an aircraft.

If the beacon message is invalid the MCC will indicate "NIL" for this field.

MF #52 Identification (Paragraph 6)

The beacon identification information includes:

- Serial number
- Aircraft Operator Designator
- Aircraft 24-Bit address
- Radio Callsign
- MMSI

If the beacon message is invalid the MCC will indicate "NIL" for this field.

MF #53 Emergency Code (Paragraph 7)

A provision exists in the User (short non-location) beacon coding protocol to indicate the nature of distress in accordance with the International Maritime Organisation (IMO) maritime emergency codes. These codes can indicate Fire/Explosion, Flooding, Collision, Grounding, Listing, in danger of capsizing, Sinking, Disabled and Adrift and Unspecified Distress.

A provision also exists in the beacon coding to indicate non-maritime emergencies and these include an indication of a fire, if medical assistance is required and if disabled or not.

This message field is not protected, ie. is not subject to automated error detection and correction. As a consequence the information provided for this message field should be treated with caution.

Currently there are no beacons type approved with this capability and in most cases the Cospas-Sarsat distress alert message will indicate a "NIL" for this message field. However there are known to be some beacons that have been coded by default to indicate "unspecified distress".

If the beacon message is invalid the MCC will indicate "NIL" for this field.

MF #54 Position Information (Paragraph 8)

Position information associated with the A&B Doppler positions, resolved position and the encoded position, as available are provided in the distress message. It should be noted that the time associated with the position is the TCA provided by message field #48 in paragraph 3 of the SIT 185 alerts. RCCs should be aware when plotting positions on a chart that the encoded positions are provided in WGS 84 or GTRF geodetic reference systems. Doppler locations are provided in the Bureau International de l'Heure (BIT) geodetic reference system.

MF #54a Resolved Position
The latitude and longitude of the resolved Doppler position.

MF #54b A Position & Probability
The latitude and longitude of the A Doppler Position and the percentage probability that the A Position is the actual position of the incident.

MF #54c B Position & Probability
Same as MF#54b above but for the B Position.

MF #54d Encoded Position and Time of Update
The latitude and longitude of the encoded position. The accuracy of the encoded position is dependant upon the beacon protocol used. See MF #60 for further details and example 6.b (i)

The time of update will indicate that the encoded position is within 4 hours of the TCA detection time as provided in paragraph 3 of the SIT 185 alert. See example 6.b (i).

If the beacon message is invalid the MCC will indicate “NIL” for this field.

MF #55 Source of Encoded Position Data (Paragraph 9)

This message field indicates whether the encoded position data was provided to the beacon by an internal or external GNSS device.

Subsequent transmissions of the updated position from a beacon with an internal GNSS device shall not occur more frequently than every 20 minutes. A beacon designed to accept position data from an external device, which will provide position input at intervals not longer than 20 minutes for EPIRBs and PLBs and 1 minute for ELTs prior to beacon activation.

If the navigation input fails or is not available the beacon will retain the last valid position for 4 hours after which the encoded position will be set to default values.

If the Standard or National location protocol message format is truncated then this message field should be treated with caution. Truncation will result in an accuracy statement being made in paragraph 14 (MF #60) indicating 4 minutes or 30 minutes of latitude and longitude accuracy.

If the beacon message is invalid the MCC will indicate “NIL” for this field.

MF #56 Next Pass Times (Paragraph 10)

The next pass time is the predicted time at which the next beacon event will be processed for the reported position in real-time by a LUT tracking a LEO satellite. There may be other satellites that will see the beacon prior to the next pass time but that satellite may not be tracked by the LUT.

The next pass times are calculated based on mutual visibility between the reported beacon position, satellite and LUT sufficient to provide accurate Doppler locations. As a consequence, some passes with less than ideal pass geometry may still see the beacon prior to the next pass time stated in the alert message and provide a Doppler location.

MF #56a Next Time of Visibility of Resolved Position

MF #56b Next Time of Visibility A Doppler Position

MF #56c Next Time of Visibility B Doppler Position

MF #56d Next Time of Visibility of Encoded Position

MF #57 Beacon HEX ID & Homing Signal (Paragraph 11)

The HEX ID is the fifteen character hexadecimal representation of a beacon identification code as mentioned in section 3.4.

Homing Signal Interpretation:

a) NIL - no homing transmitter

b) 121.5 - 121.5 MHz ELT/EPIRB signal in addition to 406 MHz

c) 9 GHZ SART - Maritime 9 GHz Search and Rescue Radar Transponder (SART) in addition to 406 MHz

d) OTHER - a nationally assigned signal has been included in the beacon

The User protocol can provide information on one of the four types of homing indicators, however the Standard and National Location protocols can only indicate whether a 121.5 MHz homing capability exists.

MF #58 Activation Type (Paragraph 12)

The type of beacon activation is only available for the non-Location User protocol. It is intended to provide information with respect to the switching mechanism built into the beacon; i.e. some beacons can only be activated manually, and others can be activated automatically or manually. A float-free EPIRB will indicate “automatic or manual” activation in the distress alert message. A non float-free beacon can only be activated manually.

Ship security alert messages always indicate “manual” activation.

This message field is not protected, i.e. is not subject to automated error detection and correction. As a consequence the information provided for this message field should be treated with caution.

If the beacon message is invalid the MCC will indicate “NIL” for this field.

MF #59 Beacon Number (Paragraph 13)

The User protocol allows the coding of multiple beacons using the same radio callsign or MMSI. For the first beacon on board the vessel the message field will be identified as zero (0). Other beacons on board the vessel will be identified as 1 to 9 and A to Z.

A beacon number with zero also indicates that the beacon is float free and thus the associated activation type should be “automatic or manual”.

The Standard Location protocol allows 16 EPIRBs (numbers 0 - 15) to be coded for the same MMSI. The serial user aircraft address protocol allows 64 ELTs (numbers 0-63) to be coded for the same 24-bit address. When only one ELT is coded for a 24-bit address the number is set to “0” (zero).

The aviation user protocol allows 4 ELTs (numbers 0 to 3) to be coded for the same aircraft registration marking.

If the beacon message is invalid the MCC will indicate "NIL" for this field.

MF #60 Other Encoded Information (Paragraph 14)

Other information decoded from the 406 MHz message as determined by the servicing MCC includes information with respect to:

a) Cospas-Sarsat beacon type approval certificate number from which the beacon model and manufacturer can be ascertained;

b) the uncertainty inherent in the encoded position accuracy which maybe plus-minus 4 minutes or 30 minutes of latitude and longitude dependant upon the beacon protocol; and

c) an aircraft 24-bit address country assignment and its registration marking.

MF #61 Operational Information (Paragraph 15)

Operational information is obtained separately from the encoded information provided in the beacon message. The information includes:

a) Doppler position reliability if suspect due to less than ideal satellite pass geometry processing parameters;

b) Doppler position reliability if suspect due to a satellite manoeuvre (when an error greater than 10 km is suspected);

c) identity of the LUT that processed the beacon message;

d) beacon database registry information;

e) determination of the image position prior to Doppler position ambiguity resolution; and

f) if the beacon message is invalid then the warning "data decoded from the beacon message is not reliable" is included.

MF #62 Remarks (Paragraph 16)

Additional information may be provided at the discretion of the originating MCC in this paragraph and may include human value added information.

For ship security alerts, advice will be included that the alert will need to be processed in accordance with relevant security procedures.

MF #63 End of Message

This text is added to the message to give an unambiguous indication to the message recipient that there is no further information.

- END OF SECTION 4 -

5. DISTRESS INCIDENT REPORT OF SAR EVENTS

To assess the effectiveness of the contribution being made by the Cospas-Sarsat System to search and rescue worldwide, information on distress incidents is provided by MCCs. To assist MCCs in this role RCCs and SPOCs are requested to provide feedback to their supporting MCC using the following format:

FORMAT OF DISTRESS INCIDENT REPORT FOR DOCUMENTATION OF SAR EVENTS AND PERSONS RESCUED

a) Type of incident (aviation, maritime, land etc.) and frequency band
Beacon HEX ID code (15 Hex characters)

b) Date of incident

c) Location of incident

d) Identification / type of craft involved

e) Circumstances of distress situation

f) Nature of Cospas-Sarsat alert data:
- only alert
- first alert
- supporting data

g) Number of persons:
- involved ....
- rescued ....

h) The search and/or rescue operation was assisted by Cospas-Sarsat data:
- Yes
- No

i) Other significant information
....
....
....
....

- END OF SECTION 5 -

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6. REAL WORLD EXAMPLES OF DISTRESS ALERTS

A sample of real world Cospas-Sarsat distress alert messages is provided and these are:

a) Beacon HEX ID: BEEE015F3000001
   i. GEOSAR unlocated alert
   ii. LEOSAR unlocated alert
   iii. LEOSAR initial alert
   iv. LEOSAR resolved alert

These four examples show the logical sequence of Cospas-Sarsat distress alerts, commencing with a GEOSAR unlocated alert, then a LEOSAR unlocated alert then an initial alert and finally a resolved alert.

b) Beacon HEX ID: 3467000780FFBFF
   i. LEOSAR encoded position alert
   ii. LEOSAR position conflict alert

These two examples demonstrate the concept of a conflict alert. It illustrates that the alert with the Doppler locations received after the initial encoded alert did not match.

c) Beacon HEX ID: BEEC400A1400261
   i. GEOSAR unlocated alert
   ii. LEOSAR initial alert

These two examples illustrate the concept of image position determination.

d) Beacon HEX ID: 2A5917C900FFBFF
   i. GEOSAR ship security unlocated alert
   ii. LEOSAR ship security initial alert

e) Beacon HEX ID: 2148D00801490AE
   LEOSAR initial alert (invalid beacon message)

f) Beacon HEX ID: B708D35934D34D1
   LEOSAR resolved alert (satellite manoeuvre)

g) Beacon HEX ID: 452C3B8158FFBFF
   LEOSAR NOCR alert

h) 406 MHz Interferer
   LEOSAR 406 MHz interferer initial alert

The above five examples illustrate various alert types with comments in paragraphs 15 and 16 of the alert, such as:

- Ship security;
- Unreliable data in the beacon message; and
- Doppler position suspect due to a satellite manoeuvre.

6.1 Example 6.a (i) – GEOSAR Unlocated Alert

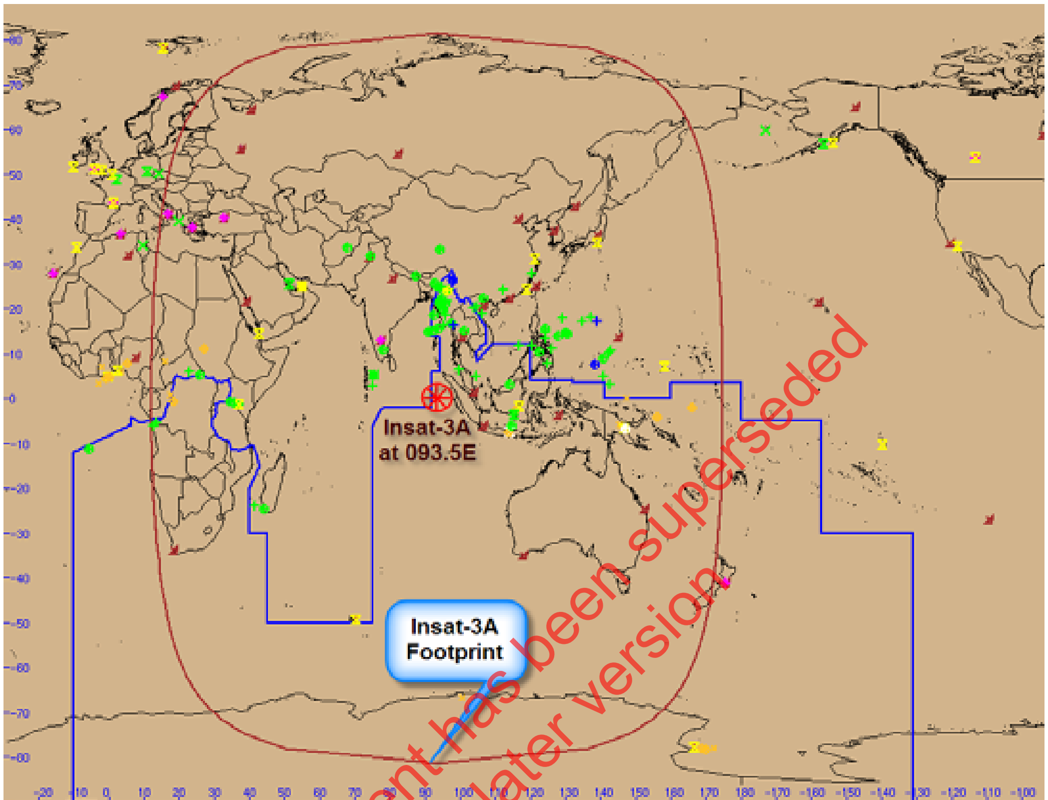
Beacon HEX ID: BEEE015F3000001:

020901Z JAN 08[1]
FM AUMCC
TO RCC AUSTRALIA
BT
1. DISTRESS COSPAS-SARSAT (UNLOCATED) ALERT
2. MSG NO: 12301 AUMCC REF: BEEE015F3000001
3. DETECTED AT: 02 JAN 08 0859 UTC[1] BY INSAT-3A
4. DETECTION FREQUENCY: 406.0286 MHz
5. COUNTRY OF BEACON REGISTRATION: 503/ AUSTRALIA
6. USER CLASS:
SERIAL USER
EPIRB (NON FLOAT FREE) SERIAL NO: 0022476
7. EMERGENCY CODE: NIL
8. POSITIONS:
RESOLVED - NIL
DOPPLER A - NIL
DOPPLER B - NIL
ENCODED - NIL
9. ENCODED POSITION PROVIDED BY: NIL
10. NEXT PASS TIMES:
RESOLVED - NIL
DOPPLER A - NIL
DOPPLER B - NIL
ENCODED - NIL
11. HEX ID: BEEE015F3000001 HOMING SIGNAL: 121.5 MHZ
12. ACTIVATION TYPE: AUTOMATIC OR MANUAL
13. BEACON NUMBER ON AIRCRAFT OR VESSEL NO: NIL
14. OTHER ENCODED INFORMATION: NIL
15. OPERATIONAL INFORMATION:
LUT ID: BANGALORE GEOLUT, INDIA
16. REMARKS: NIL
END OF MESSAGE

Notes:

1. The transmission time of the message and the detection time in paragraph 3 indicates that the GEOSAR system has provided an almost real-time detection.
2. Given this is a serial user beacon with serial number ID, details of the source can only be obtained from a beacon registration database.
3. Information in paragraphs 7 and 12 are not protected, i.e. is not subject to automated error detection and correction, and therefore the information should be treated with caution.
4. The “NIL” entries in respect of the various paragraphs as information for these message fields is not available on account of the beacon protocol and on account that it is a GEOSAR alert.

Figure 6.1: GEOSAR Unlocated Alert



Notes:

1. The beacon is expected to be located within the footprint of the INSAT-3A GEO satellite which is located at 0 Lat 093.5E Long.
2. Beacon registration information may provide further information as to the possible general location of the EPIRB. Given that this is a serial number coding details of the parent vessel can only be determined through a beacon registration database.
3. The satellite footprint is drawn with a zero degree elevation.

6.2 Example 6.a (ii) – LEOSAR Unlocated Alert

Beacon HEX ID: BEEE015F3000001:

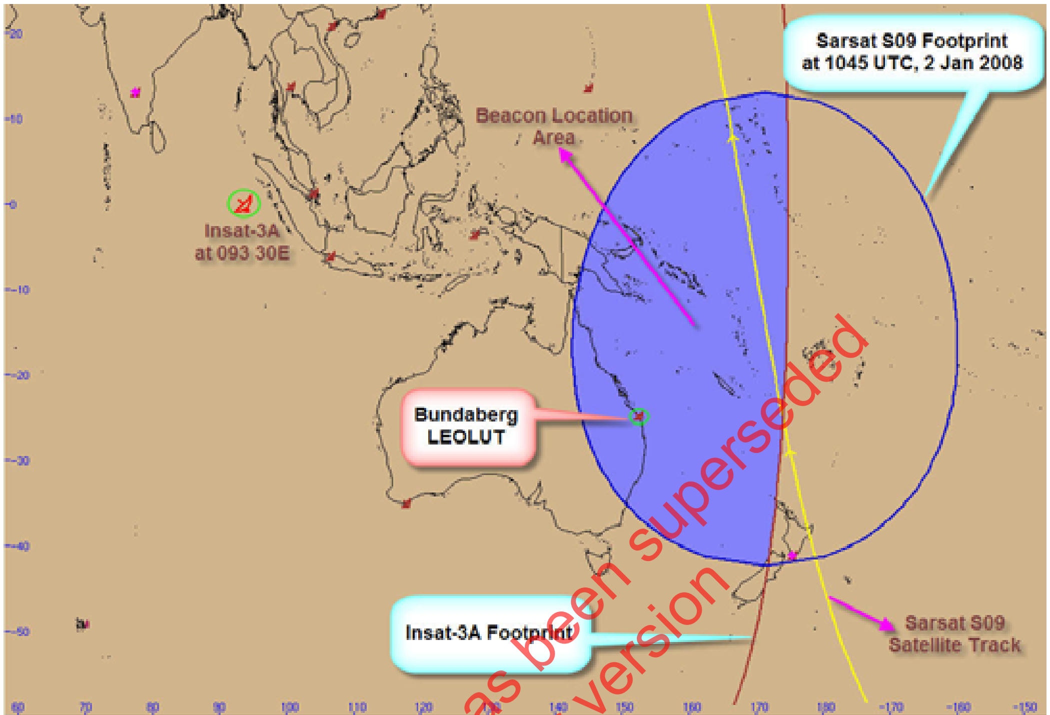
021047Z JAN 08
FM AUMCC
TO RCC AUSTRALIA
BT
1. DISTRESS COSPAS-SARSAT (UNLOCATED) ALERT
2. MSG NO: 12306 AUMCC REF: BEEE015F3000001
3. DETECTED AT: 02 JAN 08 1045 UTC BY SARSAT S09
4. DETECTION FREQUENCY: 406.0298 MHZ
5. COUNTRY OF BEACON REGISTRATION: 503/ AUSTRALIA
6. USER CLASS:
SERIAL USER
EPIRB (NON FLOAT FREE) SERIAL NO: 0022476
7. EMERGENCY CODE: NIL
8. POSITIONS:
RESOLVED - NIL
DOPPLER A - NIL
DOPPLER B - NIL
ENCODED - NIL
9. ENCODED POSITION PROVIDED BY: NIL
10. NEXT PASS TIMES:
RESOLVED - NIL
DOPPLER A - NIL
DOPPLER B - NIL
ENCODED - NIL
11. HEX ID: BEEE015F3000001 HOMING SIGNAL: 121.5 MHZ
12. ACTIVATION TYPE: AUTOMATIC OR MANUAL
13. BEACON NUMBER ON AIRCRAFT OR VESSEL NO: NIL
14. OTHER ENCODED INFORMATION: NIL
15. OPERATIONAL INFORMATION:
LUT ID: BUNDABERG LUT, AUSTRALIA
16. REMARKS: NIL
END OF MESSAGE

Notes:

1. The detection time provided in paragraph 3 is 106 minutes after the GEOSAR detection time given in example 6.a (i).

2. The message number in paragraph 2 is sequential for the particular addressee and the reference number, the 15 HEX ID, will remain constant for all detections transmitted for this beacon. The first alert for this beacon was message nr. 12301 but for the alert above it is 12306, which means that other alerts not relevant to the reference HEX ID were transmitted to RCC Australia during the intervening period.

Figure 6.2: LEOSAR Unlocated Alert



Notes:

1. Overlaying the footprints of the GEO and LEO satellites can provide an indication of the beacon location – this is shown in blue in the above figure. Some MCCs can provide this information on request.

2. The satellite footprint is drawn with a zero degree elevation.

6.3 Example 6.a (iii) – LEOSAR Initial Alert

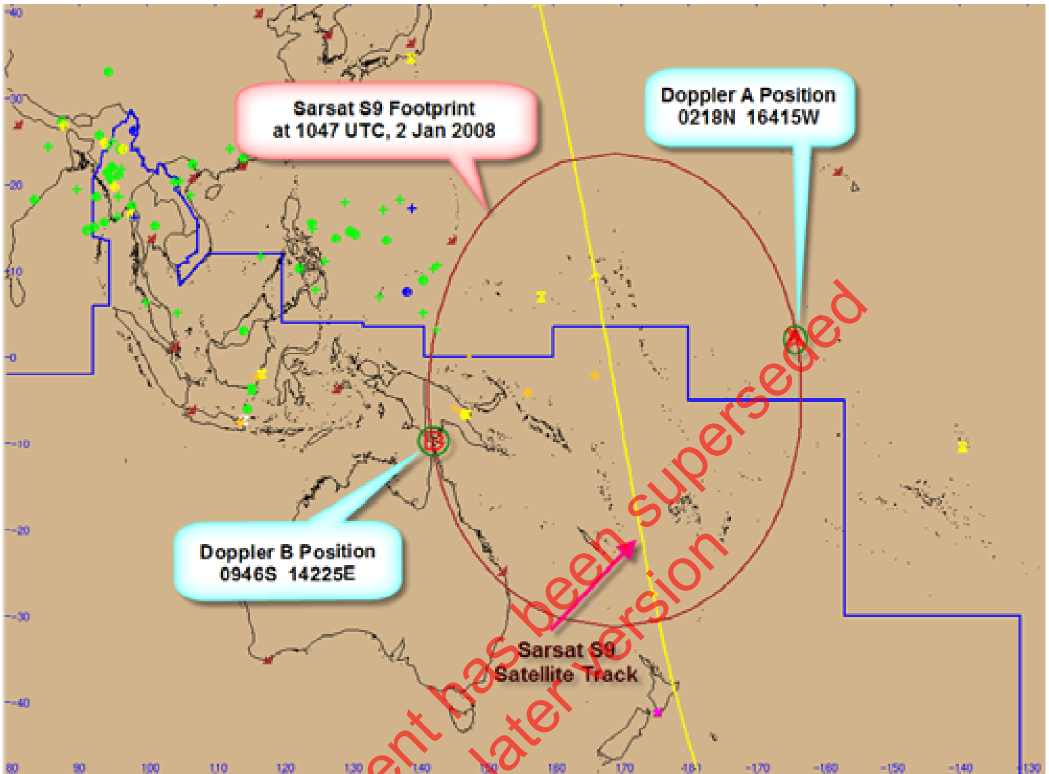
Beacon HEX ID: BEEE015F3000001:

021102Z JAN 08
FM AUMCC
TO RCC AUSTRALIA
BT
1. DISTRESS COSPAS-SARSAT INITIAL ALERT
2. MSG NO: 12307 AUMCC REF: BEEE015F3000001
3. DETECTED AT: 02 JAN 08 1047 UTC BY SARSAT S09
4. DETECTION FREQUENCY: 406.0277 MHZ
5. COUNTRY OF BEACON REGISTRATION: 503/ AUSTRALIA
6. USER CLASS:
SERIAL USER/USER LOCATION
EPIRB (NON FLOAT FREE) SERIAL NO: 0022476
7. EMERGENCY CODE: NIL
8. POSITIONS:
RESOLVED - NIL
DOPPLER A - 02 18 N 164 15 W PROBABILITY 50 PERCENT
DOPPLER B - 09 46 S 142 25 E PROBABILITY 50 PERCENT
ENCODED - NIL
9. ENCODED POSITION PROVIDED BY: NIL
10. NEXT PASS TIMES:
RESOLVED - NIL
DOPPLER A - NIL
DOPPLER B - 02 JAN 08 1112 UTC BUNDABERG LUT AUSTRALIA
ENCODED - NIL
11. HEX ID: BEEE015F3000001 HOMING SIGNAL: 121.5 MHZ
12. ACTIVATION TYPE: AUTOMATIC OR MANUAL
13. BEACON NUMBER ON AIRCRAFT OR VESSEL NO: NIL
14. OTHER ENCODED INFORMATION: NIL
15. OPERATIONAL INFORMATION:
RELIABILITY OF DOPPLER POSITION DATA - SUSPECT
LUT ID: GUAM LUT, USA
16. REMARKS: NIL
END OF MESSAGE

Notes:

1. Whilst the transmission time of the message and the detection time provided in paragraph 3 indicates a 15-minute difference it was not a real-time detection.
2. The probability that the source of the transmission is in either the A or B positions is 50% as indicated in paragraph 8. Whilst this is an unusual situation for a 406 MHz detection it is not improbable. The probability of 50% is further supported by the comment in paragraph 15 indicating that the reliability of the beacon locations is suspect.

Figure 6.3: LEOSAR Initial Alert



Notes:

1. The location of the Doppler positions are on the edge of the satellite footprint as a consequence of the satellite pass geometry with respect to the beacon, resulting in the Guam LUT receiving just 3 message bursts. The processing of just 3 bursts during a less than ideal pass geometry resulted in the Doppler positions being considered suspect.
2. The satellite footprint is drawn with a zero degree elevation.

6.4 Example 6.a (iv) – LEOSAR Resolved Alert

Beacon HEX ID: BEEE015F3000001:

021108Z JAN 08
FM AUMCC
TO RCC AUSTRALIA
BT
1. DISTRESS COSPAS-SARSAT POSITION RESOLVED ALERT
2. MSG NO: 12309 AUMCC REF: BEEE015F3000001
3. DETECTED AT: 02 JAN 08 1110 UTC BY SARSAT S11
4. DETECTION FREQUENCY: 406.0278 MHZ
5. COUNTRY OF BEACON REGISTRATION: 503/ AUSTRALIA
6. USER CLASS:
SERIAL USER/USER LOCATION
EPIRB (NON FLOAT FREE) SERIAL NO: 0022476
7. EMERGENCY CODE: NIL
8. POSITIONS:
RESOLVED - 09 51 S 142 24 E
DOPPLER A - 09 50 S 142 18 E
DOPPLER B - NIL
ENCODED - NIL
9. ENCODED POSITION PROVIDED BY: NIL
10. NEXT PASS TIMES :
RESOLVED - 02 JAN 08 1228 UTC BUNDABERG LUT AUSTRALIA
DOPPLER A - NIL
DOPPLER B - NIL
ENCODED - NIL
11. HEX ID: BEEE015F3000001 HOMING SIGNAL: 121.5 MHZ
12. ACTIVATIOTYPE: AUTOMATIC OR MANUAL
13. BEACON NUMBER ON AIRCRAFT OR VESSEL NO:
14. OTHER ENCODED INFORMATION: NIL
15. OPERATIONAL INFORMATION:
LUT ID: WELLINGTON LUT, NEW ZEALAND
16. REMARKS: NIL
END OF MESSAGE

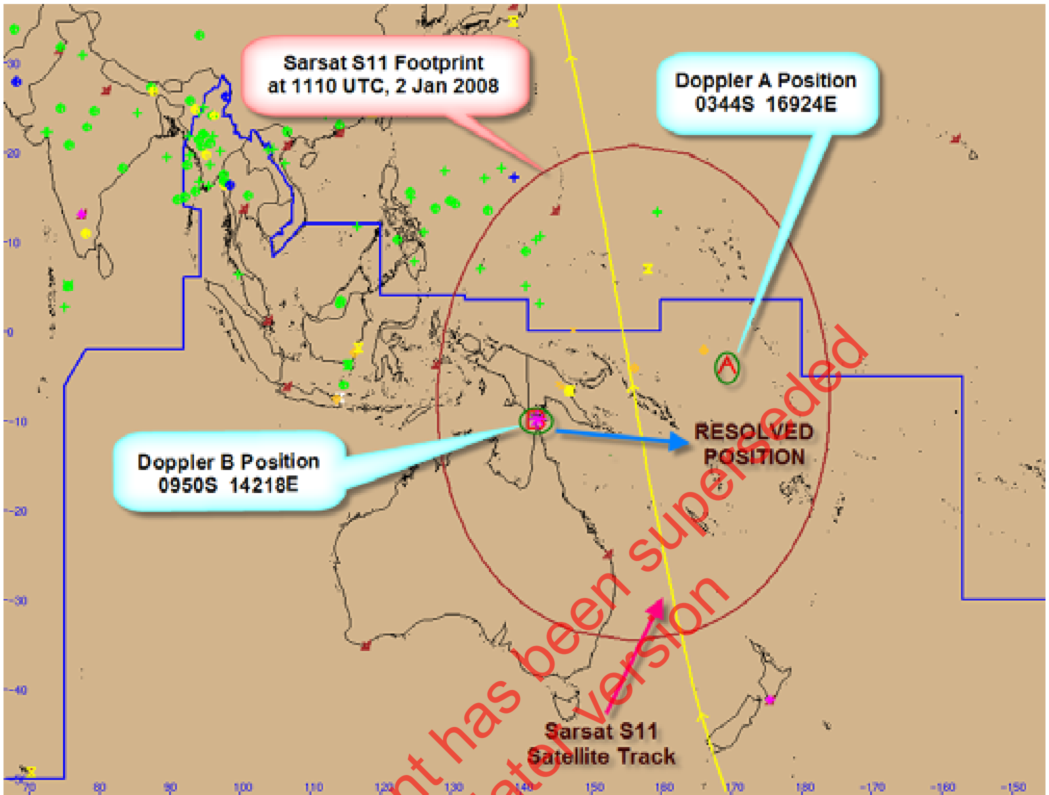
Notes:

1. The transmission time of the message and the detection time provided in paragraph 3 indicate that the detection time was 2 minutes after the transmission time. This is not an error as the Wellington LUT had to calculate and propagate the time of closest approach into the future given the beacon bursts were received as the satellite was heading north and away from the LUT.

2. The detection time in paragraph 3 and the next pass information provided in the first initial alert, example 6.a (iii) shows the reliability of the next pass prediction.

3. The Doppler A position is provided along with the resolved position in paragraph 8. The resolved position obtained from the initial and subsequent alerts is biased to the location that is more likely to be accurate (magnitude of the error ellipse is less). The Doppler A position information provides for a check to ensures that the MCC processing is normal.

Figure 6.4: LEOSAR Resolved Alert



Notes:

1. The satellite is heading north away from the Wellington LUT in New Zealand and stops tracking the satellite prior to the time of closest approach to the beacon.
2. The B position matches the B position of the initial alert which results in a resolved location being processed.
3. The satellite footprint is drawn with a zero degree elevation.

6.5 Example 6.b (i) – LEOSAR Encoded Position Alert

Beacon HEX ID: 3467000780FFBFF

020652Z JAN 08
FM AUMCC
TO INMCC[1]
BT
1. DISTRESS COSPAS-SARSAT INITIAL (ENCODED) ALERT
2. MSG NO: 00006 AUMCC REF: 3467000780FFBFF
3. DETECTED AT: 02 JAN 08 0649 UTC BY SARSAT S10
4. DETECTION FREQUENCY: 406.0334 MHZ
5. COUNTRY OF BEACON REGISTRATION: 419/ INDIA
6. USER CLASS:
STANDARD LOCATION
ELT - AIRCRAFT 24-BIT ADDRESS 6 HEX CHARACTERS: 8003C0
7. EMERGENCY CODE: NIL
8. POSITIONS:
RESOLVED - NIL
DOPPLER A - NIL
DOPPLER B - NIL
ENCODED - 13 00 00 N
- 093 00 00 E
ENCODED - UPDATE TIME WITHIN 4 HOURS OF DETECTION TIME
9. ENCODED POSITION PROVIDED BY: EXTERNAL DEVICE
10. NEXT PASS TIMES:
RESOLVED - NIL
DOPPLER A - NIL
DOPPLER B - NIL
ENCODED - NIL
11. HEX ID: 3467000780FFBFF HOMING SIGNAL 121.5 MHZ
12. ACTIVATION TYPE: NIL
13. BEACON NUMBER ON AIRCRAFT OR VESSEL NO: NIL
14. OTHER ENCODED INFORMATION:
ENCODED POSITION UNCERTAINTY PLUS-MINUS 30 MINUTES OF LATITUDE AND LONGITUDE
AIRCRAFT 24-BIT ADDRESS ASSIGNED TO: INDIA
15. OPERATIONAL INFORMATION:
LUT ID: ALBANY LUT, AUSTRALIA
16. REMARKS: NIL
END OF MESSAGE

Notes:

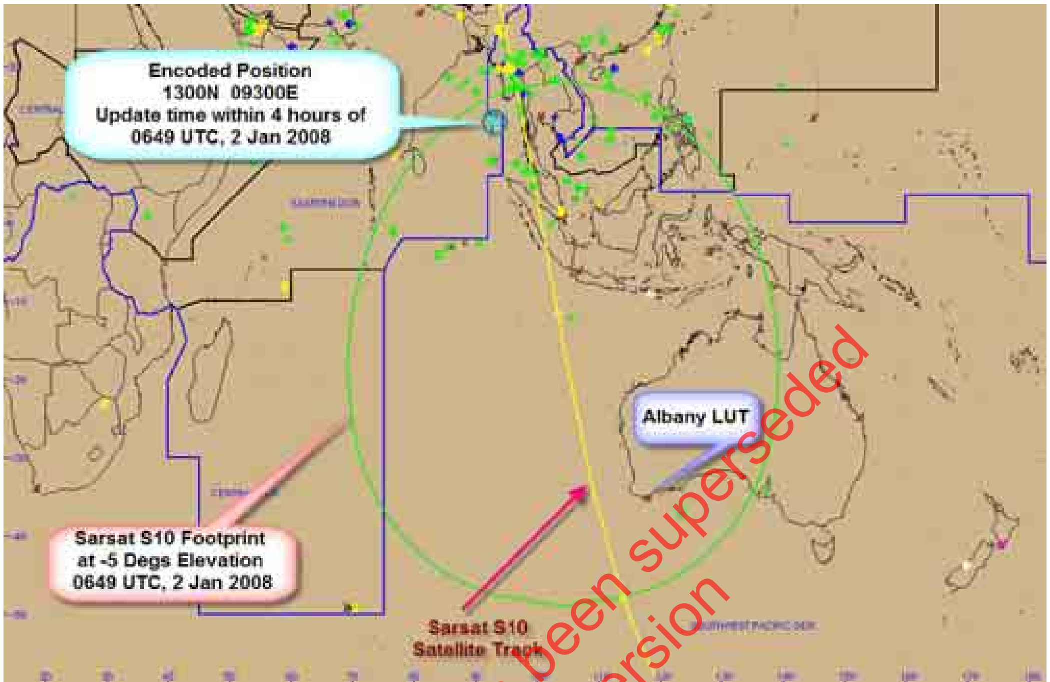
1. This alert was transmitted to INMCC in a MCC to MCC format and the above is the equivalent MCC to RCC format.
2. This alert was obtained from just one beacon burst and the long message bits are defaulted by the LUT processing thus the full accuracy of the encoded position of 4 seconds of latitude and longitude is not possible.
3. Given that the long message is defaulted message fields, MF #55 (source of encoded position data) and MF #57 (homing signal) would not be subject to automated error detection and correction and the output should be treated with caution.
4. Paragraph 8 states that the time the encoded position was updated was at some point between 0249 and 0649 UTC, 2 Jan 2008.

5. The encoded position uncertainty provided in paragraph 14. The minutes of latitude and longitude can only be in multiples of 15 minutes or zero minutes.
6. Paragraph 9 indicates that the encoded position was provided by an external device and no further updates to the encoded position will be possible under normal activation.
7. Paragraphs 7, 12 and 13 have “NIL” as the output, given that these message fields are not relevant for this user class of beacon.
8. The ICAO 24-bit allocation for India is “1000 00”. The remaining 18 bits allow 262,144 aircraft to be coded with the Indian allocation. The 24-bit equivalent of the 6 HEX chars (8003C0) as provided in paragraph 6 is “100000000000000001111000000” with the initial 6 bits identifying it as an Indian allocation. Thus the note provided in paragraph 14 indicating that it is an Indian allocation. An extract from the ICAO document concerning 24-bit addressing is provided below.

Figure 6.5: ICAO 24-bit Addressing

State	Number of addresses in block					Allocation of blocks of addresses (a dash represents a bit value equal to 0 or 1)
	1 024	4 096	32 768	262 144	1 048 576	
Democratic People's Republic of Korea			*			0111 00 100 --- -- ----------
Democratic Republic of the Congo		*				0000 10 001 100 -- ----------
Denmark			*			0100 01 011 --- -- ----------
Djibouti	*					0000 10 011 000 00 ----------
Dominican Republic		*				0000 11 000 100 -- ----------
Ecuador		*				1110 10 000 100 -- ----------
Egypt			*			0000 00 010 --- -- ----------
El Salvador		*				0000 10 110 010 -- ----------
Equatorial Guinea		*				0000 01 000 010 -- ----------
Eritrea	*					0010 00 000 010 00 ----------
Estonia	*					0101 00 010 001 00 ----------
Ethiopia		*				0000 01 000 000 -- ----------
Fiji		*				1100 10 001 000 -- ----------
Finland			*			0100 01 100 --- -- ----------
France				*		0011 10 --- --- -- ----------
Gabon		*				0000 00 111 110 -- ----------
Gambia		*				0000 10 011 010 -- ----------
Georgia	*					0101 00 010 100 00 ----------
Germany				*		0011 11 --- --- -- ----------
Ghana		*				0000 01 000 100 -- ----------
Greece			*			0100 01 101 --- -- ----------
Grenada	*					0000 11 001 100 00 ----------
Guatemala		*				0000 10 110 100 -- ----------
Guinea		*				0000 01 000 110 -- ----------
Guinea-Bissau	*					0000 01 001 000 00 ----------
Guyana		*				0000 10 110 110 -- ----------
Haiti		*				0000 10 111 000 -- ----------
Honduras		*				0000 10 111 010 -- ----------
Hungary			*			0100 01 110 --- -- ----------
Iceland		*				0100 11 001 100 -- ----------
India				*		1000 00 --- --- -- ----------
Indonesia			*			1000 10 100 --- -- ----------
Iran, Islamic Republic of			*			0111 00 110 --- -- ----------
Iraq			*			0111 00 101 --- -- ----------
Ireland		*				0100 11 001 010 -- ----------

Figure 6.6: LEOSAR Encoded Position Alert



Notes:

1. The satellite footprint has been drawn at minus 5 degrees elevation. This is to ensure that either the encoded position is conclusively within the satellite footprint or not.
2. The encoded position is within the Indian MCC service area.
3. The mutual visibility between the Albany LUT, Sarsat-10 satellite and the beacon would have been limited which resulted in just one burst being processed.

6.6 Example 6.b (ii) – LEOSAR Position Conflict Alert

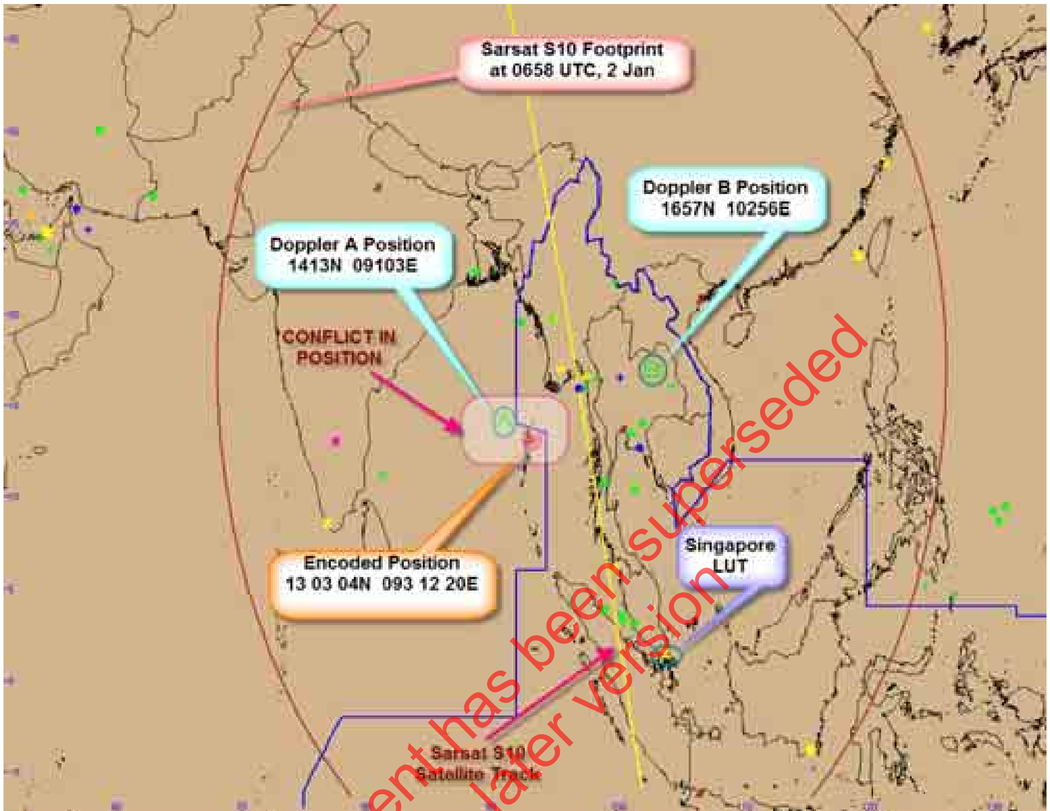
Beacon HEX ID: 3467000780FFBFF:

020706Z JAN 08
FM AUMCC
TO INMCC[1]
BT
1. DISTRESS COSPAS-SARSAT DOPPLER POSITION CONFLICT ALERT
2. MSG NO: 00007 AUMCC REF: 3467000780FFBFF
3. DETECTED AT: 02 JAN 08 0658 UTC BY SARSAT S10
4. DETECTION FREQUENCY: 406.0247 MHZ
5. COUNTRY OF BEACON REGISTRATION: 419/ INDIA
6. USER CLASS:
STANDARD LOCATION
ELT - AIRCRAFT 24BIT ADDRESS 6 HEX CHARACTERS: 8003C0
7. EMERGENCY CODE: NIL
8. POSITIONS
RESOLVED - NIL
DOPPLER A - 14 13 N 091 03 E PROBABILITY 56 PERCENT
DOPPLER B - 16 57 N 102 56 E PROBABILITY 44 PERCENT
ENCODED - 13 03 04 N
- 093 12 20 E
ENCODED - UPDATE TIME WITHIN 4 HOURS OF DETECTION TIME
9. ENCODED POSITION PROVIDED BY: EXTERNAL DEVICE
10. NEXT PASS TIMES:
RESOLVED - NIL
DOPPLER A - NIL
DOPPLER B - NIL
ENCODED - NIL
11. HEX ID: 3467000780FFBFF HOMING SIGNAL 121.5 MHZ
12. ACTIVATION TYPE: NIL
13. BEACON NUMBER ON AIRCRAFT OR VESSEL NO: NIL
14. OTHER ENCODED INFORMATION:
AIRCRAFT 24-BIT ADDRESS ASSIGNED TO: INDIA
15. OPERATIONAL INFORMATION:
LUT ID: SILUT1 SINGAPORE
16. REMARKS:
THIS POSITION 250 KILOMETRES FROM PREVIOUS ALERT
END OF MESSAGE

Notes:

1. This alert was transmitted to INMCC in a MCC to MCC format and the above is the equivalent MCC to RCC format.
2. The conflict in position between the Doppler A position (1413N 09103E) and the previous alert encoded position (1300N 09300E) is 250 kilometres. A position conflict also exists between the Doppler and encoded position of this alert.
3. The encoded position when provided in seconds should be in multiples of 4 seconds.

Figure 6.7: LEOSAR Position Conflict Alert



Notes:

1. The satellite is tracking from south to north and was initially tracked by the Albany LUT in Australia (example 6.b (i)). The Singapore LUT subsequently tracks the satellite, which is able to provide alert data from 5 beacon bursts and provide all information contained in the long message. The detection time is just 9 minutes after the Albany LUT detection.

2. The satellite footprint is drawn with a zero degree elevation.

6.7 Example 6.c (i) – GEOSAR Unlocated Alert

Beacon HEX ID: BEEC400A1400261:

060644Z DEC 07
FM AUMCC
TO RCC AUSTRALIA
1. DISTRESS COSPAS-SARSAT (UNLOCATED) ALERT
2. MSG NO: 11461 AUMCC REF: BEEC400A1400261
3. DETECTED AT: 06 DEC 07 0641 UTC BY GOES 11
4. DETECTION FREQUENCY: 406.0279 MHZ
5. COUNTRY OF BEACON REGISTRATION: 503/ AUSTRALIA
6. USER CLASS:
SERIAL USER
ELT - AIRCRAFT SERIAL NO: 0000645
7. EMERGENCY CODE:
EMERGENCY TYPE: NIL
8. POSITIONS:
RESOLVED - NIL
DOPPLER A - NIL
DOPPLER B - NIL
ENCODED -
9. ENCODED POSITION PROVIDED BY: NIL
10. NEXT PASS TIMES:
RESOLVED - NIL
DOPPLER A - NIL
DOPPLER B - NIL
ENCODED - NIL
11. HEX ID: BEEC400A1400261 HOMING SIGNAL: 121.5 MHZ
12. ACTIVATION TYPE: AUTOMATIC OR MANUAL
13. BEACON NUMBER ON AIRCRAFT OR VESSEL NO:
14. OTHER ENCODED INFORMATION:
CSTA CERTIFICATE NO: 0152
BEACON MODEL - ARTEX, USA: ME406
15. OPERATIONAL INFORMATION:
LUT ID: WELLINGTON GEOLUT, NEW ZEALAND
16. REMARKS: NIL
END OF MESSAGE

Notes:

1. This alert uses the beacon serial number coding protocol and details on the carrier will need to be obtained from a beacon registration database.
2. Information on the beacon model is provided in paragraph 14 as this is available through the Cospas-Sarsat type approval certificate number coded into the beacon. Where a beacon is not registered in a database further information on the carrier can be sought from the beacon manufacturer and supplier.
3. This alert was transmitted to the RCC in almost real-time after beacon detection by the GEOSAR system.
4. The graphics depiction of this alert is provided in Figure 6.8.

6.8 Example 6.c (ii) – LEOSAR Initial Alert (Image Position)

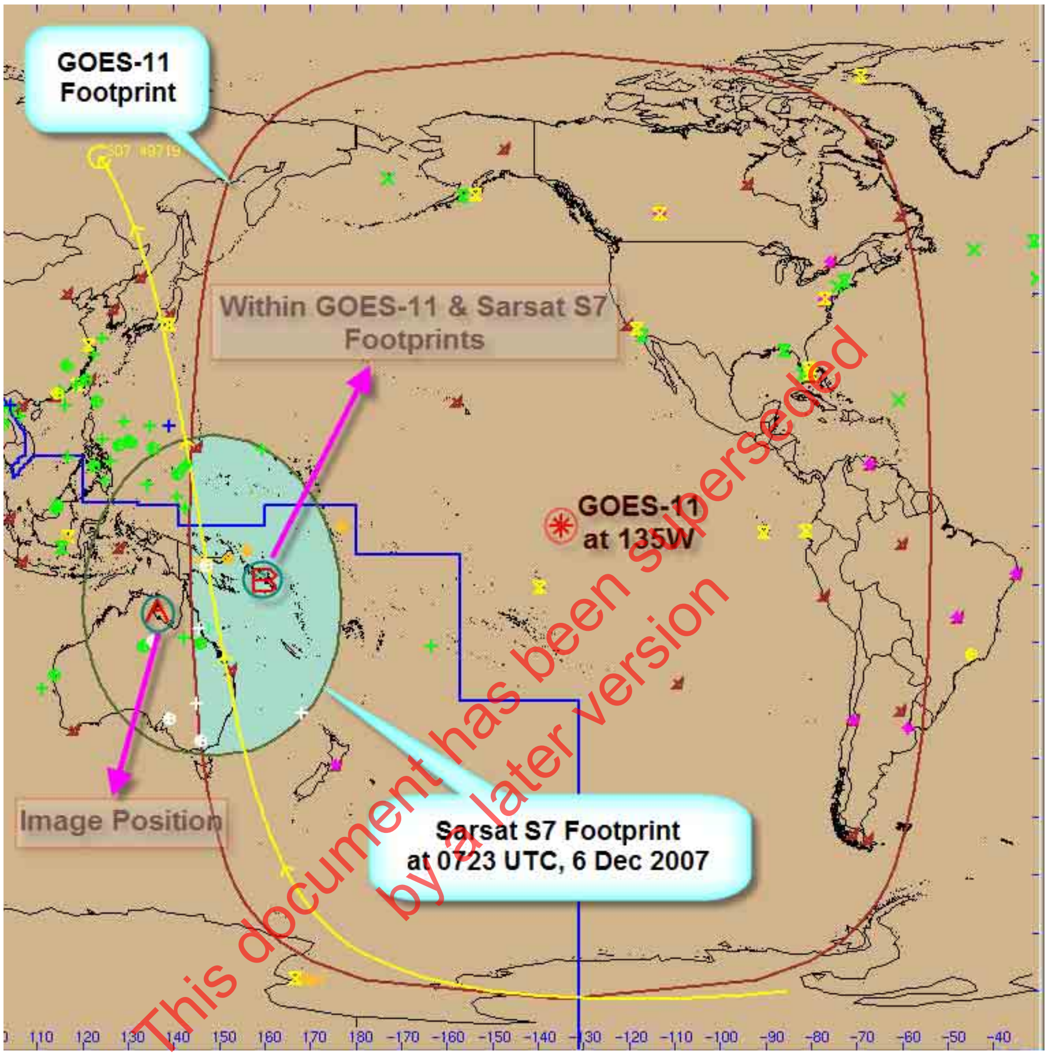
Beacon HEX ID: BEEC400A1400261:

060720Z DEC 07
FM AUMCC
TO RCC AUSTRALIA
1. DISTRESS COSPAS-SARSAT INITIAL ALERT
2. MSG NO: 11463 AUMCC REF: BEEC400A1400261
3. DETECTED AT: 06 DEC 07 0723 UTC BY SARSAT S07
4. DETECTION FREQUENCY: 406.0281 MHZ
5. COUNTRY OF BEACON REGISTRATION: 503/ AUSTRALIA
6. USER CLASS:
SERIAL USER
ELT - AIRCRAFT SERIAL NO: 0000645
7. EMERGENCY CODE: NIL
8. POSITIONS:
RESOLVED - NIL
DOPPLER A - 14 34 S 136 28 E PROBABILITY 50 PERCENT
DOPPLER B - 09 19 S 160 11 E PROBABILITY 50 PERCENT
ENCODED - NIL
9. ENCODED POSITION PROVIDED BY: NIL
10. NEXT PASS TIMES:
RESOLVED - NIL
DOPPLER A - 06 DEC 07 0747 UTC BUNDABERG LUT AUSTRALIA
DOPPLER B - 06 DEC 07 1029 UTC BUNDABERG LUT AUSTRALIA
ENCODED - NIL
11. HEX ID: BEEC400A1400261 HOMING SIGNAL: 121.5 MHZ
12. ACTIVATION TYPE: AUTOMATIC OR MANUAL
13. BEACON NUMBER ON AIRCRAFT OR VESSEL NO: NIL
14. OTHER ENCODED INFORMATION: NIL
CSTA CERTIFICATE NO: 0152
BEACON MODEL - ARTEX, USA: ME406
15. OPERATIONAL INFORMATION:
RELIABILITY OF DOPPLER POSITION DATA - SUSPECT
THE A POSITION IS LIKELY TO BE AN IMAGE POSITION
LUT ID: WELLINGTON LUT, NEW ZEALAND
16. REMARKS: NIL
END OF MESSAGE

Notes:

1. This alert was generated from just three message bursts with detection time, or time of closest approach (TCA), 3 minutes after the time of transmission of the message. This resulted in poor Doppler positions with 50% probability and suspect Doppler locations as indicated in paragraph 15.
2. Paragraph 15 further indicates that the Doppler A position is likely to be the “image” position and this is depicted in the next figure. It should be noted that the Cospas-Sarsat alert does not indicate that ambiguity in the Doppler positions have been resolved at this time.

Figure 6.8: GEOSAR Unlocated Alert and LEOSAR Initial Alert



Notes:

1. The GOES-11 and Sarsat-7 footprints at zero degrees elevation are overlayed on the graphics and show that the Doppler B position is within both footprints indicating that the Doppler A position is likely to be the image position.

6.9 Example 6.d (i) – GEOSAR Ship Security Unlocated Alert

Beacon HEX ID: 2A5917C900FFBFF:

072021Z JAN 08
FM AUMCC
TO “COMPETENT AUTHORITY”
BT
1. SHIP SECURITY COSPAS-SARSAT (UNLOCATED) ALERT
2. MSG NO: 00285 AUMCC REF: 2A5917C900FFBFF
3. DETECTED AT: 07 JAN 08 2020 UTC BY GOES 11
4. DETECTION FREQUENCY: 406.0278 MHZ
5. COUNTRY OF BEACON REGISTRATION: 338/ USA
6. USER CLASS:
STANDARD LOCATION
SHIP SECURITY - MMSI LAST 6 DIGITS: 573000
7. EMERGENCY CODE: NIL
8. POSITIONS:
RESOLVED - NIL
DOPPLER A - NIL
DOPPLER B - NIL
ENCODED - NIL
9. ENCODED POSITION PROVIDED BY: EXTERNAL DEVICE
10. NEXT PASS TIMES:
RESOLVED - NIL
DOPPLER A - NIL
DOPPLER B - NIL
ENCODED - NIL
11. HEX ID: 2A5917C900FFBFF HOMING SIGNAL: NIL
12. ACTIVATION TYPE: MANUAL
13. BEACON NUMBER ON AIRCRAFT OR VESSEL NO: NIL
14. OTHER ENCODED INFORMATION: NIL
15. OPERATIONAL INFORMATION:
LUT ID: WELLINGTON GEOLUT, NEW ZEALAND (GOES 11)
16. REMARKS: **THIS IS A SHIP SECURITY ALERT.**
PROCESS THIS ALERT ACCORDING TO RELEVANT SECURITY
REQUIREMENTS
END OF MESSAGE

Notes:

1. This is an example of a ship security alert as transmitted to a competent authority. MCCs would transmit this alert to the USMCC irrespective of the location of the alert.
2. The activation type provided in paragraph 12 will always indicate “MANUAL” for a ship security alert.
3. This alert was processed in almost real-time.
4. The graphics depiction of this alert is provided in Figure 6.9.

6.10 Example 6.d (ii) – LEOSAR Ship Security Initial Alert

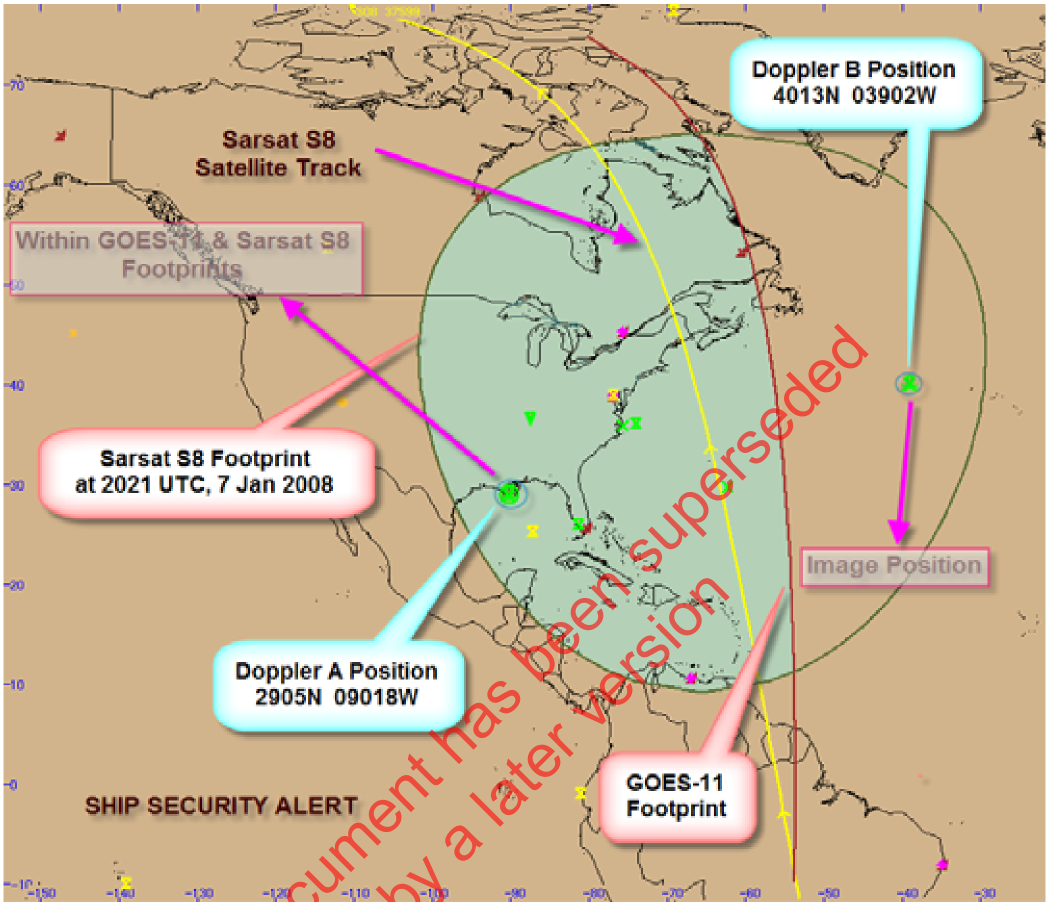
Beacon HEX ID: 2A5917C900FFBFF:

072119Z JAN 08
FM AUMCC
TO “COMPETENT AUTHORITY”
BT
1. SHIP SECURITY COSPAS-SARSAT INITIAL ALERT
2. MSG NO: 00286 AUMCC REF: 2A5917C900FFBFF
3. DETECTED AT: 07 JAN 08 2021 UTC BY SARSAT S08
4. DETECTION FREQUENCY: 406.0278 MHZ
5. COUNTRY OF BEACON REGISTRATION: 338/ USA
6. USER CLASS:
STANDARD LOCATION
SHIP SECURITY - MMSI LAST 6 DIGITS: 573000
7. EMERGENCY CODE: NIL
8. POSITIONS:
RESOLVED - NIL
DOPPLER A - 29 05 N 090 18 W PROBABILITY 76 PERCENT
DOPPLER B - 40 13 N 039 02 W PROBABILITY 24 PERCENT
ENCODED - NIL
9. ENCODED POSITION PROVIDED BY: EXTERNAL DEVICE
10. NEXT PASS TIMES:
RESOLVED - NIL
DOPPLER A - NIL
DOPPLER B - NIL
ENCODED - NIL
11. HEX ID: 2A5917C900FFBFF HOMING SIGNAL NIL
12. ACTIVATION TYPE: MANUAL
13. BEACON NUMBER ON AIRCRAFT OR VESSEL NO: 00
14. OTHER ENCODED INFORMATION: NIL
15. OPERATIONAL INFORMATION:
THE B POSITION IS LIKELY TO BE AN IMAGE POSITION
LUT ID: ALBANY LUT, AUSTRALIA
16. REMARKS: **THIS IS A SHIP SECURITY ALERT.**
PROCESS THIS ALERT ACCORDING TO RELEVANT SECURITY
REQUIREMENTS
END OF MESSAGE

Notes:

1. This alert was generated from eight message bursts from the beacon. A ship security beacon has the capability to provide an encoded position but in this case none was available.
2. Doppler position B with 24% probability has been further identified as being the likely image position given the initial GEOSAR detection. See the graphics in Figure 6.9.

Figure 6.9: Ship Security Unlocated and Initial Alert



Note:

1. The GOES-11 and Sarsat-8 footprints at zero degrees elevation are overlayed on the graphics and shows that the Doppler A position is within both footprints indicating that the Doppler B position is likely to be the image position.

6.11 Example 6.e – LEOSAR Initial Alert (Invalid Beacon Message)

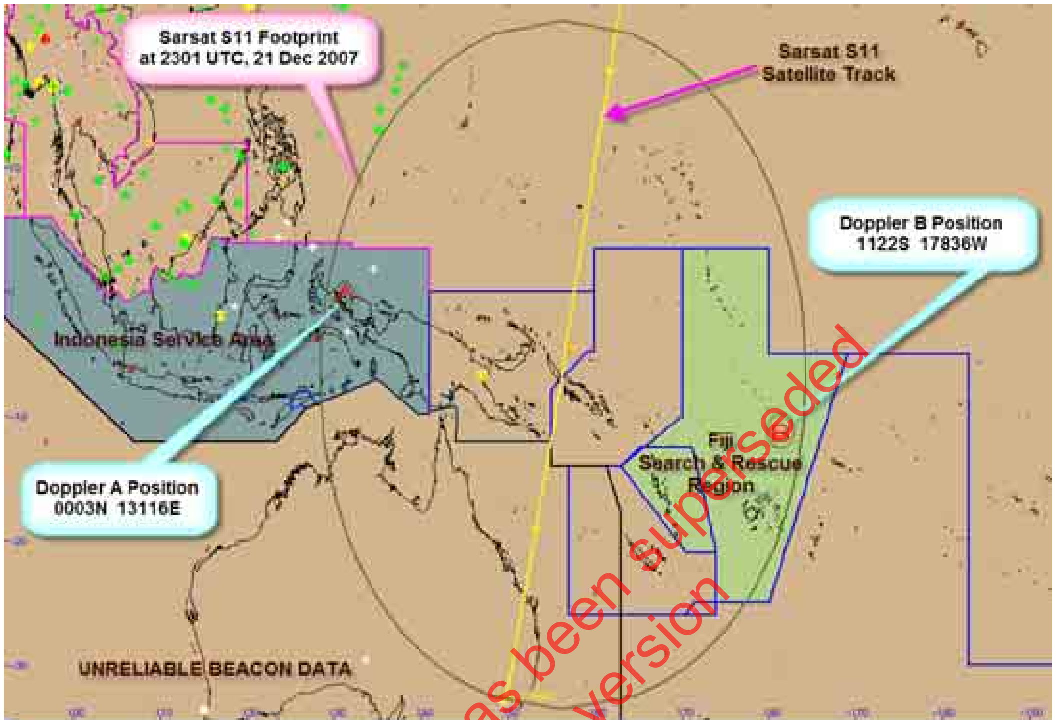
Beacon HEX ID: 2148D00801490AE:

212318Z DEC 07
FM AUMCC
TO RCC NADI
BT
1. DISTRESS COSPAS-SARSAT INITIAL ALERT
2. MSG NO: 01082 AUMCC REF: 2148D00801490AE
3. DETECTED AT: 21 DEC 07 2301 UTC BY SARSAT S11
4. DETECTION FREQUENCY: 406.0252 MHZ
5. COUNTRY OF BEACON REGISTRATION: NIL
6. USER CLASS: NIL
7. EMERGENCY CODE: NIL
8. POSITIONS:
RESOLVED - NIL
DOPPLER A - 00 03 N 131 16 E PROBABILITY 50 PERCENT
DOPPLER B - 11 22 S 178 36 W PROBABILITY 50 PERCENT
ENCODED - NIL
9. ENCODED POSITION PROVIDED BY: NIL
10. NEXT PASS TIMES:
RESOLVED - NIL
DOPPLER A - 22 DEC 07 1918 UTC BUNDABERG LUT AUSTRALIA
DOPPLER B - 21 DEC 07 2318 UTC BUNDABERG LUT AUSTRALIA
ENCODED - NIL
11. HEX ID: 2148D00801490AE
12. ACTIVATION TYPE: NIL
13. BEACON NUMBER ON AIRCRAFT OR VESSEL NO: NIL
14. OTHER ENCODED INFORMATION: NIL
15. OPERATIONAL INFORMATION:
RELIABILITY OF DOPPLER POSITION DATA - SUSPECT
DATA DECODED FROM THE BEACON MESSAGE IS NOT RELIABLE
LUT ID: NZLUT WELLINGTON, NEW ZEALAND
16. REMARKS: NIL
END OF MESSAGE

Notes:

1. Despite the error detection and correction capability of the LUT it was not able to correct all errors in the beacon message received for this particular detection. As a consequence all the various message fields have been assigned a “NIL” indicator due to the unreliability of the data. However, the Doppler location calculated for this alert is valid and RCCs need to take this into account along with any collateral information.

Figure 6.10: LEOSAR Initial Alert (Invalid Beacon Message)



Notes:

1. Whilst the beacon message is considered invalid in all other respects the Doppler position processing is normal given that the locations are within the footprint of the satellite and appear logically separated, equidistant from the satellite track.
2. This example shows one Doppler position within the search and rescue region of Fiji, which is within the Australian service area and the other Doppler position within the Indonesian service area.
3. The satellite footprint is drawn with a zero degree elevation.

6.12 Example 6.f – LEOSAR Resolved Alert (Satellite Manoeuvre)

Beacon HEX ID: B708D35934D34D1:

P 131800Z JUL 07
FM RCC AUSTRALIA/AUMCC
TO SAMCC
BT
1. DISTRESS COSPAS-SARSAT POSITION RESOLVED ALERT
2. MSG NO: 01526 AUMCC REF: B708D35934D34D1
3. DETECTED AT: 13 JUL 07 1743 UTC BY SARSAT S11
4. DETECTION FREQUENCY: 406.0248 MHZ
5. COUNTRY OF BEACON REGISTRATION: 440/ SOUTH KOREA
6. USER CLASS:
USER - MARITIME USER
MMSI - LAST 6 DIGITS: 002000
7. EMERGENCY CODE: NIL
8. POSITIONS:
RESOLVED - 24 12 N 060 51 E
DOPPLER A - 24 12 N 060 51 E
DOPPLER B - NIL
ENCODED - NIL
9. ENCODED POSITION PROVIDED BY: NIL
10. NEXT PASS TIMES:
RESOLVED - NIL
DOPPLER A - NIL
DOPPLER B - NIL
ENCODED - NIL
11. HEX ID: B708D35934D34D1 HOMING SIGNAL: 121.5 MHZ
12. ACTIVATION TYPE: AUTOMATIC OR MANUAL
13. BEACON NUMBER ON AIRCRAFT OR VESSEL NO: 0
14. OTHER ENCODED INFORMATION: NIL
15. OPERATIONAL INFORMATION:
LUT ID: ANKARA LUT, TURKEY
RELIABILITY OF DOPPLER POSITION DATA
- SUSPECT DUE TO SATELLITE MANOEUVRE
16. REMARKS: NIL
END OF MESSAGE

Notes:

1. This alert was generated subsequent to a manoeuvre of Sarsat-11 satellite and thus the cautionary entry in paragraph 15.
2. The beacon number, zero, provided in paragraph 13 indicates that this is the first or only FLOAT-FREE beacon on board the carrier.
3. Only the last 6 digits of the MMSI number is provided in paragraph 6. To obtain the full MMSI number the country of beacon registration code needs to be included. For this alert the MMSI number will be 44000200.
4. The ITU provides a search capability at: www.itu.int/cgi-bin/htsh/mars/ship_search.sh. The results of the MMSI search are provided at Figure 6.11.
5. The graphical depiction of the alert is provided in Figure 6.12.

Figure 6.11: NOCR Alert Message

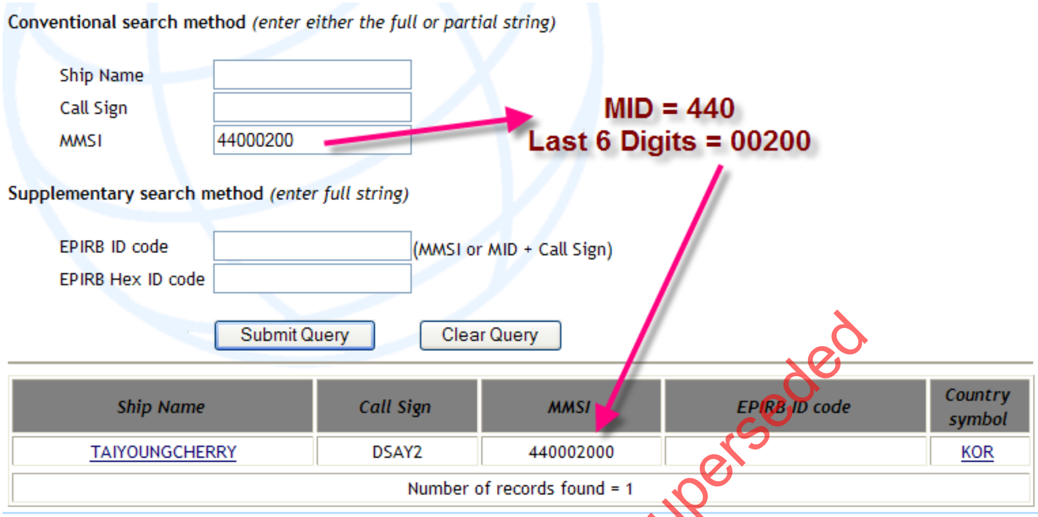
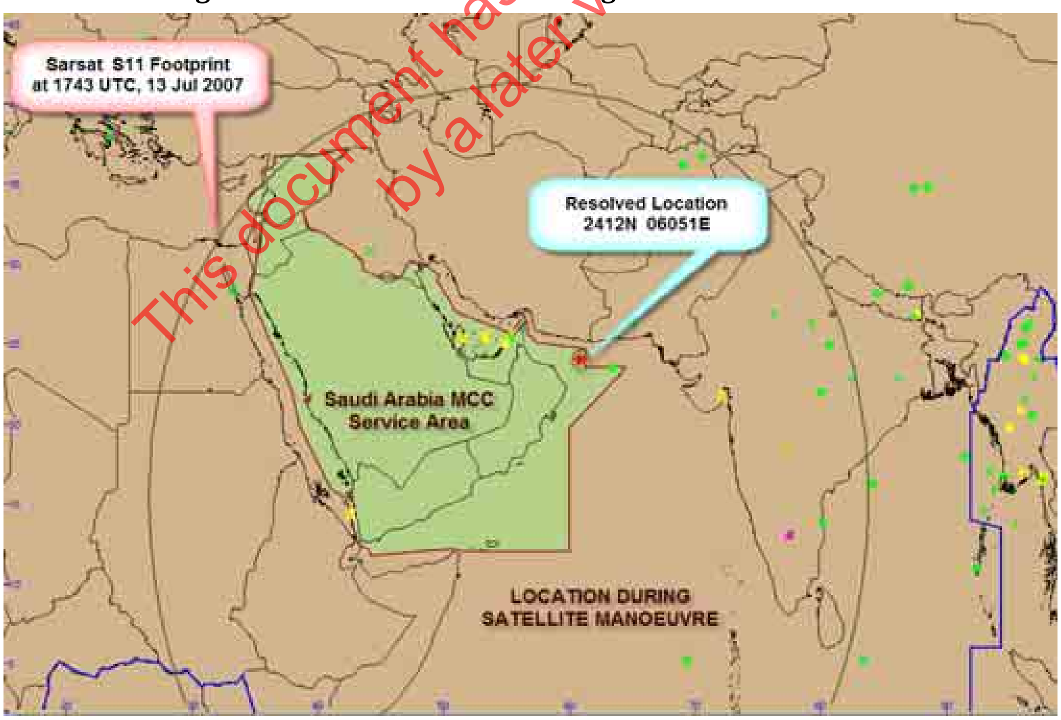


Figure 6.12: Resolved Alert during Satellite Manoeuvre



Notes:

1. The satellite footprint is drawn with a zero degree elevation.

6.13 Example 6.g – LEOSAR NOCR Alert

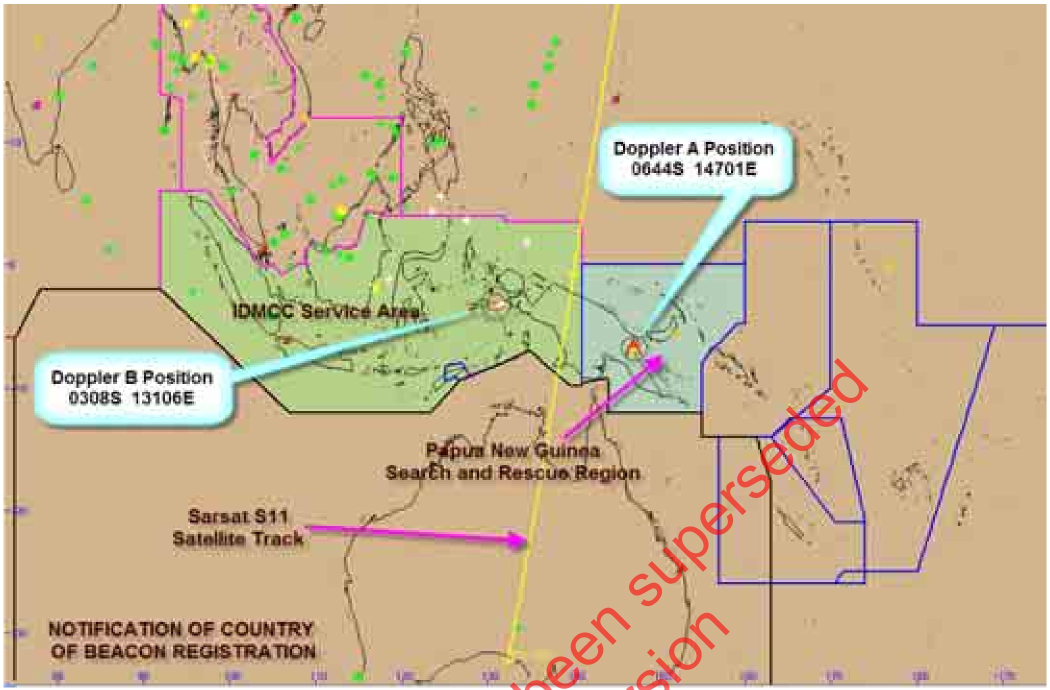
Beacon HEX ID: 452C3B8158FFBFF:

P 070025Z JAN 08
FM RCC AUSTRALIA/AUMCC
TO ATS MORESBY
MRCC PORT MORESBY
RCC PORT MORESBY
BT
1. DISTRESS COSPAS-SARSAT **NOTIFICATION OF COUNTRY OF BEACON REGISTRATION**
2. MSG NO: 02476 AUMCC REF: 452C3B8158FFBFF
3. DETECTED AT: 07 JAN 08 0011 UTC BY SARSAT S11
4. DETECTION FREQUENCY: 406.0276 MHZ
5. COUNTRY OF BEACON REGISTRATION: 553/ PAPUA NEW GUINEA
6. USER CLASS:
 STANDARD LOCATION
 EPIRB - SERIAL NO: 00172
7. EMERGENCY CODE: NIL
8. POSITIONS:
RESOLVED - NIL
DOPPLER A - 06 44 S 147 01 E PROBABILITY 71 PERCENT
DOPPLER B - 03 08 S 131 06 E PROBABILITY 29 PERCENT
ENCODED - NIL
9. ENCODED POSITION PROVIDED BY: INTERNAL DEVICE
10. NEXT PASS TIMES:
RESOLVED - NIL
DOPPLER A - 07 JAN 08 0235 UTC BUNDABERG LUT AUSTRALIA
DOPPLER B - 07 JAN 08 0235 UTC BUNDABERG LUT AUSTRALIA
ENCODED - NIL
11. HEX ID: 452C3B8158FFBFF HOMING SIGNAL 121.5 MHZ
12. ACTIVATION TYPE: NIL
13. BEACON NUMBER ON AIRCRAFT OR VESSEL NO: NIL
14. OTHER ENCODED INFORMATION: NIL
CSTA CERTIFICATE N: 0119
BEACON MODEL - MCMURDO, UK: G4A, G4M, G4C
15. OPERATIONAL INFORMATION:
LUT ID: BUNDABERG LUT, AUSTRALIA
16. REMARKS: NIL
END OF MESSAGE

Notes:

1. A NOCR alert message is transmitted by the MCC in whose service area the beacon location is (i.e. location of the beacon must be reported).
2. The NOCR alert message is intended to alert the RCC responsible for the country code regardless of the location of the beacon. In the alert message above the Indonesian MCC (IDMCC) would transmit a NOCR alert message to the Australian MCC (AUMCC) for forwarding to the Papua New Guinea SAR authorities given that the Doppler B position is in the IDMCC service area.
3. A graphical representation of the NOCR alert message is provided in Figure 6.13.

Figure 6.13: Graphical Representation of the NOCR Alert Message



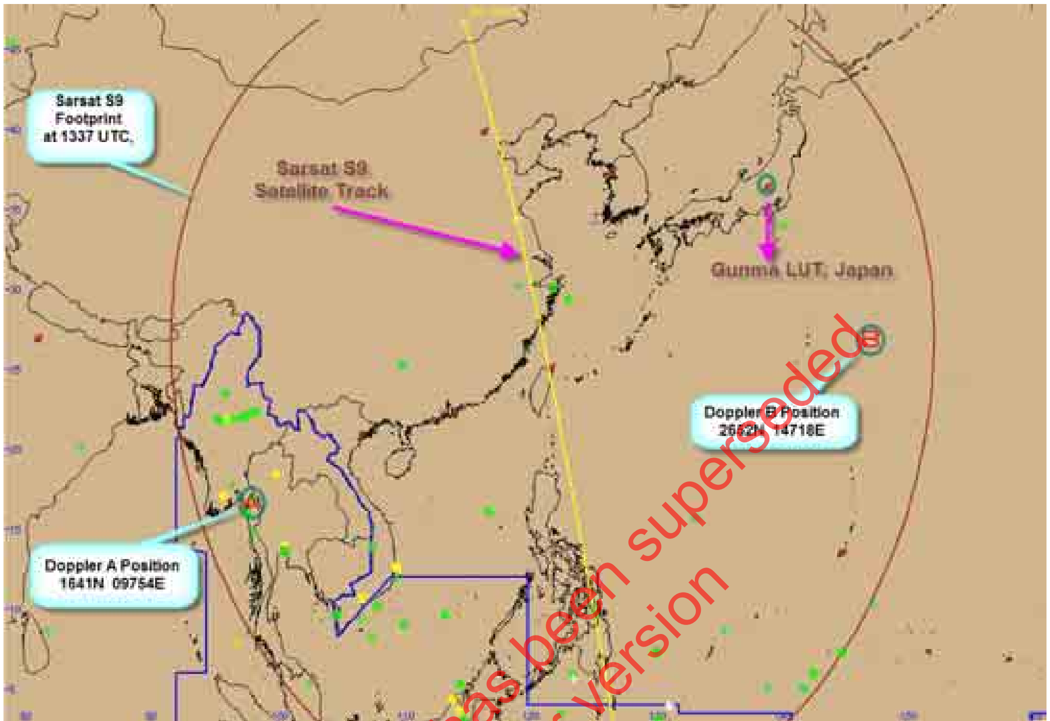
6.14 Example 6.h – LEOSAR Initial 406 MHz Interferer Alert

P 211352Z JAN 08
FM RCC AUSTRALIA/AUMCC
TO SIMCC SINGAPORE
BT
1. DISTRESS COSPAS-SARSAT 406 MHZ INTERFERER ALERT
2. MSG NO: 25612 AUMCC REF: 02254/02432
3. DETECTED AT: 21 JAN 08 1337 UTC BY SARSAT S09
4. DETECTION FREQUENCY: 406.0350 MHz
5. COUNTRY OF BEACON REGISTRATION: NIL
6. USER CLASS: NIL
7. EMERGENCY CODE: NIL
8. POSITIONS:
RESOLVED - NIL
DOPPLER A - 16 41 N 097 54 E PROBABILITY 51 PERCENT
DOPPLER B - 26 52 N 147 18 E PROBABILITY 49 PERCENT
9. ENCODED POSITION PROVIDED BY: NIL
10. NEXT PASS TIMES (UTC):
RESOLVED - NIL
DOPPLER A - NIL
DOPPLER B - 21 JAN 08 1616 FOREIGN LUT
ENCODED - NIL
11. HEX ID: NIL
12. ACTIVATION TYPE: NIL
13. BEACON NUMBER ON AIRCRAFT OR VESSEL: NIL
14. OTHER ENCODED INFORMATION: NIL
15. OPERATIONAL INFORMATION:
LUT ID: JALUT3 GUNMA, JAPAN
16. REMARKS: PLEASE ADVISE YOUR SPECTRUM AGENCY OF ANY PERSISTENT INTERFERERS
END OF MESSAGE

Note:

1. The comments in paragraph 16 requests that the spectrum agency be advised of persistent interferers.

Figure 6.14: 406 MHz Interferer Alert



- END OF SECTION 6 -

7. FREQUENTLY ASKED QUESTIONS

7.1 The RCC/SPOC has received multiple CONFLICT alerts for the same beacon event (SBE), i.e., same satellite, same beacon HEX ID and same TCA (± 20 minutes). Why is this?

Answer: In all probability the alerts are from different LUTs, albeit the same beacon event. Different LUTs may generate different Doppler locations because different beacon bursts were available from the satellite's SARR (repeater) or the SARP (global processor) due to the different LUT locations, detection capability or time of acquisition. Different processing algorithms or orbital configuration data could result in different Doppler locations, even when two LUTs use the same beacon bursts. A subsequent conflict alert for the same beacon event is transmitted unless the new alert is determined to be of poorer quality.

7.2 A beacon was not detected at the predicted next pass time provided in an alert but was detected later. Why is this?

Answer: One reason is that the beacon may have been switched off or malfunctioning at the time. The provision of the next pass time in a Cospas-Sarsat alert is based on certain technical parameters which attempt to allow for assured visibility and location. However, the local terrain may "hide" the beacon from one satellite pass but not from another pass. It is for this reason that most MCCs do not remove the beacon from their active database until such time that 3 or more satellite passes have missed detecting the beacon.

7.3 The TCA in the distress alert just received is some 4 hours old. Why is this?

Answer: This phenomenon happens when a LUT tracks a particular satellite which it hadn't tracked for many hours and receives the recorded detection from an earlier orbit. It is assumed that the beacon had not been detected on subsequent passes by that particular satellite.

7.4 The distress alert indicates that the next pass time is 6 hours in the future but the previous alert was received 4 hours prior to this. Why is this?

Answer: The next pass time that is provided in an alert is based on certain technical parameters which allow for assured visibility and location and which can be many hours into the future. However, it is possible that an earlier satellite pass that did not quite meet the assured detection parameters provided a location. Note that the provision of a next pass is based on LOCAL mode detection and does not take into account detections in global mode by other LUTs.

7.5 Resolved Doppler location alerts are being received multiple times but the position provided is changing. Why is this? Furthermore, why is the encoded position remaining constant during this exchange?

Answer: A resolved location is calculated based on the most current (Doppler or encoded) location and the historical locations that meet the ambiguity resolution distance criterion. The resolved location is not the mean of two component locations, but is biased to the location with the smaller likely error. No two Doppler locations will be identical even when the same data from a satellite is used for processing. The encoded location will remain constant if it was received from an external source or if the beacon location has not changed by more than 4 seconds of latitude and longitude.

7.6 An encoded position conflict alert is received and when plotted indicates it is only 4 km from the previous encoded position reported in the previous alert. Why is this? If two Doppler locations are 4 km apart will the subsequent alert be reported as a conflict alert? If not, then why the difference between encoded and Doppler position processing?

Answer: When two encoded positions are matched the criterion of 3 km is used to generate a conflict alert. When two Doppler locations are matched the criterion of 50 km is used to generate a conflict alert. Encoded locations are provided by the GNSS and can provide locations with greater precision than Doppler processing; thus two different matching criteria are used.

7.7 Paragraph 15 of a Cospas-Sarsat distress alert reports that the A Doppler location is probably the image location and it has a probability of 79%. Does this mean that ambiguity has been resolved? Furthermore, why is the A position with a higher probability considered the image position? Is there a problem with the location processing?

Answer: The determination that one position is probably an image does not indicate that ambiguity has been resolved; ambiguity in a Doppler location can only be resolved by matching it with a Doppler location obtained from another satellite pass or matching it against an encoded position. On occasion, the Doppler location with the lesser probability is in fact the real position of the distress, so this should not be construed as an anomaly. The reference to "image position" is made when one position in a Doppler solution is within the footprint of another satellite that detected the beacon and the other Doppler position is not within the satellite footprint. See Figure 6.8.

7.8 The RCC has received a 406 MHz interferer alert. What should the RCC do with this information?

Answer: Persistent 406 MHz interferer transmissions negatively impact the Cospas-Sarsat system and should be turned off and reported to the ITU via the national spectrum agency. More information on 406 MHz interference is provided in the Cospas-Sarsat document C/S A.003, System Monitoring and Reporting.

7.9 The RCC needs to discuss the contents of a Cospas-Sarsat distress alert with an MCC. Where can it find contact information for the MCC?

Answer: The contact information for MCCs is provided in Annex B of the RCC Handbook.

7.10 What does it mean when the alert states that the encoded position update time is within 4 hours of detection time? Why isn't a precise time provided?

Answer: Unfortunately, the time associated with the encoded position is not part of the beacon transmission. There are not enough data bits available to transmit the time. The alert states that the location was updated within 4 hours of the detection time because the 406 MHz Beacon Specification (C/S T.001) requires that encoded location not be transmitted if it has not been updated within 4 hours. One can assume that an alert indicating an "internal" source for the encoded position is within a few minutes of the detection time. In addition, when the encoded position changes on a subsequent alert, the update time of the encoded position is between the two reported detection times.

7.11 The alert provides 6 HEX characters for an ELT 24-bit address. What is the 24-bit address and how is it useful to the RCC? Is there a database that lists all these 6 HEX characters?

Answer: The aircraft 24-bit address is used in applications which require the routing of information to or from individual, suitably equipped aircraft. Examples of this are the aeronautical telecommunication network (ATN), SSR Mode S, and the airborne collision avoidance system (ACAS). The 24-bit address transmitted by an ELT is expressed as six hexadecimal characters in the distress alert and can be used to identify the precise aircraft provided an appropriate database is maintained. The 24-bit address can also identify the country that assigned it and thus assist an RCC in its fact finding efforts. The allocation of 24-bit aircraft addresses, formerly known as Mode S addresses, is described in the ICAO convention, Chapter 9 of Annex 10, Volume III. Alternatively, contact your State aircraft registration authority.

7.12 How is it useful for the RCC to be notified that the encoded position was provided by an external device? Is it useful for the RCC to know that the activation type is "NIL?

Answer: The advice that the encoded position is provided by an external device indicates that the beacon does not have an integral GNSS which can provide updated positions as long as the beacon remains active. An external input from a ship's or aircraft's GNSS will indicate that the encoded position is unlikely to be updated after initial activation. The activation type
is only available with the user protocol and not supported in any of the location protocols. A manual activation type indicates that the beacon was activated by a survivor. A manual or automatic activation type indicator is probably not useful.

7.13 What is the HEX ID? Why does the RCC need to know this HEX ID when the ID of the beacon is provided in paragraph 6 in a manner that can be clearly understood by RCC personnel?

Answer: See section 3.4 of the RCC handbook for an explanation on HEX ID. MCCs worldwide use this HEX ID in the main to refer to a beacon and to undertake searches for specific beacon activations in their system. It should be noted that the HEX ID is unique and no two identical HEX IDs should exist on two different beacons. Furthermore most 406 MHz beacon registration databases use the HEX ID as the primary field. RCC personnel will facilitate discussions with MCCs on distress alerts if reference is made to the HEX ID. The ID provided in paragraph 6 of the alert message received by the RCC is decoded from the HEX ID and provides information in respect of the beacon coding protocol used, the beacon type and the specific identity of the source or carrier, such as the Callsign.

7.14 How can I decode the 15 character HEX ID?

Answer: There are several stand-alone programs available for this purpose. The Cospas-Sarsat website at: http://www.cospas-sarsat.org/Beacons/decode.htm provides an online capability.

7.15 The RCC would like to conduct a 406 MHz beacon test for SAR training purposes to include real-time detection by the Cospas-Sarsat GEOSAR and LEOSAR systems. What are the procedures to be followed and what information does the RCC need to provide?

Answer: The RCC should review the Cospas-Sarsat advice on beacon testing at: http://www.cospas-sarsat.org/FirstPage/testing406mhzbeacon.htm and coordinate the test with its support MCC. Several Administrations also have national requirements and advice on beacon testing..

7.16 The RCC has a question on a particular aspect of the Cospas-Sarsat system and is unable to find the answer in the handbook. Who should the RCC contact to discuss the matter?

Answer: The RCC should contact its supporting MCC in the first instance for assistance. To establish your support MCC check Annex C and then Annex B for the MCC contact details.

7.17 Paragraph 13 of the Cospas-Sarsat distress alert provides information on "beacon number on aircraft or vessel". What is the significance of this information? It is noted that, for the most part, this paragraph indicates "NIL" otherwise it is a "zero". Why is this?

Answer: Certain beacon coding protocols, e.g., Maritime User and Radio Callsign User protocols, allow multiple beacons to be coded with the same callsign or MMSI. In order to differentiate between these beacons on board the same vessel and to provide a unique HEX ID, the beacon is coded with a specific beacon number, 0 to 9 and A to Z. If the vessel carries only one such coded beacon then the specific number will be zero. Receiving a distress alert with the specific beacon number given as, say 1, indicates that there are additional beacons on board the vessel.

7.18 The RCC has received an alert for the first time for a beacon indicating a conflict alert. How is this possible when the RCC did not receive a prior alert?

Answer: The initial alert would have been transmitted to another RCC because the Doppler and/or encoded locations were in that RCC's SRR. The subsequent alert, which is in conflict, contained Doppler and/or encoded positions in the subject RCC's SRR.

7.19 The RCC has reported that it has received message number 00533 from its support MCC as per paragraph 2 of the distress alert message. However the previous message number received was 00530. The RCC wishes to account for all messages and requests an explanation.

Answer: A communication problem could cause messages to be missed. The RCC should request the MCC to retransmit any missing messages.

- END OF SECTION 7 -

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ANNEXES TO THE
HANDBOOK ON DISTRESS ALERT MESSAGES FOR RESCUE COORDINATION CENTRES (RCCs), SEARCH AND RESCUE POINTS OF CONTACT (SPOCs) AND IMO SHIP SECURITY COMPETENT AUTHORITIES

ANNEX A

GLOSSARY OF TERMS

Acronym	Meaning
24/7	Twenty-fours a day and & seven days a week
24-BIT ADDRESS	An individual aircraft address comprising 24 bits used for global communications, navigation and surveillance systems (Mode S)
AFTN	Aeronautical Fixed Telecommunication Network
ALMCC	Algerian Mission Control Centre
ARMCC	Argentine Mission Control Centre
ASMCC	South African Mission Control Centre
AUMCC	Australian Mission Control Centre
BCH	Bose and Ray-Chaudhuri and Hocquenghem error correcting code
BRMCC	Brazilian Mission Control Centre
CHMCC	Chilean Mission Control Centre
CMC	Cospas Mission Centre
CMCC	Canadian Mission Control Centre
CNMCC	Chinese Mission Control Centre
COMSAR	IMO's Radio Communications and Search and Rescue Sub-committee
Cospas	Cosmicheskaya Sistyema Poiska Avariynich Sudov
CSTA	Cospas-Sarsat Type Approval
DDP	Data Distribution Plan
DDR	Data Distribution Region
DF	Direction Finding
EC	European Commission
ELT	Emergency Locator Transmitter
EPIRB	Emergency Position Indicating Radio Beacon
ESA	European Space Agency
FMCC	French Mission Control Centre
GALILEO	A planned global navigation satellite system, being built by the European Union (EU) and ESA
GEO	Geostationary Earth Obit
GEOLUT	Ground receiving station in the GEOSAR System
GEOSAR	Geostationary Satellite System for SAR
GLONASS	**GLO**bal'naya **NA**vigatsionnaya **S**putnikovaya **S**istema; English: *Global Navigation Satellite System*)
GNSS	Global Navigation Satellite System
GOES	Geostationary Operational Environmental Satellite
GPS	Global Positioning System
GRMCC	Greek Mission Control Centre
GTRF	Galileo Terrestrial Reference Frame
HEX	Hexadecimal
HKMCC	Hong Kong Mission Control Centre
IAMSAR	International Aeronautical and Maritime Search and Rescue
IBRD	International Beacon Registration Database
ICAO	International Civil Aviation Organization
IDMCC	Indonesia Mission Control Centre
IMO	International Maritime Organization
INMCC	Indian Mission Control Centre
INSAT	Indian National Satellite System
ITA2	International Telegraph Alphabet #2

Acronym	**Meaning**
ITMCC	Italian Mission Control Centre
ITU	International Telecommunication Union
JAMCC	Japan Mission Control Centre
KOMCC	Korea Mission Control Centre
LEO	Low Earth Orbit
LEOLUT	Local User Terminal in a LEOSAR System
LEOSAR	Low Earth Orbit Satellite System for SAR
LUT	Local User Terminal
MCC	Mission Control Centre
MEO	Medium-Earth Orbit
MEOSAR	Medium-Earth Orbit Satellite System for SAR
MF	Medium Frequency
MHz	Megahertz
MID	Maritime Identification Digits
MMSI	Maritime Mobile Service Identity
MSG	Meteosat Second Generational Satellite (EUMETSAT)
NIMCC	Nigeria Mission Control Centre
NMCC	Norwegian Mission Control Centre
NOCR	Notification of Country of Beacon Registration
OOSA	Office for Outer Space Affairs
PAMCC	Pakistan Mission Control Centre
PC	Personal Computer
PEMCC	Peruvian mission Control Centre
PLB	Personal Locator Beacon
RCC	Rescue co-ordination Centre
SAMCC	Saudi Arabian Mission Control Centre
SAR	Search and Rescue
Sarsat	Search and Rescue Satellite-Aided Tracking System
SART	Search and Rescue Transponder
SBE	Same Beacon Event
SIMCC	Singapore Mission Control Centre
SID	System Interface Description
SIT	Subject Indicator Type
SPMCC	Spanish Mission Control Centre
SPOC	Search and Rescue Point of Contact
SRR	Search and Rescue Region
TAMCC	ITDC/Taipei Mission Control Centre
TCA	Time of Closest Approach
THMCC	Thailand Mission Control Centre
TRMCC	Turkey Mission Control Centre
UN	United Nations
USMCC	United States Mission Control Centre
UTC	Coordinated Universal Time
VNMCC	Vietnam Mission Control Centre
WGS	World Geodetic System

- END OF ANNEX A -

ANNEX B

MCC ADDRESS AND CONTACT NUMBERS

MCC addresses and contact numbers are available on the Cospas-Sarsat website (www.cospas-sarsat.org)

Table B.1: Nodal MCC Address and Contact Numbers

MCC Name & Code	AFTN	Fax	Telephone	E-mail	Mailing Address
AUMCC 5030	YSARYCYX	(61.2) 62306868	(61.2) 62306820	rccaus@amsa.gov.au	AusSAR Australian Maritime Safety Authority GPO Box 2181, Canberra City ACT 2601 AUSTRALIA
CMC 2730	UUUUYCYX	(7.495) 6269375 6261460	(7.495) 6261215 4233200 6261516	cmc@morflot.ru cmc@marsat.ru	1/4 Rozhdestvenka St. Moscow 103759 RUSSIA
FMCC 2270	LFIAZSZX	(33.5) 61274878	(33.5) 61254382	fmcc@cnes.fr	CNES - Centre Spatial de Toulouse Cospas-Sarsat FMCC – bpi 903 18 avenue Edouard Belin 31401 Toulouse Cedex 9, FRANCE
JAMCC 4310	RJTTYKYY	(81.3) 35916107	(81.3) 35916106	jamcc@kaiho.mlit.go.jp	Japan Coast Guard (JCG) Operation Centre - JAMCC 2-1-3 Kasumigaseki Chiyodaku Tokyo 100-8989, JAPAN
SPMCC 2240	GCMPZSZX	(34.928) 727107	(34.928) 727104 727105 727106	spmcc@inta.es	Cospas-Sarsat / SPMCC INTA, Centro Espacial de Canarias, Aptdo.29 35100 Maspalomas, Las Palmas SPAIN
USMCC 3660	KZDCZSZA	(1.301) 8174568	(1.301) 8174576	usmcc@noaa.gov	USMCC E/SP3, NSOF NOAA, 4321 Suitland Road Suitland, MD 20746-4304, USA
USMCC Back-up Facility	KZDCZSZC	(1.301) 7946535	(1.301) 7946536		

- END OF ANNEX B -

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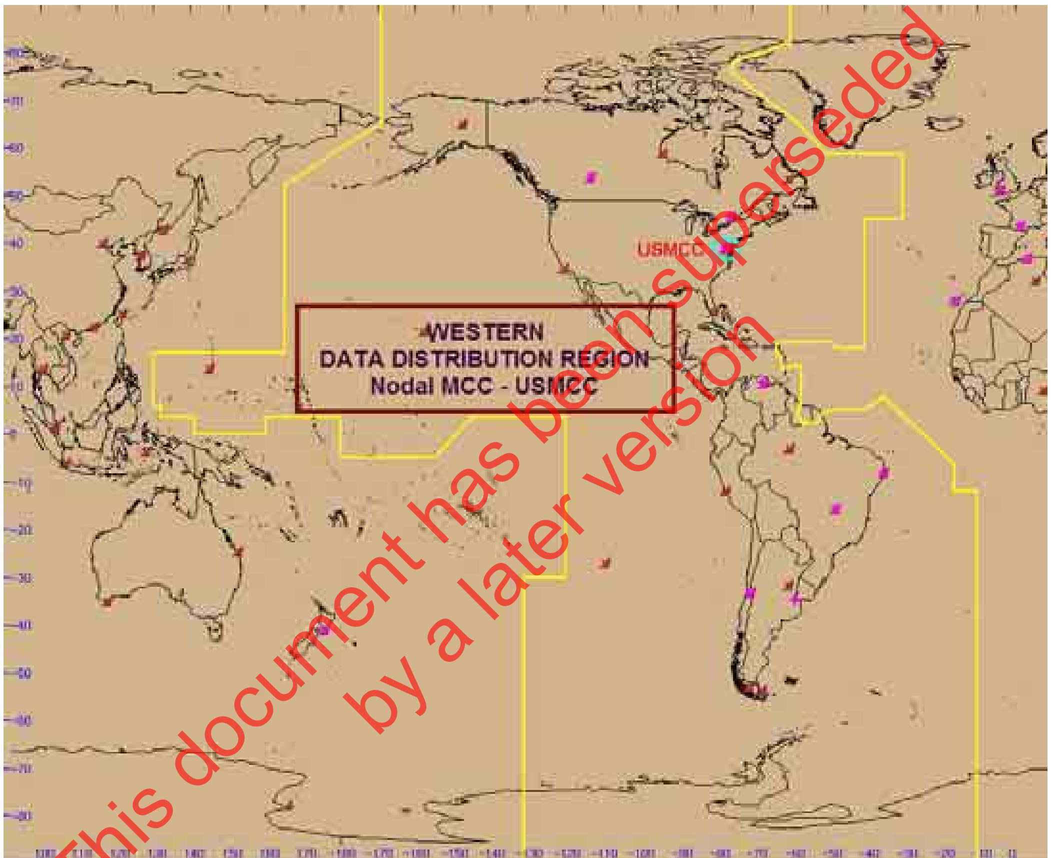
ANNEX C

DATA DISTRIBUTION REGIONS

C.1 WESTERN DDR

Figure C.1: Western DDR Map



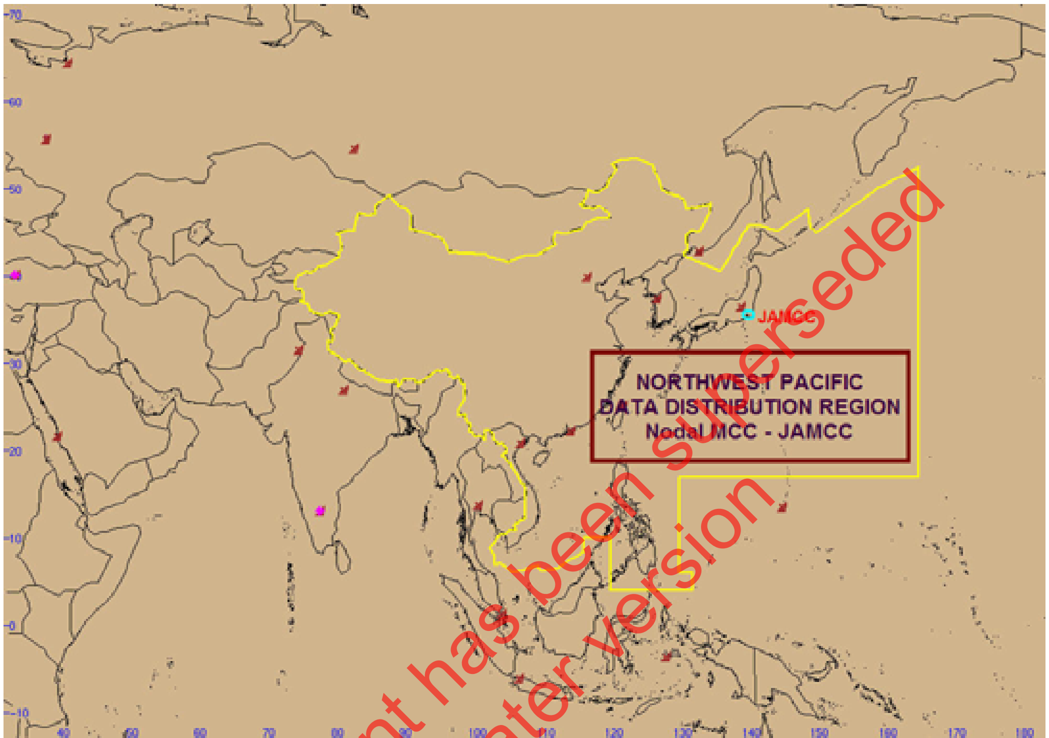
Countries/Regions and MIDs supported by the Western DDR MCCs

ARMCC			
Argentina 701	Falklands Islands/Malvinas 740		
BRMCC			
Brazil 710			
CHMCC			
Bolivia 720	Chile 725	Paraguay 755	Uruguay 770
CMCC			
Canada 316	St. Pierre and Miquelon 361		

PEMCC				
Peru 760				
USMCC				
Alaska 303	Aruba 307	Bahamas 308/309/311	Barbados 314	Belize 312
Bermuda 310	British Virgin Islands 378	Cayman Islands 319	Colombia 730	Costa Rica 321
Cuba 323	Dominican Republic 327	Ecuador 735	El Salvador 359	Grenada 330
Guatemala 332	Guyana 750	Haiti 336	Honduras 334	Jamaica 339
Marshall Islands 538	Mexico 345	Micronesia 510	Netherlands Antilles 306	Nicaragua 350
Northern Mariana Islands 536	Palau 511	Panama 351/352/353/354/ 355/356/357/370/ 371/372	Puerto Rico 358	St. Vincent and the Grenadines 375/376/377
Trinidad and Tobago 362	Turks and Caicos Islands 364	USA 338/366/367/368/ 369	US Virgin Islands 379	Venezuela 775

C.2 NORTH WEST PACIFIC DDR

Figure C.2: North West Pacific DDR Map

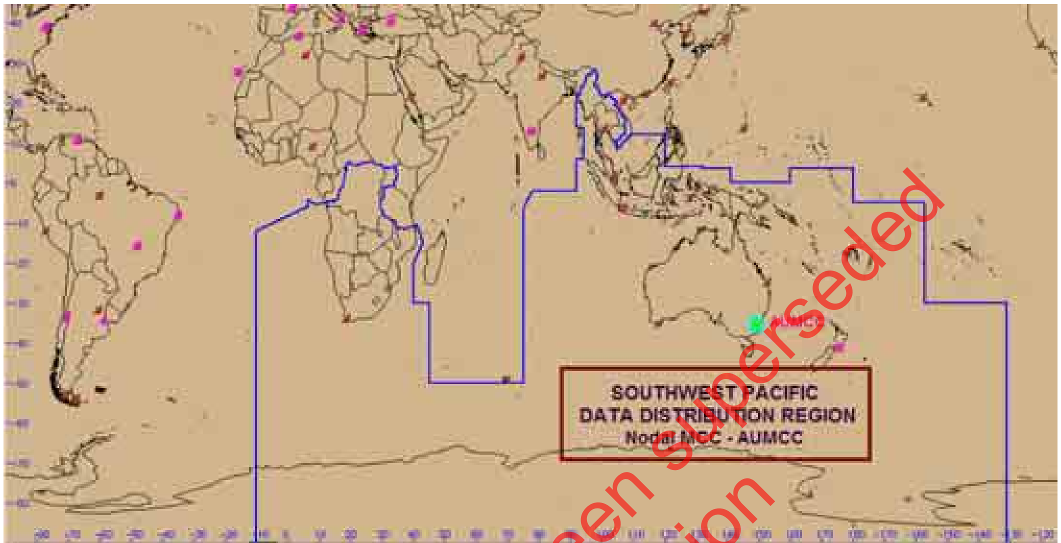


Countries/Regions and MIDs supported by the North West Pacific DDR MCCs

CNMCC		
China 412/413		
HKMCC		
Hong Kong, China 477	Macao, China 453	Philippines 548
JAMCC		
Japan 431/432		
KOMCC		
Democratic People's Rep. of Korea 445	Korea (Rep. of) 440/441	
TAMCC		
Chinese Taipei 416		
VNMCC		
Cambodia 514/515	Laos 531	Vietnam 574

C.3 SOUTH WEST PACIFIC DDR

Figure C.3: South West Pacific DDR Map



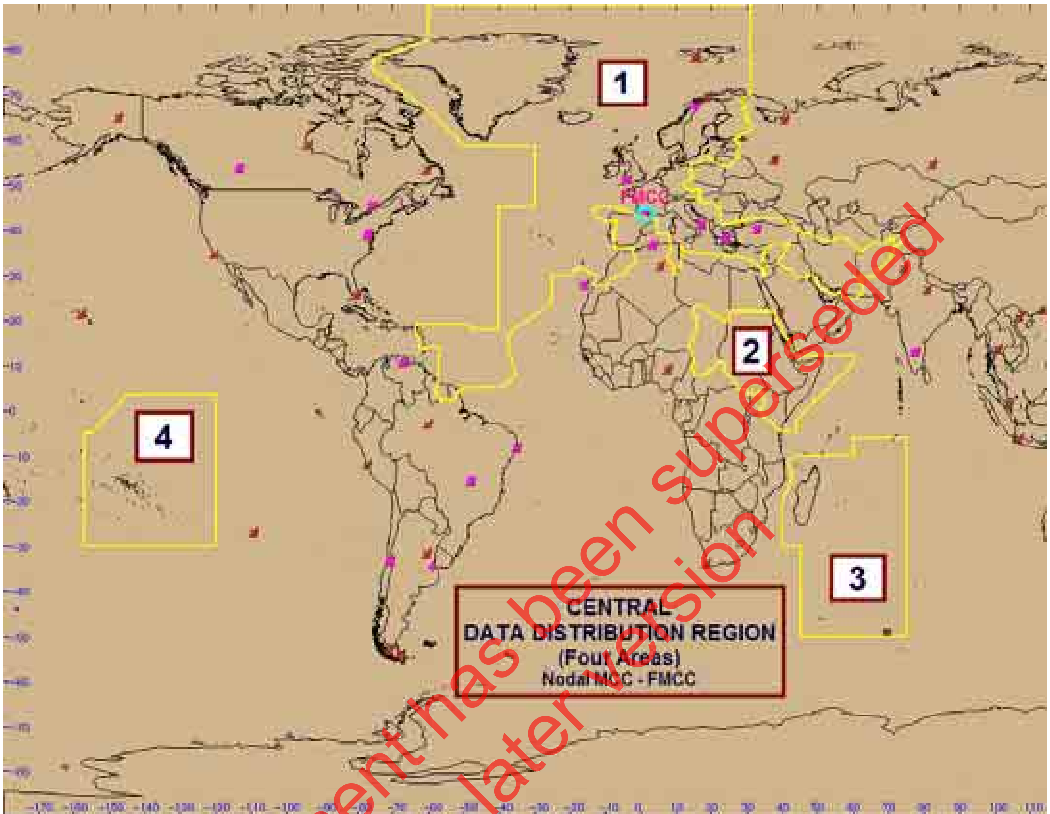
Countries/Regions and MIDs supported by the South West Pacific DDR MCCs

ASMCC				
Angola 603	Botswana 611	Burundi 609	DR of Congo 676	Lesotho 644
Malawi 655	Mozambique 650	Namibia 659	Rwanda 661	South Africa 601
St. Helena 665	Swaziland 669	Uganda 675	Zambia 678	Zimbabwe 679
AUMCC				
Adelie Land 501	American Samoa 559	Australia 503	Christmas Island 516	Cocos Islands 523
Cook Islands 518	Fiji 520	Kiribati 529	Nauru 544	New Caledonia 540
New Zealand 512	Niue 542	Papua New Guinea 553	Saint Paul & Amsterdam 607	Samoa 561
Solomon Islands 557	Tonga 570	Tuvalu 572	Vanuatu 576	Wallis & Futuna 578
IDMCC				
Indonesia 525	East Timor * (see below)			
SIMCC				
Brunei 508	Malaysia 533	Myanmar 506	Singapore 563/564/565	
THMCC				
Thailand 567				

* : country code to be determined

C.4 CENTRAL DDR

Figure C.4: Central DDR Map



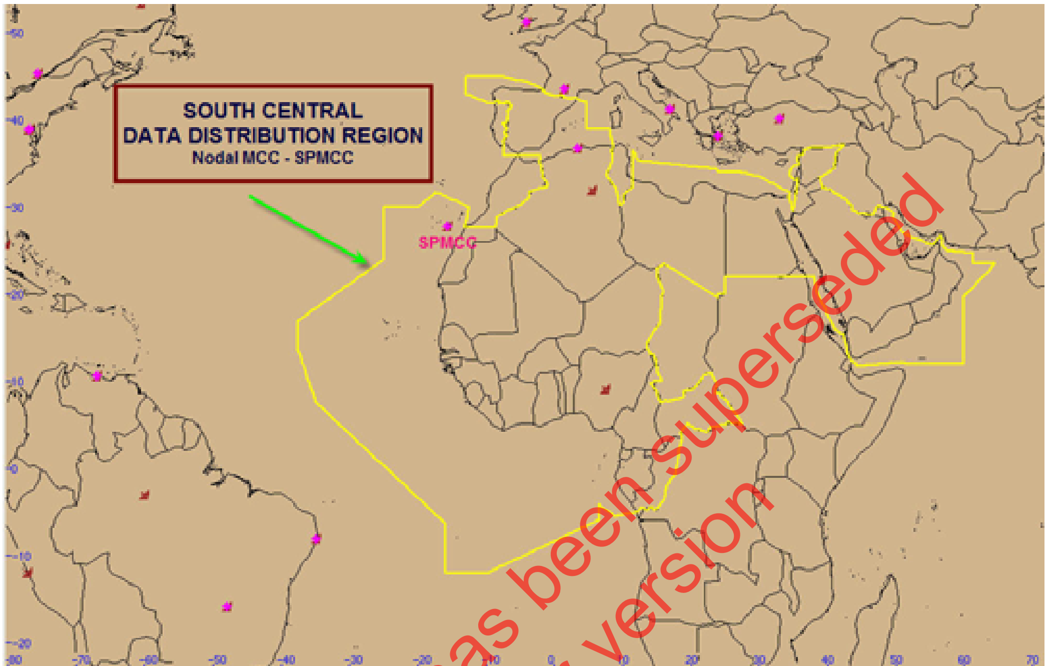
Countries/Regions and MIDs supported by the Central DDR MCCs

FMCC				
Andorra 202	Anguilla 301	Antigua and Barbuda 304/305	Austria 203	Azores 204
Belgium 205	Chad 670	Djibouti 621	Comoros 616	Crozet Archipelago 618
Dominica 325	France 226/227/228	French Guiana 745	French Polynesia 546	Germany 211/218
Gibraltar 236	Guadeloupe 329	Kerguelen Islands 635	Liechtenstein (via Swiss SPOC) 252	Luxemburg 253
Madagascar 647	Madeira 255	Martinique 347	Mauritius 645	Monaco 254
Montserrat 348	Morocco 242	Netherlands 244/245/246	Pitcairn 555	Portugal 263
Reunion/Mayotte 660	Saint Kitts and Nevis 341	Saint Lucia 343	Suriname 765	Switzerland 269
Tunisia 672				

GRMCC				
Greece 237/239/240				
ITMCC				
Eritrea 625	Ethiopia 624	Kenya 634	Somalia 666	Sudan 662
Cyprus 209/210/212	Israel 428	Albania 201	Bosnia and Herzegovina 478	Croatia 238
Italy 247	Malta 215/248/249/256	Montenegro 262	San Marino 268	Serbia 279
Slovenia 278	The Former Yugoslav Rep. of Macedonia 274	Palestine 443	Vatican City 208	
NMCC				
Denmark 219/220	Estonia 276	Faroe Islands 231	Finland 230	Greenland 331
Iceland 251	Latvia 275	Lithuania 277	Norway 257/258/259	Sweden 265/266
TRMCC				
Afghanistan 401	Iran 422	Iraq 425	Turkey 271	
UKMCC				
United Kingdom 232/233/234/235	Ireland 250			

C.5 SOUTH CENTRAL DDR

Figure C.5: South Central DDR Map

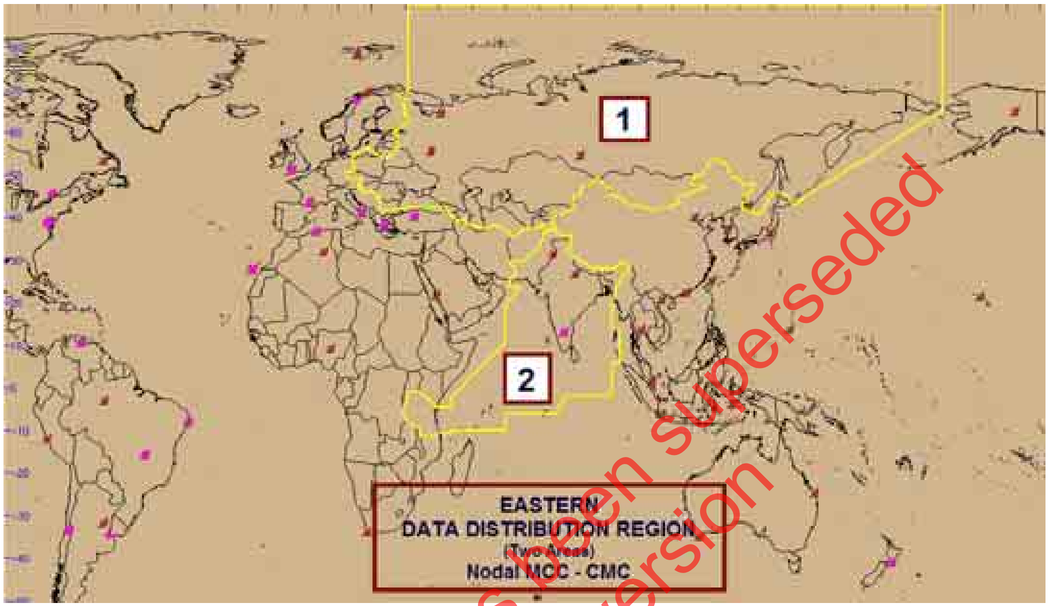


Countries/Regions and MIDs supported by the various South Central DDR MCCs

ALMCC				
Algeria 605	Burkina Faso 633	Egypt 622	Libya 642	Niger 656
NIMCC				
Nigeria 657				
SAMCC				
Bahrain 408	Jordan 438	Kuwait 447	Lebanon 450	Oman 461
Qatar 466	Saudi Arabia 403	Syria 468	United Arab Emirates 470	Yemen 473/475
SPMCC				
Ascension 608	Benin 610	Cameroon 613	Cape Verde 617	Central African Republic 612
Congo 615	Côte d'Ivoire 619	Equatorial Guinea 631	Gabon 626	Gambia 629
Ghana 627	Guinea 632	Guinea-Bissau 630	Liberia 636/637	Mali 649
Mauritania 654	Sao Tome and Principe 668	Senegal 663	Sierra Leone 667	Spain 224/225
Togo 671				

C.6 EASTERN DDR

Figure C.6: Eastern DDR Map



Countries/Regions and MIDs supported by the various Eastern DDR MCCs

CMC				
Armenia 216	Azerbaijan 423	Belarus 206	Bulgaria 207	Czech Republic 270
Georgia 213	Hungary 243	Kazakhstan 436	Kyrgyz Rep. 451	Moldova 214
Russia 273	Tajikistan * (see below)	Turkmenistan 434	Ukraine 272	Uzbekistan 437
Poland 261	Romania 264	Mongolia 457		
INMCC				
Bangladesh 405	Bhutan 410	India 419	Maldives 455	Nepal 459
Seychelles 664	Sri Lanka 417	Tanzania 674/677		
PAMCC				
Pakistan 463				

* : country code to be determined

- END OF ANNEX C -

ANNEX D

RCC PERSONNEL COSPAS-SARSAT COURSE

1. Concept of the Cospas-Sarsat System

2. Space Segment (LEO, GEO and MEO)

- Status of Space Segment
- Satellite manoeuvres

4. Ground Segment

- Overview of worldwide disposition of LUTs and MCCs
- Status of the Ground Segment

5 LUTs

- Functions of a LUT
- Location data concepts and jargon eg. Doppler curve, A and B positions, TCA, CTA, number of points, TCA within and without points, partial Doppler curves, theoretical number of points given a particular satellite and CTA, etc.
- Large location errors and possible causes

6. MCCs

- Functions of an MCC
- Communications to and from MCC

7. Cospas-Sarsat Data Distribution Procedures

- Concept of Service areas and DDRs and nodal MCCs
- Concept of RCCs and SPOCs and search and rescue regions
- Matching and merging of beacons
  - o Doppler to Doppler matching
  - o Doppler to encoded matching
  - o Encoded to encoded matching
- Concept of LEO-GEO alerts
- Data distribution
  - o Unlocated and ambiguity resolution alerts
  - o Conflict alerts
  - o Continued transmissions
  - o NOCR service
- Data validation
- Concept of filtering redundant data and better quality alerts
  - o Based on same beacon event (SBE), poor quality flag indicators, distance criterion and image position determination
- Ship Security Alerting

8. Cospas-Sarsat message Formats

- International character set as per Table 4.1 of C/S A.002 document
- MCC to RCC/SPOCs (SIT 185 formats)
- Concept of message fields
- Types of message alerts
  - Initial, resolved, unlocated, encoded, conflict and NOCR
  - Interferer alerts

9. Beacons

- Beacon specifications
- Beacon coding and protocols
  - User and location protocols (User, Standard and National)
  - SSAS
  - Orbitography and reference beacons
  - Time reference beacon
- Beacon 15 Hexadecimal ID
- Beacon homing and sweep
- Beacon registration information SIT 925 format
- Beacon registration and IBRD
- Beacon testing policy
- Beacon disposal

10. Communications

- FTPV Standard
- AFTN Standard
- E-mail
- Fax

11. Contingency Procedures

- Backup procedures
- Use of e-mail for transfer of SIT messages

12. Documentation Set

- Cospas-Sarsat RCC Handbook
- IAMSAR Manual
- Cospas-Sarsat Data Distribution Plan, document C/S A.001
- Cospas-Sarsat System Interface Description, document C/S A.002
- Cospas-Sarsat 406 MHz Beacon Specification, document C/S T.001

- END OF ANNEX D -

- END OF DOCUMENT -

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