

# Communication Systems and Equipment of the GMDSS

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1. GMDSS principles
2. GMDSS equipment
3. Overview of carriage requirements for SOLAS vessels
4. Means of ensuring availability of ship station equipment

The Global Maritime Distress and Safety System (GMDSS) is a globally accepted and adopted set of rules protocols and prescriptions, which assure safety navigation and shipping.

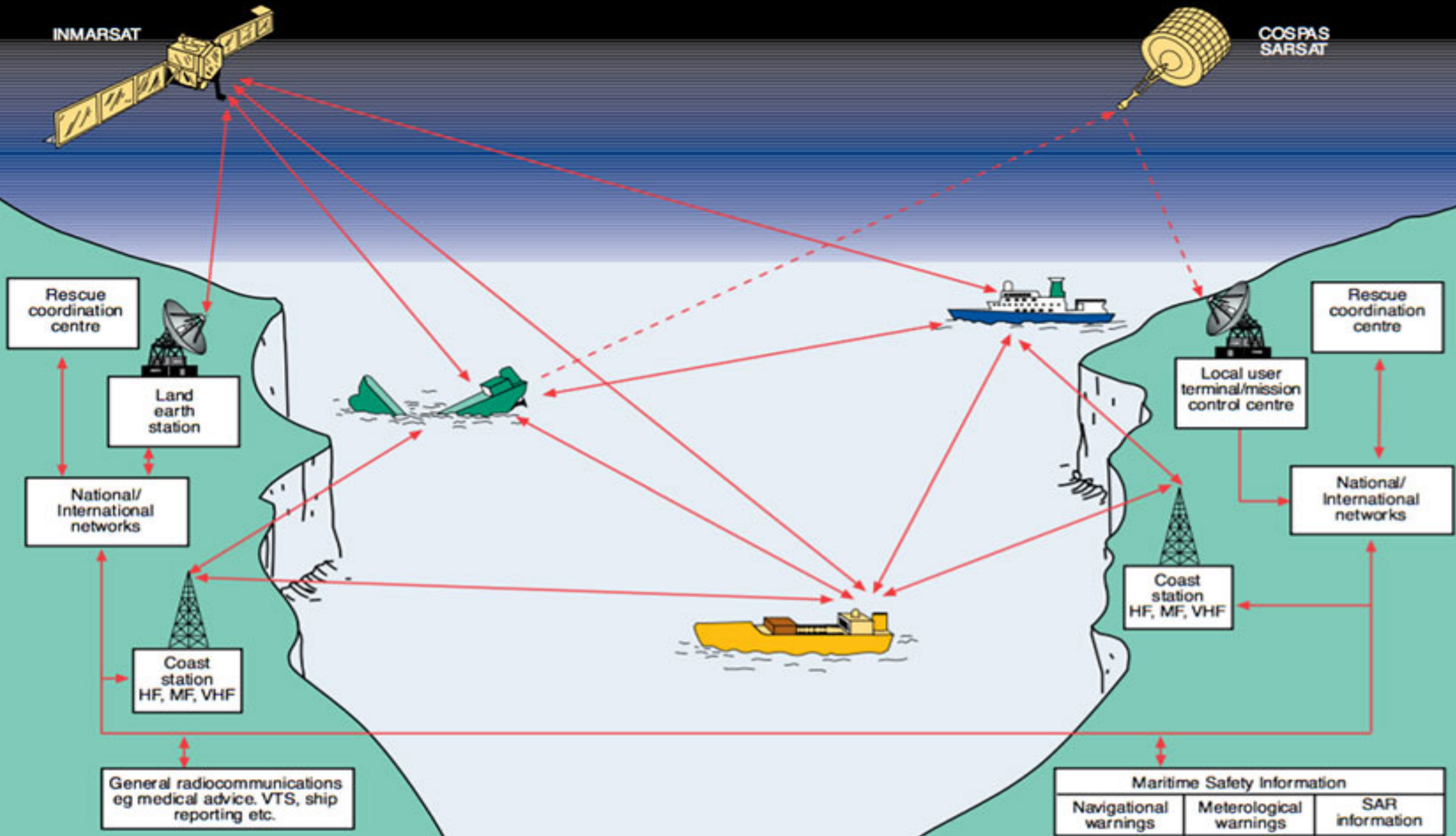
The GMDSS equipment is applied to increase safety and make it easier and faster to rescue distressed ships, boats and aircrafts.

The GMDSS enables a ship in distress to send an alert using various radio systems.

Thanks to this system the alerts has a very high contingency to be received by either shore rescue authorities and/or other vessels in the area.

INMARSAT

COSPAS  
SARSAT



General radiocommunications  
eg medical advice, VTS, ship  
reporting etc.

Maritime Safety Information		
Navigational warnings	Meteorological warnings	SAR information

The GMDSS composes of different systems performing the following functions:

- alerting (including position determination of the unit in distress);
- SAR coordination;
- locating (homing)
- maritime safety information broadcasts
- general communications; and
- bridge-to-bridge communications.

Specific radio **carriage requirements depend upon the ship's area of operation**, rather than its tonnage. The GMDSS also considers back-up instrumentation of distress alerting, and emergency sources of power.

Every SOLAS vessel shall be capable:

- of **transmitting ship-to-shore distress alerts** by at least **two separate and independent means**, each using a different radiocommunication service (some exceptions);
- of **receiving shore-to-ship distress alerts**;
- of transmitting and receiving ship-to-ship distress alerts;
- of transmitting and receiving **search and rescue co-ordinating communications**;
- of transmitting and receiving **on-scene communications**;
- of transmitting and receiving **signals for locating**;
- of transmitting and receiving **maritime safety information**;
- of transmitting and receiving **general radiocommunications** to and from shore-based radio systems or networks; and
- of transmitting and receiving **bridge-to-bridge communications**.

## GMDSS operational areas

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The GMDSS has divided the world's oceans into four distinct areas. All **vessels are required to carry equipment appropriate to the sea area or areas in which they trade.**

### Area A1

within the radiotelephone coverage of at least one VHF coast station in which continuous VHF DSC alerting is available;

### Area A2

within the radiotelephone coverage of at least one MF coast station in which continuous MF DSC alerting is available (excluding sea area A1);

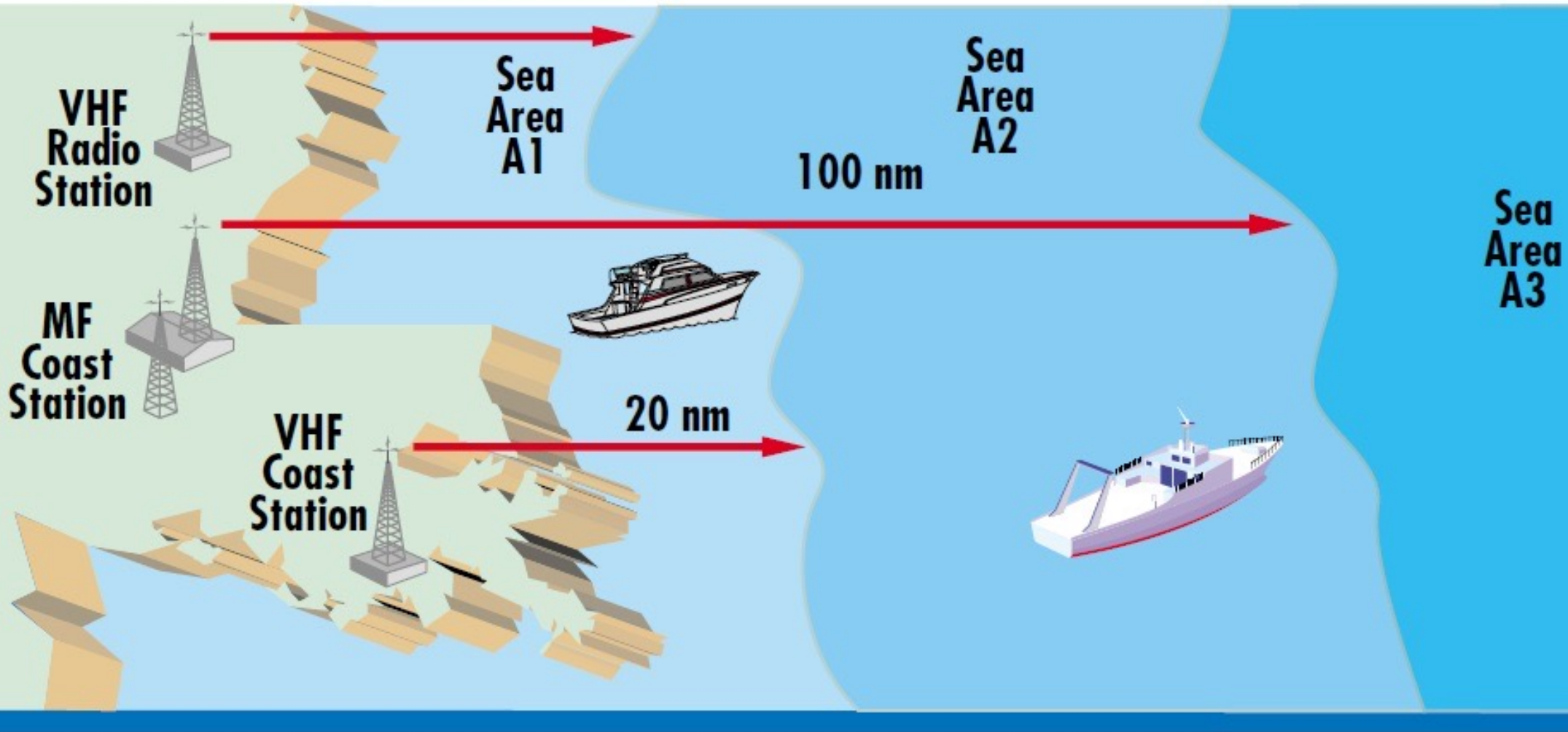
### Area A3

within the coverage area of an INMARSAT geostationary satellite in which continuous alerting is available (excluding sea areas A1 and A2); and

### Area A4

the remaining sea areas outside areas A1, A2 and A3 (basically, the polar regions).

## GMDSS operational areas (cont.)





### **Digital selective calling (DSC)**

**Emergency position indicator radio beacon (EPIRB)** – automated identification and locator device for Search and Rescue operations.

**NAVTEX** - One of the international automated services for delivery of navigational and meteorological warnings, forecasts and urgent maritime safety information to ships (MSI).

**Search and Rescue Transponder (SAR)** – automatically leading Search and Rescue units to the position of distress by signaling search and rescue radar transponders.

**Portable two-way VHF radiotelephone apparatus** – for use in survival crafts

**IRIDIUM & INMARSAT** – Global mobile satellite communication systems providing two-way data and messaging.

## Digital Selective Calling (DSC)

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DSC was developed to replace a voice call in older procedures.

DSC is a standard for sending pre-defined digital messages from ship to ship, ship to shore and shore to ship. Based on VHF, MF and HF Maritime radio communication.

DSC allows a radio operator to send a digital call, or 'Alert' to one or more selected radio stations. In many ways DSC is similar to a telephone pager, sounding an alarm and leaving a very basic message on the selected station's DSC receiver.

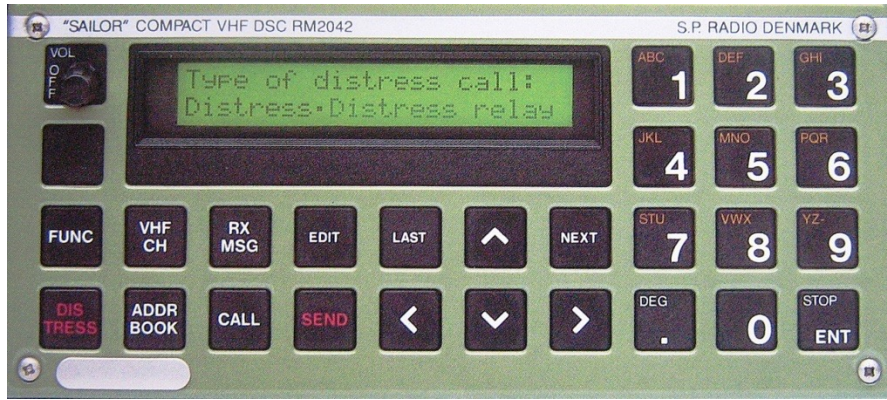
The main purpose of a DSC Alert is to warn the recipient that a voice transmission is about to be made that is of direct concern to them. In all cases, a DSC Alert should be followed by a radiotelephone voice transmission.

A slightly longer (up to 25%) longer range

DSC senders are programmed with the ship's MMSI number and are connected to the ship's GPS. So a distress signal will include identity and position.

DSC is considered the automated watch on distress channels running on VHF, MF/HF radios.

## Digital Selective Calling (DSC) - (cont.)



Often, ships use separate VHF DSC and MF/HF DSC controllers.

For VHF, DSC has its own dedicated receiver for monitoring Channel 70, but uses the main VHF transceiver for transmission. However, for the user, the controller is often a single unit



MF/HF DSC devices monitor multiple bands for distress, urgency and safety transmissions in the 2, 4, 6, 8, 12 and 16 MHz marine bands.

At minimum, controllers will monitor 2187.5 kHz and 8414.5 kHz and one more band.

## Emergency position indicator radio beacon (EPIRB)



Small portable devices using the global COSPAS-SARSAT Satellite System and sending signals on the 406MHz frequency

Provides automated identification and locator device for Search and Rescue operations

Automatically send distress signals, when coming in contact with water.

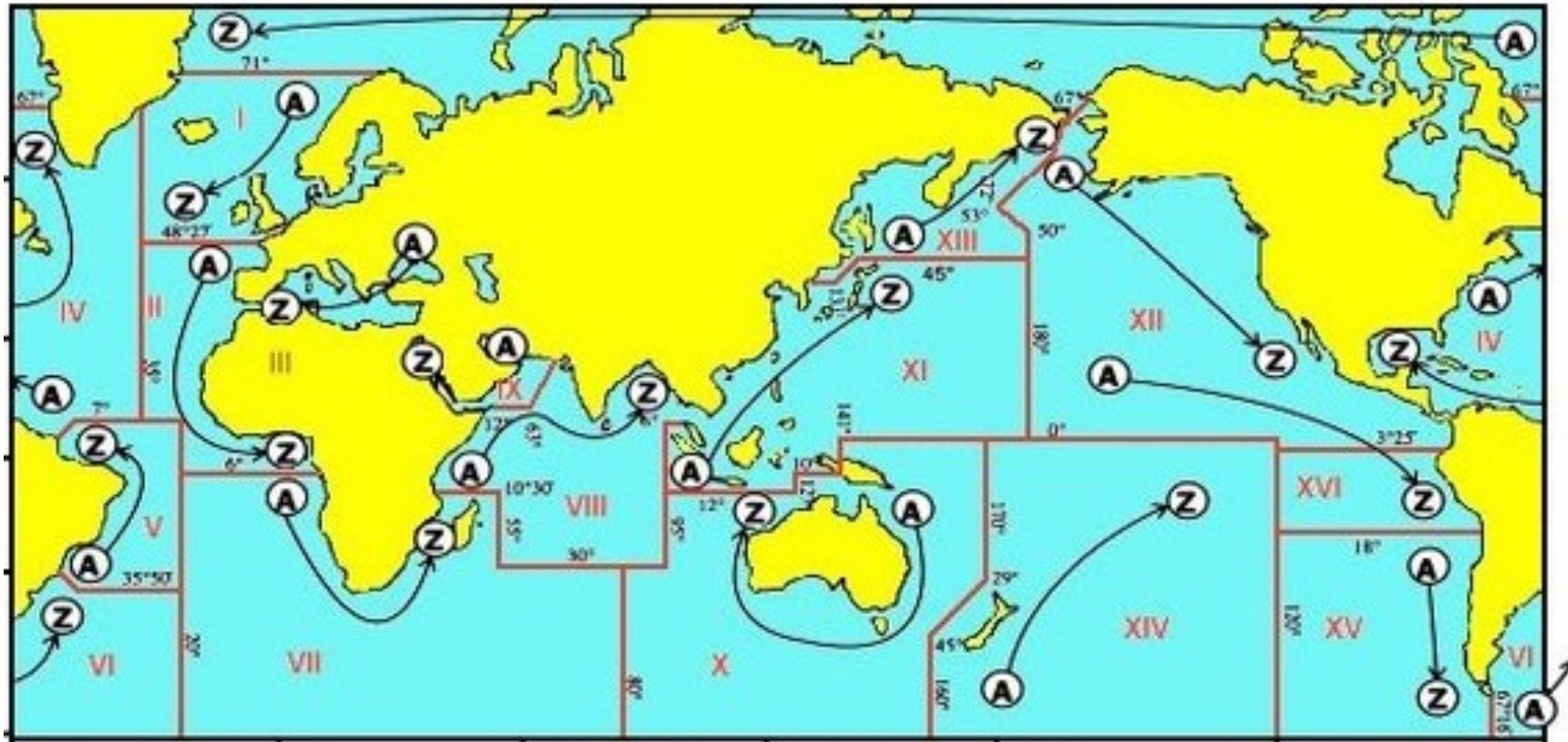
## Emergency position indicator radio beacon (EPIRB) (cont.)

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- The signal is detected by COSPAS-SARSAT satellites
- The satellites calculate the position or utilize the GPS coordinates of the beacon and quickly passes the information to the appropriate local first responder organization, which performs the search and rescue.
- As Search and Rescue approach the search areas, they use Direction Finding (DF) equipment to locate the beacon using the 121.5 MHz homing signal, or in newer EPIRBs, the AIS location signal.

NAVTEX is an acronym meaning Navigational Telex, and as its name shows, it is a kind of narrow band radioteletype system for sending (by frequency shift keying) text messages expressed in a 7-unit code. The difference is that a NAVTEX transmitter transmits nine control characters (header code) ahead of the main message so that the receiver can identify the station, message type and serial number automatically.





NAVTEX broadcasts are primarily made on the medium frequencies of **518 kHz** and **490 kHz**.

The **international NAVTEX frequency is 518 kHz** and these broadcasts should always be in English.

National transmission of NAVTEX, where supported, uses **490 kHz specifically for broadcasts in local languages**.

### **NAVTEX transmission schedule**

Each station identifier has a fixed 10-minute time slot, starting with A at 0000UTC. The time slots are repeated at 4 hour intervals. Within each time slot, a mix of navigation warnings, weather forecasts, ice information and other content may be sent, and this is normally according to a structured plan for that specific station. For example, in the first and third time slot they may decide to transmit navigation warnings, and weather forecasts in the others. Normally each NAVAREA or sub-NAVAREA has only one station at each slot.

### **Message Format**

For automatic identification of messages, each message starts with nine control characters, called “Header codes”.

The first five characters are always “ZCZC\_“ and common to all messages. This part is used for message synchronization. The latter four characters are designed as B1, B2, B3 and B4 indicate origin, category and a serial number of the message.

Character B1 is the identification letter of the Navtex station “A” thru “Z”.

Character B2 indicates the type of message. “A” thru “Z”, as listed below.

Character B3 and B4 indicate the serial number of the message. The serial numbers are counted up from “01” to “99”, and starts from “01” again. Number “00” is specially reserved for important emergency messages.

The end of each message is indicated by “NNNN” (four successive N’s)



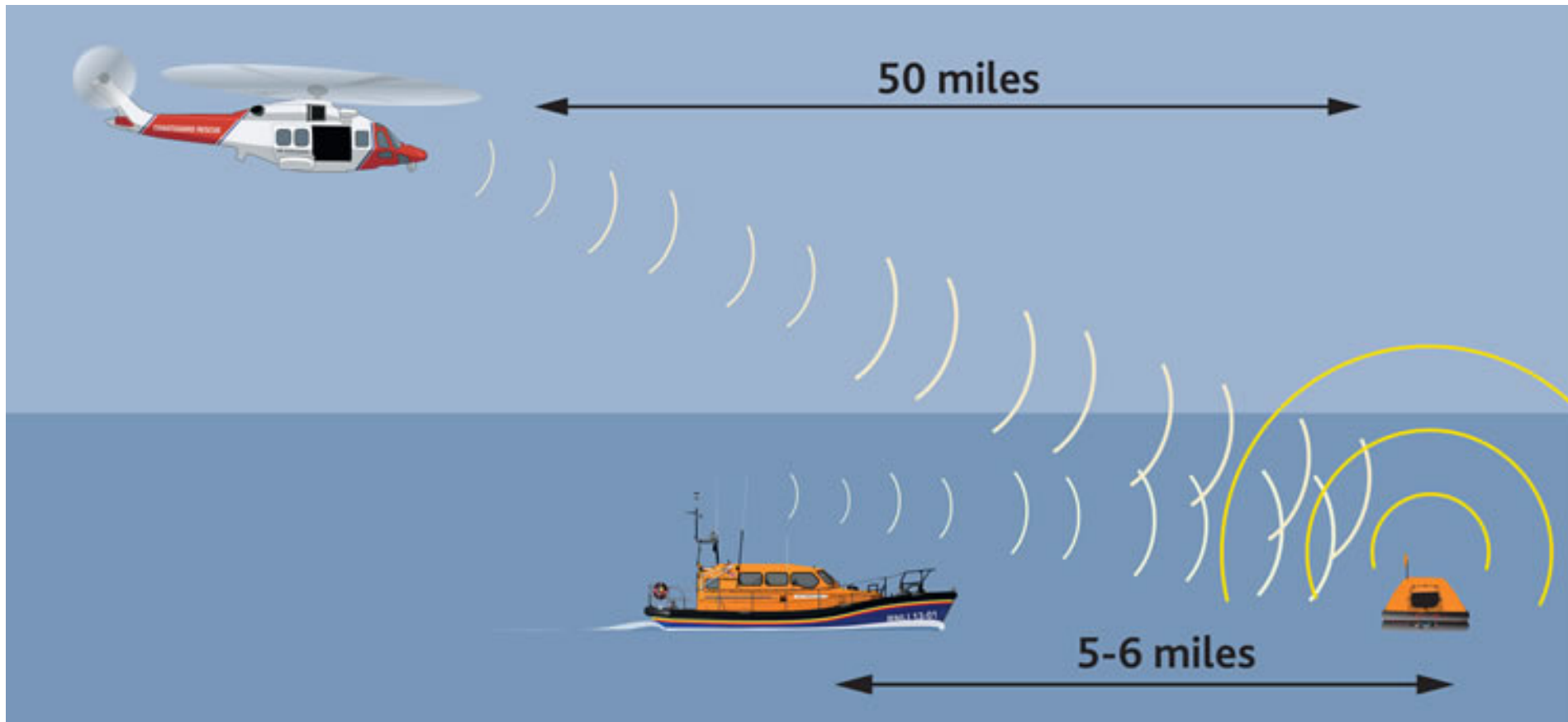
## Search and Rescue Transponder (SART)



- SART operates on the 9GHz frequency band (9.2 to 9.5 GHz) and generates a series of clips on the radar it is interrogated by (3 cm/X Band radar).
- It is capable of floating free of the survival craft
- SART is mounted on a mounting bracket, which is fixed to a bulkhead on a ship, on the bridge
- The SART is activated manually and hence responds only when interrogated
- The SART also has an audio or visual indication of its correct operation and informs survivors when interrogated by the radar
- An audible beep is heard every 12 seconds when there are no radars in sight and every 2 seconds when interrogated by radar

## Search and Rescue Transponder (SART) (cont.)

SART devices are portable radar transponders operating on the radar "X" and "S" frequency bands. SARTs are used in ships, lifeboats and liferafts.



## Search and Rescue Transponder (SART) (cont.)

When activated in a distress situation, the SART responds to radar interrogation by transmitting a signal which generates 12 blips on the radar and turns into concentric circles as the range between the two reduces..



# Survival craft portable two-way VHF radiotelephone apparatus

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## Two-way VHF radiotelephone apparatus

At least two two-way VHF radiotelephone apparatus required for cargo ships of 300-500 GT

At least three two-way VHF radiotelephone apparatus required for all passenger ships and cargo ships of 500 GT and upwards

The portable marine radio is located in the bridge in case the ships personnel have to board the survival craft

These GMDSS radios are designed for emergency use only.

Used for on scene coordination between the survival craft and the SAR units.



**Inmarsat-C** is a two-way, packet data service operated by the telecommunications company Inmarsat which operates between mobile earth stations (MES) and land earth stations (LES).

Voice communication is not possible with Inmarsat-C.

Inmarsat C is approved for use under the GMDSS

Inmarsat C also meets the requirements for Ship Security Alert Systems (SSAS) defined by the International Maritime Organization (IMO) and is the most widely used service in fishing Vessel Monitoring Systems (VMS).

In January 2020, the **Iridium** constellation was certified for use in the Global Maritime Distress and Safety System (GMDSS). The certification ended a monopoly on the provision of maritime distress services that had previously been held by Inmarsat since the system became operational in 1999.

## Carriage requirements for SOLAS vessels – The minimum requirement (A1 area)

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- A **VHF radio** installation capable of transmitting DSC on channel 70, and radiotelephony on channels 16, 13 and 6. (see Note 1).
- A **DSC watchkeeping receiver operating on VHF 70** (may be distinct of above VHF equipment or incorporated).
- A **SART** (Two on vessels over 500 GRT, one on vessels 300 - 500 GRT);
- Two portable **VHF transceivers** for use in survival craft if under 500 GRT, three if over 500 GRT.
- A **NAVTEX** receiver, if the ship passes in any area where a NAVTEX service is provided.
- An **Inmarsat EGC receiver**, if the ship is engaged on voyages outside of International NAVTEX coverage (see note 2).
- **A 406 MHz EPIRB**

*Note 1 - Voice watch is effectively required on channel 16 until further notice.*

*Note 2 - in practice, this means that all GMDSS A3 and A4 vessels are required to carry at least one Inmarsat C system.*

In addition to minimum requirements :

- An MF radio installation capable of transmitting and receiving on the frequencies 2187.5 kHz using DSC and 2182 kHz using radiotelephony; and
- A DSC watchkeeping receiver operating on 2187.5 kHz.
- Ability to transmit and receive general radiocommunications using radiotelephony or direct-printing telegraphy by either:
  - A HF radio installation operating on working frequencies in the (marine) bands between 1,605 kHz and 27,500 kHz. (This requirement is normally fulfilled by the MF equipment referred to earlier - all GMDSS MF transceivers also cover HF) or
  - Inmarsat ship earth station.

## Carriage requirements on SOLAS vessels for A1, A2 and A3

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**These vessels have two options** to satisfy their GMDSS requirements. The options allow a vessel to choose from the primary method to be used for ship-shore alerting;

- An **Inmarsat C ship earth station**
- An **MF radio installation and 2187.5 kHz DSC watchkeeping receiver** (can be the same one as required for A2);

**OR**

- **An MF/HF radio installation** capable of transmitting and receiving on all distress and safety frequencies in the (marine) bands between 1,605 kHz and 27,500 kHz using DSC, radiotelephony and NBDP.
- **An MF/HF DSC watchkeeping receiver** capable of maintaining DSC watch on 2,187.5 kHz, 8,414.5 kHz and on at least one of the distress and safety DSC frequencies 4,207.5 kHz, 6,312 kHz, 12,577 kHz or 16,804.5 kHz; at any time, it shall be possible to select any of these DSC distress and safety frequencies

**AND**

Ships shall be capable of **transmitting and receiving general radiocommunications** using radiotelephony or direct-printing telegraphy by an MF/HF radio installation operating on working frequencies in the (marine) bands between 1,605 kHz and 27,500 kHz. This requirement is normally fulfilled by the addition of this capability in the MF/HF equipment referred to earlier - there is no MF only equipment made.



Same requirements as for A1, A2 et A3 areas

But if solution 2 chosen : *power of MF/HF installation  $\geq 400$  W)*

## **In addition for Passenger ships :**

Every passenger ship shall be provided with means of two way on scene-radiocommunications for SAR purposes using the VHF aeronautical frequencies 121.5 MHz and 123.1 MHz from the position from which the ship is normally navigated.

## Means of ensuring availability of ship station equipment

Regulation 15 of the SOLAS GMDSS regulations defines 3 methods to ensure availability of GMDSS equipment at sea;

- **At sea electronic maintenance**, requiring the carriage of a qualified radio/electronic officer (holding a GMDSS First or Second class Radio-Electronics Certificate) and adequate spares and manuals;
- **Duplication of certain equipment; or**
- **Shore based maintenance**

Ships engaged on voyages in sea areas **A1 and A2 are required to use at least one** of the three maintenance methods outlined above, or a combination as may be approved by their administration.

Ships engaged on voyages in sea areas **A3 and A4 are required to use at least two** of the methods outlined above.

*Note:*

*In fact, A3 GMDSS ships, along with probably 100% of A1 and A2 GMDSS ships do not opt for at sea maintenance - they either duplicate the equipment and use shore based maintenance (for A3 ships), or use shore based maintenance only (A1 and A2 ships).*

SOLAS Vessels operating in A3 areas are required to provide the following duplicated equipment;

- Two complete VHF installations (including DSC), and either;
- Two complete Inmarsat C systems and one MF radio system, or;
- One complete Inmarsat C system and one complete MF/HF radio system (including a scanning DSC receiver and NBDP equipment).

## How have the requirements for shipborne GMDSS equipment changed after 1 January 2024?

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Except for replacing VHF-EPIRB with satellite-EPIRB in sea area A1, no additional or replacement GMDSS equipment is required.

However, the function of NBDP for MF/HF radio installation is no longer required.

Thank you for your  
attention