1. INTRODUCTION

Radio has been the foundation of the distress and safety systems used by ships at sea. It was soon realized that, to be effective, a radio-based distress and safety system had to be founded on internationally agreed rules concerning the type of equipment, the radio frequencies used, and operational procedures. The current system is called the **Global Maritime Distress and Safety System (GMDSS).**

GMDSS was adopted by the International Maritime Organization (IMO) in 1988 and replaced the 500 kHz Morse code system. The basic concept of the GMDSS is that search and rescue authorities ashore, as well as shipping in the immediate vicinity of the ship in distress, will be rapidly alerted to a distress incident so that they can assist in a coordinated SAR operation with minimum delay. The system also provides for urgency and safety communications and the promulgation of Maritime Safety Information (MSI) – navigational and meteorological warnings and forecasts and other urgent safety information to ships. In other words, every ship is able, irrespective of the area in which it operates, to perform those communication functions, which are essential for the safety of the ship itself and of other ships operating in the same area.

2. STATUTORY FRAMEWORK OF THE MARITIME MOBILE SERVICE

2.1 International Convention of Safety of Life at Sea (SOLAS)

Since the establishment of International Maritime Organization (IMO) in 1959, its efforts to enhance safety at sea by the adoption of the highest practicable standards, has sought to improve the radio communication provisions of the International Convention for the Safety of Life at Sea (SOLAS) and to exploit the advances made in radio communication technology.

The SOLAS Convention has become one of the main instruments of the IMO. It was adopted in 1974, 1978, and 1988 and amended from time to time. The GMDSS used by most of the world's shipping until 1992, is defined in chapter IV of the SOLAS Convention and the ITU Radio Regulations (RR). There was a transition period from the old to the new system in order to give the industry time to overcome any unforeseen problems in implementation of the new system. The transitional period began on 1 February 1992 and continued until 1 February 1999.

2.1.1 Functional requirements

The GMDSS is a largely, but not fully, automated system which requires ships to have a range of equipment capable of performing the nine radio communication functions of the GMDSS in accordance with **Regulation 4-1 of the SOLAS Convention**. Every ship, while at sea, should be capable of the following:

- transmission of ship-to-shore distress alerts by at least two separate and independent means, each using a different radio communication service;
- reception of shore-to-ship distress alerts;
- transmission and reception of ship-to-ship distress alerts;
- transmission and reception of search and rescue co-ordinating communications;
- transmission and reception of on-scene communications;
- transmission and reception of signals for locating;
- transmission and reception of maritime safety information;
- transmission and reception of general radio communications to and from shore-based radio systems or networks; and
- transmission and reception of bridge-to-bridge communications.

2.1.2 Sea areas

The GMDSS is based on the concept of using four marine communication sea areas to determine the operational, maintenance and personnel requirements for maritime radio communications.

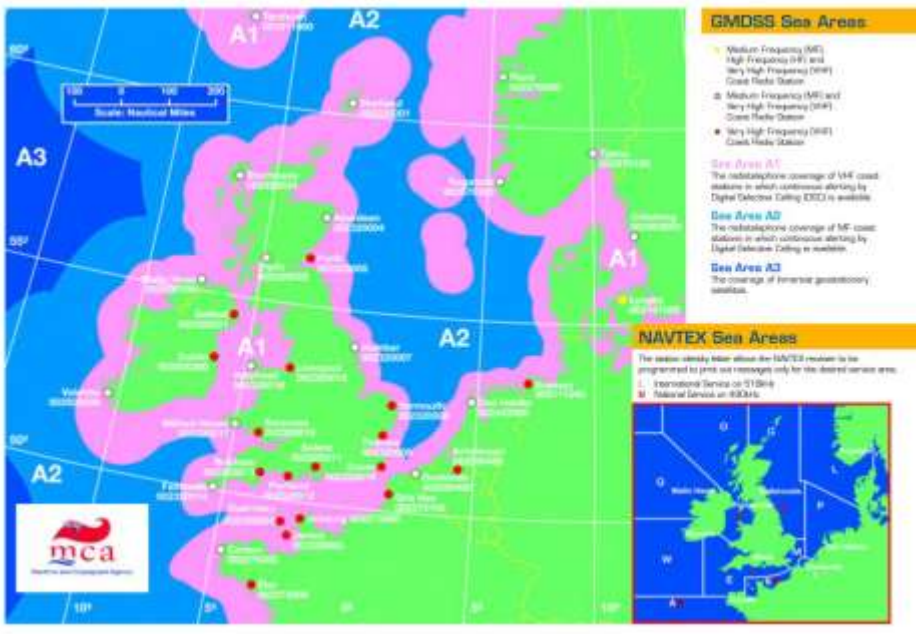
- **Sea area A1** means an area within the radiotelephone coverage of at least one VHF coast station in which continuous Digital Selective Calling (DSC) alerting is available, as may be defined by a Contracting Government. Such an area could extend typically about 30 *nautical miles* (nm) from the coast station (**SOLAS Chapter IV, Reg. 2-12**).

- **Sea area A2** means an area, excluding sea area A1, within the radiotelephone coverage of at least one MF coast station in which continuous DSC alerting is available, as may be defined by a Contracting Government. For planning purposes this area typically extends to up to 150 nm offshore, but would exclude any A1 designated areas. In practice, satisfactory coverage may often be achieved up to around 300 nm offshore (**SOLAS Chapter, IV, and Reg. 2- 13**).

- **Sea area A3** means an area, excluding sea areas A1 and A2, within the coverage of an Inmarsat geostationary satellite in which continuous alerting is available. This area lies between about latitudes 76° north and 76° south, but excludes A1 and/or A2 designated areas (**SOLAS Chapter IV, Reg. 2-14**).

- **Sea area A4** means an area outside sea areas A1, A2 and A3. This is essentially the Polar Regions, north and south of about 76° of latitude, but excludes any other areas (**SOLAS Chapter IV, Reg. 2-15**).

In all areas of operation, the continuous availability of alerting is required. The criteria for establishing those GMDSS sea areas are given in Resolution A.801(19).



Limits of sea areas British Isles and North West Europe DSC

2.1.3 Carriage requirements

Equipment carriage requirements for ships at sea depend upon the sea area in which the ship is sailing. Furthermore, ships operating in the GMDSS areas are required to carry a primary and a secondary means of distress alerting. This means having VHF DSC as a primary system for a ship near coastal areas, backed up by a satellite *Emergency Position Indicating Radio Beacon* (EPIRB). A ship operating in an offshore ocean area could have Medium-Frequency DSC, High-Frequency DSC or Inmarsat satellite communications as a primary system backed up by a satellite EPIRB. The type of equipment used in the primary system is determined by the sea area in which the ship will be navigating. The carriage requirements are defined in SOLAS chapter IV, Reg. 7 to 9 for the four sea areas. Table 1 shows how the SOLAS Regulations would translate into the bare minimum carriage requirements for the four sea areas. The majority of ships will, however, be fitted with a more comprehensive radio installation

MF/HF-DSC VHF-DSC

Radiotelex Inmarsat C

Battery Charger

Inmarsat C Distress Panel

Example of a Maritime Radio Station for terrestrial and satellite communication

- Details of equipment specifications A1, A2, A3 and A4

Equipment	Sea areaA1	Sea areaA2	Sea areaA3	Sea areaA4
VHF with DSC	X	X	X	X
SART (2)	X	X	X	X
NAVTEX receiver	X	X	X	X
EGC receiver	X	X	X	X
EPIRB	X	X	X	X
VHF portable (2 or 3)	X	X	X	X
MF telephony with DSC		X	X	X
plus				
Inmarsat-B or Inmarsat-C			X *or*	
MF/HF telephony with DSC and telex			X	X

Notes: X - Required in sea areas where the NAVTEX service is available.
X - Required in sea areas where the NAVTEX service is NOT available. The EGC receiver facility may be included in the standard Inmarsat-C terminal.
X - 406 MHz COSPAS-SARSAT EPIRB

Equipment specification

- **Details of carriage requirements**

Every ship shall be provided in accordance with **SOLAS IV, Reg. 7**:

- A VHF radio installation capable of transmitting and receiving DSC and radiotelephony (Minimum ch70, ch06, ch13 and ch16) a radio installation capable of maintaining a continuous DSC watch on *VHF channel 70* (ch70).
- A search and rescue locating device capable of operating either in the 9 GHz band or on frequencies dedicated for *Automatic Identification System* (AIS).
- A receiver capable of receiving international *Navigational Text Message* (NAVTEX) service broadcasts if the ship is engaged on voyages in any area in which an international NAVTEX service is provided.
- A radio facility for reception of maritime safety information by the Inmarsat enhanced group calling system if the ship is engaged on voyages in any area of Inmarsat coverage but in which an international NAVTEX service is not provided.
- An EPIRB which shall be capable of transmitting a distress alert through the polar orbiting satellite service operating in the 406 MHz band
- Every passenger ship shall be provided with means for two-way on-scene radio communications for search and rescue purposes using the 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**

The means of ensuring the availability of equipment is determined by the sea areas in which the ship sails (**SOLAS Chapter IV, Reg. 15**).

In sea areas A1 and A2, the availability of equipment shall be ensured by using one of the following methods:

- duplication of equipment;
- shore-based maintenance;
- at-sea electronic maintenance; or
- a combination of the above, as may be approved by the Administration.

In sea areas A3 and A4, the availability of equipment shall be ensured by using a combination of at least two of the above mentioned methods, as may be approved by the Administration.

- **Primary and secondary means of alerting**

The method of distress alerting may depend on the sea area in which the ship is sailing and on the equipment carried. As provided in SOLAS, transmitting ship-to-shore distress alerts by at least two separate and independent means, each using a different radio communication service (**SOLAS Chapter IV, Reg. 4**). The likely methods of initiating a distress alert in the four sea areas are shown below:

<u>Sea Area A1</u>

- VHF DSC on channel 70
- EPIRB (Cospas/Sarsat)
- Search and Rescue Transponder (SART)

Sea Area A2

- VHF DSC on channel 70 (for ships in a range of 30 nm)
- MF DSC on 2187.5 kHz
- Inmarsat
- EPIRB (Cospas/Sarsat)
- Search and Rescue Transponder (SART)

Sea Area A3

- VHF DSC on channel 70 (for ships in a range of 30 nm)
- MF DSC on 2187.5 kHz (for ships in a range of 150 nm)
- Inmarsat and/or
- HF DSC on 8414.5 kHz and all other HF DSC frequencies
- EPIRB (Cospas/Sarsat)
- Search and Rescue Transponder (SART) (Radar and/or AIS)

Sea Area A4

- VHF DSC on channel 70 (for the ships in a range of 30 nm)
- MF DSC on 2187.5 kHz (for the ships in a range of 150 nm)
- HF DSC on 8414.5 kHz and all other HF DSC frequencies
- EPIRB(Cospas/Sarsat)
- Search and Rescue Transponder (SART) (Radar and/or AIS)

- **Bridge alarm panel and its purpose**

A distress alarm panel is a device that makes it possible to initiate transmission of distress alerts by the radio from the position from which the ship is normally navigated. It is normally connected to the VHF-DSC, MF-DSC and Inmarsat-C terminal. (**SOLAS Chapter IV, Reg. 9 to 11**).

Function Buttons

Display

Distress Button
VHF, MF-HF, Inmarsat

Bridge alarm panel

- Requirements for radio safety certificates

A Cargo Ship Safety Radio Certificate shall be issued after an initial or renewal survey to a cargo ship that complies with the relevant requirements of SOLAS Chapter IV by the Administration under which flag the vessel is sailing. The validation of the certificate shall not exceed five years (SOLAS Chapter I, Reg. 12 and 13).

2.1.4 Watchkeeping

- Watchkeeping procedures as defined in the Radio Regulations (RR)

Ships, whilst at sea, shall maintain a continuous watch appropriate to the sea area in which the ship is sailing (SOLAS Chapter IV, Reg. 12) using:

- VHF DSC channel 70
- MF DSC distress and safety frequency 2187.5 kHz
- HF DSC distress and safety frequencies: 8414l5 kHz and also on at least one of the distress and safety DSC frequencies 4207.5 kHz, 6312.0 kHz, 12577.0 kHz or 16804.5 kHz, appropriate to the time of day and the geographical position of the ship, if the ship is fitted with an MF/HF radio station. This watch may be kept by means of a scanning receiver
- VHF channel 16, if practicable
- an Inmarsat *Ship Earth Station* (SES) (if the ship is fitted with) for satellite shore-to-ship distress alerts
- a radio watch for broadcasts of *Maritime Safety Information* (MSI) on the appropriate frequency or frequencies on which such information is broadcast for the area in which the ship is navigating.

A continuous watch for broadcasts of MSI shall also be kept, for the area in which the ship is sailing, by:

- NAVTEX (518 kHz) receiver
- Inmarsat-C or *Enhanced Group Call* (EGC) SafetyNET receiver
- HF telex

- Other watchkeeping procedures

Weather and navigational warnings are also transmitted at fixed times throughout the day by coast stations on MF, HF and VHF. The ITU List of Radio Determination and Special Service Stations should be consulted for further details. National publications, such as the *Admiralty List of Radio Signals* (ALBS) Vol. 5, may be consulted as useful additional aids.

Detailed radio communication watchkeeping requirements are set forth in part A, Chapter VIII and part B, Chapter VIII of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978 as amended as well as in the RR Chapter VII Art. 31–12 to 31–20. In addition to the distress and safety DSC frequencies ship stations should monitor automatically the DSC ship-to-ship routine calling frequency 2177 kHz in the MF band and the international routine DSC frequencies used by coast stations in order to receive Public Correspondence (CP).

2.1.5 Radio operators

Regulation IV/16 of the SOLAS Convention requires that:
Every ship shall carry personnel qualified for distress and safety radio communication purposes to the satisfaction of the Administration. The personnel shall be holders of certificates specified in the RRs as appropriate, any one of whom shall be designated to have primary responsibility for radio communications during distress incidents.

The provisions of the RRs require that the personnel of ship stations and ship earth stations for which a radio installation is compulsory under international agreements and which use the frequencies and techniques of the GMDSS shall include at least:

– *For stations on board ships which sail beyond the range of VHF coast stations:*

A holder of a first- or second- class radio electronic certificate or a *General Operator's Certificate* (GOC)

– *For stations on board ships which sail within the range of VHF coast stations:*

A holder of a first-or second- class radio electronic certificate or a General Operator's Certificate or a Restricted Operator's Certificate (ROC). An ROC only covers the operation of GMDSS equipment required for GMDSS sea area A1, and does not cover the operation of GMDSS A2/A3/A4 equipment fitted on a ship over and above the basic A1 requirements, even if the ship is in a sea area A. The combined effect of the requirements for maintenance and personnel in the four sea areas is that there must be at least one GOC holder on board ships sailing in A2, A3 or A4 sea areas.

The STCW Convention requires that all deck officers shall hold an appropriate qualification to operate VHF radio communication equipment – that is, ROC standard on GMDSS ships or whatever international/ national requirements determine.

In those cases, particularly in sea area A1, where additional equipment, over and above the minimum carriage requirements is fitted, a higher standard of operator's certification may also be required in order to ensure that the operator knowledge requirements match the actual equipment comprising the radio installation (SOLAS Chapter IV, Reg. 16).

2.1.6 Sources of power

To comply with the SOLAS Convention, ships are required to have a supply of electrical energy available sufficient to operate the radio installations, and to be able to charge any batteries used as part of a reserve source of energy, at all times while at sea.

- Reserve power supplies, capacity and duration as defined in SOLAS Convention

Reserve source or sources of energy are a mandatory requirement and must be capable of powering the radio installation in the event of failure of the ship's main and emergency source of electrical energy for the purpose of conducting distress, urgency and safety radio communications (SOLAS Ch. IV, Reg. 13). The reserve sources of energy have to be capable of simultaneously operating the VHF radio installation and, as appropriate for the sea area or sea areas for which the ship is equipped, either the MF radio installation, the HF radio installation or the ship earth station and other necessary loads, such as navigational equipment linked to the radio installation or essential emergency lighting for the installation. AIS was included after 1 July 2002.

The reserve sources of energy should be adequate for at least one hour or six hours, depending on whether the ship is provided with an emergency source of electrical power complying with SOLAS Ch. 11-1/42 or 43 and Ch. IV/13.2.1 and 13.2.2, as appropriate. The reserve power supply must be independent of the propelling power of the ship and the ship's electrical system (SOLAS Chapter IV, Reg. 13).

- Reserve source of energy

The radio communication equipment may operate either from the ship's DC or AC mains supply (often stepped down to 24 V DC), or from 24 V DC supplied by a bank of batteries. The batteries often form a reserve source of energy, which are on a "Float Charging System" so that, should the mains supply fail, the batteries automatically take over. The float charging

system ensures that the batteries are always fully charged. If necessary, a "boost" charge can be given at any time, i.e., a higher current charging supply is applied to secure a quicker charging period.

- Prohibitions on the connection of non-GMDSS equipment

All equipment to which this chapter applies shall be of a type approved by the Administration. Such equipment shall conform to appropriate performance standards not inferior to those adopted by the Organization (SOLAS Chapter IV, Reg. 14).

2.2 Radio Regulations

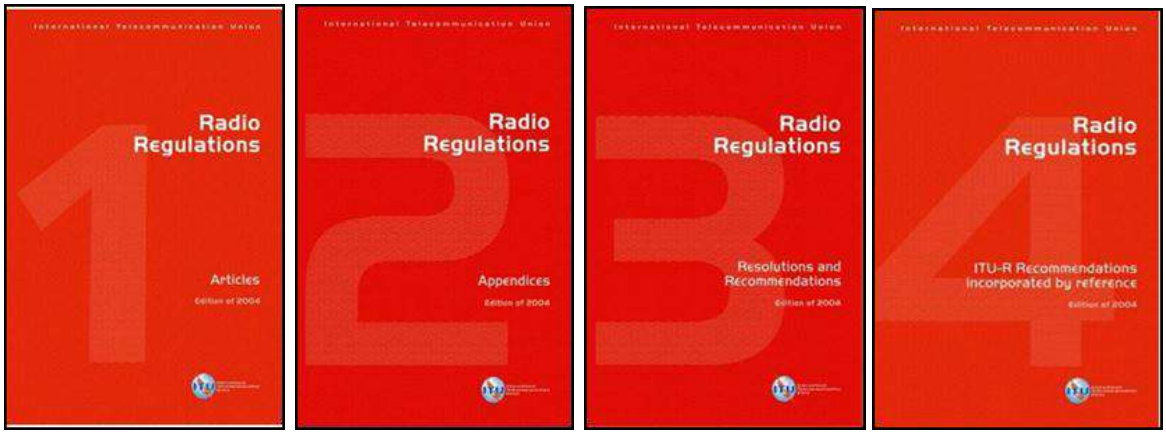
Since the global use and management of frequencies and the maritime radio operational procedures require a high level of international cooperation, one of the principal tasks in the International Telecommunication Union's (ITU) Radio Communication Sector is to facilitate the complex intergovernmental negotiations needed to develop legally binding agreements between sovereign States. These agreements are embodied in the RRs and in world and regional plans adopted for different space and terrestrial services.

Today, the RR apply to frequencies ranging from 9 kHz to 400 GHz, and incorporate over 1000 pages of information describing how the spectrum must be used and shared around the globe. In an increasingly "unwired" world, some 40 different radio services compete for allocations to provide the spectrum needed to extend applications or support a larger number of users.

Covering both legal and technical issues, these Regulations serve as an international instrument for the optimal international management of the spectrum covering radio and communication procedures.

The four volumes of the RR are published with their Articles, Appendices, Resolutions and Recommendations by the ITU. The regulations regard, among other things, to:

- Operational procedures
- Distress, urgency and safety signals
- Authority of the master
- Secrecy of correspondence
- Ship station licenses
- Inspection of stations
- Radio Operators Certificates
- Frequencies
- Watchkeeping
- Identification of radio stations



Radio Regulations

- Authority of the master

The service of a ship station is placed under the sole authority of the master or of the person responsible for the ship or other vessel carrying the station. The person holding this authority shall require that each operator comply with the RRs and that the ship station for which the operator is responsible is used, at all times, in accordance with the RRs.

The master or the person responsible, as well as all persons who may have knowledge of the text or even of the existence of a radio telegram, or of any information obtained by means of the radio communication service, are placed under the obligation of observing and ensuring the secrecy of correspondence.

- Secrecy of correspondence

The holder of a radio station license is required to preserve the secrecy of telecommunications, as provided in the RRs.

Administrations shall undertake the necessary measurements to prohibit and prevent the unauthorized interception of radio communications not intended for the general use of the public or other than that which the station is authorized to receive. The divulgence of the contents, simple disclosure of the existence, publication of any use, without authorization of information of any nature obtained by the interception of radio communications is prohibited.

In cases where unauthorized correspondence is involuntarily received it shall not be reproduced, nor communicated to third parties, nor used for any purpose. Even its existence shall not be disclosed.

- Ship station licenses

No transmitting station may be established or operated by a private person or by any enterprise without a license issued in an appropriate form and in conformity with the provisions of these regulations by or on behalf of the government of the country to which the station in question is subject (RRs, Chapter V, and Art. 18).

The government that issues a license to a mobile station or a mobile earth station shall indicate therein in clear form the particulars of the station, including its name, call sign and, where appropriate, the public correspondence category, as well as the general characteristics of the installation.

To facilitate the verification of licenses issued to mobile stations and mobile earth stations, a translation of the text in one of the working languages of the Union shall be added, when necessary, to the text written in the national language.

- Inspection of stations

The governments or appropriate Administrations of countries which a ship station or ship earth station visits may require the production of the license for examination.

The operator of the station, or the person responsible for the station, shall facilitate this examination. The license shall be kept in such a way that it can be produced upon request. As much as possible, the license, or a copy certified by the authority which has issued it, should be permanently exhibited in the station.

The inspectors shall have in their possession an identity card or badge, issued by the competent authority, which they shall show on request of the master or person responsible for the ship or other vessel carrying the ship station or the ship earth station. When the license cannot be produced or when manifest irregularities are observed, governments or administrations may inspect the radio installations in order to satisfy themselves that these conform to the conditions imposed by the RRs.

In addition, inspectors have the right to require the production of the operators' certificates, but proof of professional knowledge may not be demanded. When a government or an Administration has found that the operators' certificates cannot be produced, then this Administration must inform the Administration under which the ship station or ship earth station is registered as soon as possible.

According to SOLAS Regulations the radio stations of passenger ships including those used in life-saving appliances shall be subject to an initial survey before the ship is put into service and annual surveys.

The radio installations, including those used for life-saving appliances, of cargo ships shall be subject to an initial survey before the ship is put in service and a renewal and periodical survey at intervals specified by the Administration.

The surveys for passenger and cargo ships shall be such as to ensure that the ships' radio stations, including those used in life-saving appliances, are in all respects in satisfactory working conditions.

Before leaving, the inspector should report the result of his inspection to the master, or the person responsible for the ship or other vessel carrying the ship station or ship earth station. The inspector should make this report in writing.

- Radio Operator's Certificates

The service of every ship radiotelephone station, ship earth station and ship station using the frequencies and techniques for GMDSS, as prescribed in Chapter VII of the RR, shall be controlled by an operator holding a certificate issued or recognized by the government to which the station is subject. Provided the station is so controlled, other persons besides the holder of the certificate may use the equipment (RR, Chapter IX, Art. 47).

There are six categories of certificates, shown in descending order of requirements, for personnel of ship stations and ship earth stations using the frequencies and techniques prescribed in Chapter VII. An operator meeting the requirements of a certificate automatically meets all of the requirements of lower order certificates (World Radio Communication Conference 2007).

- First-class radio electronic certificate
- Second-class radio electronic certificate

- General operator's certificate
- Restricted operator's certificate.
- Long range certificate (only for non-SOLAS vessels)
- Short range certificate (only for non-SOLAS vessels)

The holder of one of the first four certificates specified above may carry out the operation of SOLAS ship stations or ship earth stations using the frequencies and techniques prescribed in Chapter VI of the RR. After a period of 5 years, the certificates for service on SOLAS ships have to be revalidated.

The restricted operator's certificate covers only the operation of GMDSS equipment required for GMDSS sea areas A1, and does not cover the operation of GMDSS A2/A3/A4 equipment fitted on a ship over and above the basic A1 requirements, even if the ship is operating in a sea area A1. GMDSS sea areas A1, A2, A3 and A4 are identified in the SOLAS convention. See also 0 of this compendium.

The holder of one of these certificates may carry out the service of ship stations or ship earth stations on board leisure crafts using the frequencies and techniques prescribed in Chapter VI of the RR. These certificates have a lifelong validation.

- Frequencies

Interferences

All stations are forbidden to carry out unnecessary transmissions, or the transmission of superfluous signals, or the transmission of false or misleading signals, or the transmission of signals without identification. Transmitting stations shall radiate only as much power as is necessary to ensure a satisfactory service.

In order to avoid unlawful interferences:

- Locations of transmitting stations and, where the nature of the service permits, locations of receiving stations shall be selected with particular care;
- Radiation in and reception from unnecessary directions shall be minimized by taking the maximum practical advantage of the properties of directional antennas whenever the nature of the service permits;
- The choice and use of transmitters and receivers shall be in accordance with the provisions of the RRs. Special consideration shall be given to avoiding interference on distress and safety frequencies.

The class of emission to be employed by a station should be such as to achieve minimum interference and to assure efficient spectrum utilization.

Use of and restrictions for different emissions according to frequencies in the Maritime Mobile Service (MMS)

All kinds of emission are described in the RR appendix 1. Some popular emissions in the MMS are shown below:

Types of emission and their application

Kind of emission	Explanation	Used in Band
A1A	Unmodulated Morse Code	MF, HF
A2A	Double Sideband Morse Code	MF, HF
H2A	Single Sideband Morse Code	MF, HF
J2B	Single Sideband Telex	MF, HF
F1B	Frequency Modulated Telex	MF, HF
A3E	Double Sideband Telephony	No more applicable

Kind of emission	Explanation	Used in Band
H3E	Single Sideband Telephony (full carrier)	2182 kHz (MF)
R3E	Single Sideband Telephony (reduced carrier)	MF, HF
J3E	Single Sideband Telephony (suppressed carrier)	MF, HF
F3E	Frequency Modulated Telephony	VHF
G3E	Phase Modulated Telephony	VHF

The emission H3E is only allowed on 2182 kHz. The emission J3E is the most frequently used emission for radiotelephony in MF and HF bands.

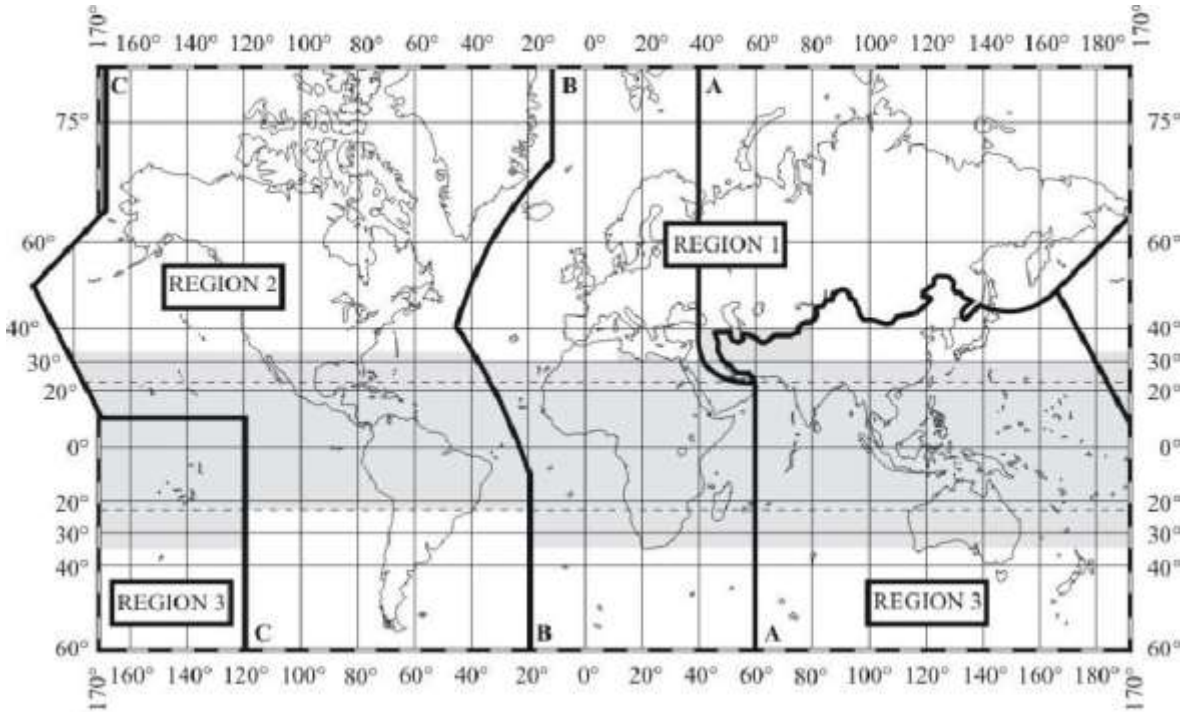
Role of the various modes of communication

Modes of communication

Kind of emission	Use
A1A	Morse telegraphy, Free line signal on Telex frequencies
A2A	Morse telegraphy, Free line signal on Telex frequencies
H2A	Morse telegraphy, Free line signal on Telex frequencies
J2B	Single Sideband Radiotelex
F1B	NAVTEX, DSC
A3E	Older lifeboat station telephony
H3E	MF Telephony on 2182 kHz, Bearing signal (Carrier)
R3E	Telephony on MF and HF, not often used
J3E	MF/HF Telephony with ship- or coast stations
F3E	VHF telephony
G3E	VHF telephony on ships

Use of MF, HF, VHF, UHF and SHF frequency bands in the MMS

For the allocation of frequencies the world has been divided into three Regions as shown in the map below:



ITU Regions (Article V RR)

To avoid mutual interferences there are certain MF frequency bands allocated for each region. In addition other frequency bands can also be used regardless of the region. As shown in the table below, single frequency bands can be allocated to different radio services in the appropriate regions. The use of single frequencies in each MF band in its region is allocated by the responsible Authority of each country.

MF frequency bands

Region 1

1 606.5-1 625
FIXED
MARITIME MOBILE
LAND MOBILE

1 635-1 800
FIXED
MARITIME MOBILE
LAND MOBILE

1 850-2 000
FIXED
MOBILE except aeronauticalmobile

2 000-2 025
FIXED
MOBILE except aeronautical mobile (R)

2 045-2 160
FIXED
MARITIME MOBILE
LAND MOBILE

2 170-2 173.5
MARITIME MOBILE

2 173.5-2 190.5
MOBILE (distress and calling)

2 190.5-2 194
MARITIME MOBILE

2 194-2 300
FIXED
MOBILE except aeronautical mobile (R)

2 300-2 498
FIXED
MOBILE except aeronautical mobile (R)
BROADCASTING

2 502-2 625
FIXED
MOBILE except aeronautical mobile (R)

2 625-2 650
MARITIME MOBILE
MARITIME RADIONAVIGATION

2 650-2 850
FIXED
MOBILE except aeronautical mobile (R)

3 155-3 200
FIXED
MOBILE except aeronautical mobile (R)

3 200-3 230
FIXED
MOBILE except aeronautical mobile (R)
BROADCASTING

3 230-3 400
FIXED
MOBILE except aeronautical mobile
BROADCASTING

3 500-3 800
AMATEUR
FIXED
MOBILE except aeronautical mobile

Region 2

1 625-1 705
FIXED
MOBILE
BROADCASTING
RADIOLOCATION

1 705-1 800
FIXED
MOBILE
RADIOLOCATION
AERONAUTICAL
RADIONAVIGATION

1 850-2 000
AMATEUR
FIXED
MOBILE except aeronautical mobile
RADIOLOCATION
RADIONAVIGATION

2 000-2 065
FIXED
MOBILE

2 065-2 107
MARITIME MOBILE

2 107-2 170
FIXED
MOBILE

2 170-2 173.5
MARITIME MOBILE

2 173.5-2 190.5
MOBILE (distress and calling

2 190.5-2 194
MARITIME MOBILE

2 194-2 300
FIXED
MOBILE

2 300-2 495
FIXED
MOBILE
BROADCASTING

2 505-2 850
FIXED
MOBILE

3 155-3 200
FIXED
MOBILE except aeronautical mobile (R)

3 200-3 23
FIXED
MOBILE except aeronautical mobile (R)
BROADCASTING

3 230-3 400 FIXED
MOBILE except aeronautical mobile
BROADCASTING

3 750-4 000
AMATEUR
FIXED
MOBILE except aeronautical mobile (R)

Region 3

1 606.5-1 800
FIXED
MOBILE
RADIOLOCATION
RADIONAVIGATION

1 800-2 000
AMATEUR
FIXED
MOBILE except aeronautical mobile
RADIONAVIGATION
RADIOLOCATION

2 000-2 065
FIXED
MOBILE

2 065-2 107
MARITIME MOBILE

2 107-2 170
FIXED
MOBILE

2 170-2 173.5
MARITIME MOBILE

2 173.5-2 190.5 MOBILE
(distress and calling)

2 190.5-2 194
MARITIME MOBILE

2 194-2 300
FIXED
MOBILE

2 300-2 495
FIXED
MOBILE
BROADCASTING

2 505-2 850
FIXED
MOBILE

3 155-3 200 FIXED
MOBILE except aeronautical mobile (R)

3 200-3 230
FIXED
MOBILE except aeronautical mobile (R)
BROADCASTING

3 230-3 400 FIXED
MOBILE except aeronautical mobile
BROADCASTING

3 500-3 900
AMATEUR
FIXED
MOBILE

HF frequency management

In the different HF bands between 4 MHz and 26 MHz, certain frequencies are allocated for the purpose of radiotelephony, radio telex (NBDP), facsimile (fax), data and transmission. The frequency plan and channeling system are enlisted in the RRs appendix 17 and in appendix 10 - 14.

VHF telephony

The VHF maritime band between 156 MHz and 174 MHz is split into 54 channels with a bandwidth of 25 kHz each. The channel spacing of 12.5 kHz can be used if the neighbouring authorities agree. The list of VHF channels and their frequencies can be found in the RRs appendix 18 and in appendix 8.

Frequencies for distress, urgency and safety communications

Distress/ Urgency/ Safety frequencies (MF/ HF in kHz)

DSC RX	DSC TX	RTP-COM	NBDP	Direction
ch70	ch70	ch16	--	S-S, S-CS, Area
2187,5	2187,5	2182,0	2174,5	S-S, S-CS, Area
4207,5	4207,5	4125,0	4177,5	S-S, S-CS, Area
6312,0	6312,0	6215,0	6268,0	S-S, S-CS, Area
8414,5	8414,5	8291,0	8376,5	S-S, S-CS, Area
12577,0	12577,0	12290,0	12520,0	S-S, S-CS, Area
16804,5	16804,5	16420,0	16695,0	S-S, S-CS, Area

Frequencies for routine communication and reply

Routine frequencies in (MF/ HF in kHz)

DSC RX	DSC TX	RTP-COM	NBDP	Direction
ch 70	ch70	VHF-Work	--	S-S, S-CS, Area
2177,0	2177,0	MF-Work	MF-Work	S-S, Area
2177,0	2189,5	Coast-Work	Coast-Work	S-CS
4219,5	4208,0	Coast-Work	Coast-Work	S-CS
6331,0	6312,5	Coast-Work	Coast-Work	S-CS
8436,5	8415,0	Coast-Work	Coast-Work	S-CS
12657,0	12577,5	Coast-Work	Coast-Work	S-CS
16903,0	16805,0	Coast-Work	Coast-Work	S-CS
19703,5	18898,5	Coast-Work	Coast-Work	S-CS
22444,0	22374,5	Coast-Work	Coast-Work	S-CS
26121,0	25208,5	Coast-Work	Coast-Work	S-CS

The routine DSC frequencies in the HF area for calling coast stations are the first of three lines of DSC routine calling frequencies in the RR. The coast working frequencies are described in the RR, appendix 17.

- Call categories

In the GMDSS there are four (4) categories of priority:

Distress

The transmission of a distress alert and/or a distress call and message indicates that:

- a mobile unit or person is threatened by grave and imminent danger; and
- requires immediate assistance.

Distress communications shall have priority over all other communications.

Urgency

The transmission of an urgency announcement and an urgency call and message indicates that the following information refers to:

- an urgent need for assistance; or
- a medical transport; or
- a medico call/message.

Urgency communications shall have priority over all other communications, except distress communication.

Safety

The transmission of a safety announcement and a safety call and message indicates that the following information refers to:

- safety of navigation; or
- weather conditions; or
- nautical warning; or
- ship movement communication.

Safety communications shall have priority over all other communications, except distress and urgency communication.

Routine

The transmission of a routine announcement and a routine call and message indicates that the following information refers not to distress- urgency- or safety purposes. **Routine communications shall have no priority.**

- Watchkeeping

Coast stations assigned with watch-keeping responsibilities in the GMDSS shall maintain an automatic DSC watch on frequencies and for periods of time as indicated in the information published in the List of Coast Stations and Special Service Stations.

Coast earth stations assigned with watch-keeping responsibilities in the GMDSS shall maintain a continuous automatic watch for appropriate distress alerts relayed by space stations.

Ship stations, appropriately equipped, shall, whilst at sea, maintain an automatic DSC watch on the appropriate distress and safety calling frequencies in the frequency bands in which they are operating. Ship stations which have the appropriate equipment, shall also maintain watch on the appropriate frequencies for the automatic reception of transmissions of meteorological and navigational warnings and other urgent information to ships.

Ship stations complying with the provisions of the RRs should, where practicable, maintain a watch on the frequency 156.8 MHz (VHF channel 16).

Ship earth stations complying with the provisions of the RRs shall, while at sea, maintain watch except when communicating on a working channel.

3. IDENTIFICATION OF RADIO STATIONS

During transmissions carrying identification signals, a station shall be identified by a call sign by a *Maritime Mobile Service Identity* (MMSI) or by other recognized means of identification which may be one or more of the following: name of station, location of station, operating agency, official registration mark, flight identification number, selective call number or signal, selective call identification number or signal, characteristic signal, characteristic of emission or other clearly distinguishing features readily recognized internationally.

When a station operating in the maritime mobile service or the maritime mobile satellite service is required to use maritime mobile service identities, the responsible Administration shall assign an identity to the station in accordance with the provisions described in ITU-R M.585-4.

Maritime mobile service identities are formed by a series of nine digits which are transmitted over the radio in order to uniquely identify ship stations, ship earth stations, coast stations, coast earth stations, and other non-ship borne stations operating in the maritime mobile service or the maritime mobile-satellite service, and group calls. These identities are formed in such a way that the identity or part thereof can be used by telephone and telex subscribers connected to the public telecommunications network principally to call ships automatically in the shore-to-ship direction. Access to public networks may also be achieved by means of free-form numbering plans, so long as the ship can be uniquely identified using the system's registration database to obtain the ship station identity, call sign or ship name and nationality. All transmissions shall be capable of being identified by identification signals.

3.1 Identification of ship stations

Ships shall be identified by the following:

- a call sign; or
- the official name of the ship preceded, if necessary, by the name of the owner on condition that there is no possible confusion with distress, urgency and safety signals; or
- its selective call number or signal.

- **Ship's name**

Normally, the ship will be named by the owner of the vessel.

- **Call sign**

All stations open to international public correspondence, all amateur stations, and other stations which are capable of causing harmful interference beyond the boundaries of the territory or geographical area in which they are located, shall have call signs from the international series allocated to its Administration as given in the Table of Allocation of International Call Sign Series in appendix 19.

The ITU assigns call sign series to each country. Germany for example has the series DAA-DRZ and Y2A-Y9Z.

Example:
DGDC, DL4766, Y5LM

Call signs are being formed in the following manner:

- two characters and two letters, or
- two characters, two letters and one digit (other than the digits 0 or 1), or

- two characters (provided that the second is a letter) followed by four digits (other than the digits 0 or 1 in cases where they immediately follow a letter), or
- two characters and one letter followed by four digits (other than the digits 0 or 1 in cases where they immediately follow a letter). (WRC-07)

- Maritime Mobile Service Identity

Ships participating in the maritime radio services should be assigned a nine-digit unique ship station identity in the format:

M1I2D3X4X5X6X7X8X9

wherein the first three digits represent the *Maritime Identification Digits* (MID) and X is any figure from 0 to 9. The MID denotes the geographical area of the Administration responsible for the ship station so identified.

The MMSI of a vessel is assigned by an Administration of a country under which flag the vessel is sailing. An important element of an MMSI is the MID. Each Administration has been allocated one or more MID for its use. Germany, for example has been allocated 211 and 218.

Example: 211 232 000, 218 456 000

Survival craft station call signs shall conform to the following:

– The call sign of the parent ship followed by two digits (other than the digits 0 or 1 in cases where they immediately follow a letter).

- Group calling number

Group ship station call identities for calling simultaneously more than one ship are formed as follows:

01M2I3D4X5X6X7X8X9

where the first figure is zero and X is any figure from 0 to 9. The MID represents only the territory or geographical area of the Administration assigning the group ship station call identity and does not therefore prevent group calls to fleets containing more than one ship nationality.

3.2 Identification of coast stations

In addition to the call sign, coast stations in the maritime radio services should be assigned a nine-digit unique coast station identity in the format:

0102M3I4D5X6X7X8X9

where the digits 3, 4 and 5 represent the MID and X is any figure from 0 to 9. The MID reflects the territory or geographical area in which the coast station or coast earth station is located.

Group coast station call identities for calling simultaneously more than one coast station are formed as a subset of coast station identities, as follows:

0102M3I4D5X6X7X8X9

where the first two figures are zeros and X is any figure from 0 to 9. The MID represents only the territory or geographical area of the Administration assigning the group coast station call identity. The identity may be assigned to stations of one Administration which are located in only one geographical region as indicated in the relevant ITU-T Recommendations.

The combination 010293949506070809 is reserved for the All Coast Stations Identity and should address all VHF 00XXXXXXX stations. It is not applicable to MF or HF coast stations.

3.3 Identification of Search and Rescue (SAR) Stations

When an aircraft is required to use maritime mobile service identities for the purposes of conducting search and rescue communications with stations in the maritime mobile service, the responsible Administration should assign a nine-digit unique aircraft identity, in the format:

111213M4I5D6X7X8X9

where the digits 4, 5 and 6 represent the MID and X is any figure from 0 to 9. The MID represents only the territory or geographical area of the Administration assigning the aircraft call identity.

The Administration may use the seventh digit to differentiate between certain specific uses of this class of MMSI, as shown in the example applications below:

- 111MID1XX Fixed-wing aircraft
- 111MID5XX Helicopters

The combination 111213M4I5D6070809 should be reserved for a Group Aircraft Identity and should address all 111MIDXXX stations within the Administration. The Administration may further augment this with additional Group Call identities, i.e. 111MID111, etc.

3.4 Identification of Vessel Traffic Service (VTS) stations

VTS stations will normally not have call signs. They should be called by the station name followed by its purpose and the word Radio for example:

- Hamburg Pilot Radio
- Hamburg Traffic Radio
- Hamburg Port Radio
- Kiel Kanal Radio
- Hunte Bridge Radio

As the number of coast stations decreases in many countries, an Administration may wish to assign MMSI of the format above (Coast Stations) to harbour radio stations, pilot stations and other stations participating in the maritime radio services. The stations concerned should be located on land or on an island in order to use the 00MIDXXXX format.

The Administration may use the sixth digit to further differentiate between certain specific uses of this class of MMSI, as shown in the example applications below:

- 00MID1XXX Coast radio stations
- 00MID2XXX Harbour radio stations
- 00MID3XXX Pilot stations, etc.

3.5 Identification of Aids to Navigation

When a means of automatic identification is required for a station aiding navigation at sea, the responsible Administration should assign a nine-digit unique number in the format:

9192M3I4D5X6X7X8X9

where the digits 3, 4 and 5 represent the MID and X is any figure from 0 to 9. The MID represents only the territory or geographical area of the Administration assigning the call identity for the navigational aid.

The format shown above applies to unmanned AIS *aids to navigation* (AtoN) floating in the water and virtual AIS aids to navigation belonging to aids to navigation systems. The Administration may use the sixth digit to differentiate between certain specific uses of the MMSI, as shown in the example applications below:

- 99MID1XXX Physical AIS AtoN
- 99MID6XXX Virtual AIS AtoN

In addition to the use of the sixth digit to differentiate between specific navigational aids as explained above, the seventh digit may be used for national purposes, to define areas where the AIS AtoN are located or types of AIS AtoN to the discretion of the Administration concerned.

3.6 Identification of aircraft stations

Aircraft stations are identified by:

- a call sign which may be preceded by a word designating the owner or the type of aircraft; or
- a combination of characters corresponding to the official registration mark assigned to the aircraft; or
- a word designating the airline, followed by the flight identification number.

The call sign consists of two characters and three letters.

An aircraft which has to be able to communicate with ships and/or coast stations in cases other than SAR can use maritime mobile equipment. Administrations should assign the ships MMSIs.

3.7 Identification of associated craft with parent ship

Devices used on craft associated with a parent ship, need unique identification. These devices which participate in the maritime mobile service should be assigned a nine-digit unique number in the format:

9182M3I4D5X6X7X8X9

where the digits 3, 4 and 5 represent the MID and X is any figure from 0 to 9. The MID represents only the territory or geographical area of the Administration assigning the call identity for the craft associated with a parent ship.

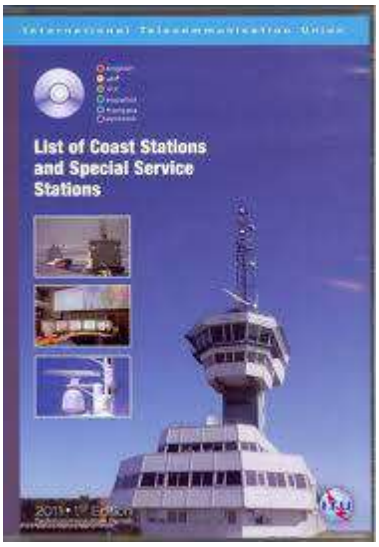
This numbering format is only valid for devices on board crafts associated with a parent ship. A craft may carry multiple devices for which an MMSI is required. These devices may be located in lifeboats, life-rafts, MOB-boats or other craft belonging to a parent ship.

3.8 Identification of Ship Earth Stations and Coast Earth Stations

- Inmarsat-B starts with number 3, all in all 9-digits
- Inmarsat-C starts with number 4, all in all 9-digits
- Inmarsat-M starts with number 6, all in all 9-digits
- Inmarsat Fleet starts with number 76, all in all 9-digits and 60 for high speed data, all in all 9-digits

4 SERVICE PUBLICATIONS

4.1. List of Coast Stations and Special Service Stations (ITU List IV)



The List IV contains important information for the mariner, in relation to radio communications including the GMDSS and CP services. Detailed information is provided in relation to the facilities available at each maritime coast radio station. These stations may provide watch keeping using DSC techniques and radiotelephony. The frequencies for transmitting, receiving and the geographical coordinates for each station are given. Details of additional services such as medical advice, navigational and meteorological warnings, MSI, AIS, meteorological bulletins and radio time signals are given with the hours of service and operational frequencies. It also contains information on Port stations, Pilot stations, Coast earth stations, VTS stations, contact information of RCC, SAR agencies, Navarea coordinators and AtoNs.

It should be noted that no supplements will be printed between two editions. However, a file containing a compilation of changes, notified to this List, will be made available for information, free of charge, through the ITU MARS webpage.

- List of Ship Stations and Maritime Mobile Service Identity Assignments (ITU List V)

The List of Ship Stations and Maritime Mobile Service Identity Assignments (List V) is a service publication prepared and issued, once a year, by the ITU, in accordance with provision no. 20.8 of the RR. As stipulated in appendix 16 to the RR, this List shall be provided to all ship stations for which a GMDSS installation is required by international agreement.

This List is published in CD-ROM format and contains the Preface and reference tables in a booklet form.

The CD-ROM contains, in pdf format, information concerning ship stations, coast stations and search and rescue aircraft for which an MMSI has been notified to the radio communication bureau as well as other ship stations, predetermined groups of ship stations, *Accounting Authority* (AA) identification codes and contact information of notifying administrations.

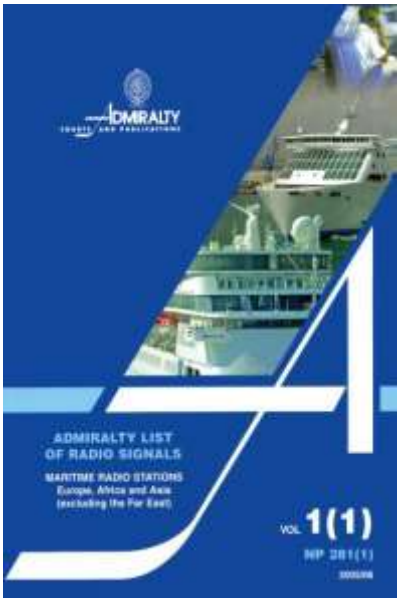
The CD-ROM also contains a database which enables users to search for and display particulars and details of ship stations, Accounting Authorities and countries responsible for the notifications.

The CD ROM also contains a database, along with an interface similar to the ITU MARS system (http://www.itu.int/ITUR/go/mars/en), which enables users to search for and display particulars and details of ship stations, AAs and countries responsible for the notifications.

4.2 Manual for use by the Maritime Mobile and Maritime Mobile-Satellite Services

The Maritime Mobile and Maritime Mobile-Satellite Services reflects the regulatory provisions and the latest decisions concerning the services by ITU conferences (including relevant decisions pertaining to the introduction of new systems and techniques). As prescribed in appendix 16 of the RR, the Manual is required to be carried in stations on board ships.

The Manual for use by the Maritime Mobile and Maritime Mobile-Satellite Services is published in accordance with Article 20 (No. 20.14) of the RR, and results from studies carried out in the ITU-R since 2008. Edition 2013 comprises two volumes, not sold separately. Volume 1 provides descriptive text of the organization and operation of the GMDSS and other maritime operational procedures, while volume 2 contains the extracts of the regulatory texts associated with maritime operations.



4.3 Admiralty List of Radio Signals

The Admiralty List of Radio Signals series provides comprehensive information on all aspects of maritime radio communications. The data is organized into six volumes, some divided into several parts for ease of handling. Each of the six volumes is presented in a user-friendly format with full colour photographs and diagrams.

Volume 1 (Parts 1 & 2) - Maritime Radio Stations
Volume 2 - Radio Aids to Navigation, Satellite Navigation Systems, Differential GPS (DGPS)
Legal Time, Radio Time Signals and Electronic Position Fixing Systems
Volume 3 (Parts 1 & 2) - Maritime Safety Information Services
Volume 4 - Meteorological Observation Stations
Volume 5 - Global Maritime Distress and Safety System (GMDSS)
Volume 6 (Parts 1 - 7) - Pilot Services, Vessel Traffic Services and Port Operations

The contents range from a complete listing of stations handling maritime public correspondence to a full range of products and services essential for compliance with the GMDSS. The volumes also feature radio stations broadcasting weather services and forecasts and a detailed explanation of the complexities of Global Satellite Position Fixing Systems. ALRS publications are presented in a user-friendly format and are updated through section VI of the weekly editions of Admiralty Notices to Mariners. New editions are published annually containing all changes to information held.

5. TECHNICAL

5.1 Radio wave propagation

The radio wave is needed to carry the signal information efficiently and without distortion. In the case of audio frequencies, which may range from about 50Hz to 15 kHz, it would not be technically feasible to radiate the information directly from a practical transmitter and antenna.

Higher frequencies can radiate efficiently from antennas having dimensions typically between a quarter and one wave length. Thus, practical communication systems use a radio wave to carry the audio or other information (e.g., vision or data) between the transmitting and receiving sites.

Three main physical mechanisms govern the propagation of radio waves:

- Line of sight
- Ground wave
- Sky wave

Each frequency range has its own propagation characteristic. The reliability of a connection between two stations with a transmitter and a receiver depends on the choice of the correct frequency band.

The Radio Frequency (RF) spectrum is divided in several major bands:

Frequency Band	Description
15 kHz - 30 kHz	*Very Low Frequency* (VLF)
30 kHz - 300 kHz	*Low Frequency* (LF)
300 kHz - 4 MHz	*Medium Frequency* (MF)
4 MHz - 30 MHz	*High Frequency* (HF)
30 MHz - 300 MHz	*Very High Frequency* (VHF)
300 MHz - 3 GHz	*Ultra High Frequency* (UHF)
3 GHz - 30 GHz	*Super High Frequency* (SHF)
30 GHz - 300 GHz	*Extra High Frequency* (EHF)

Frequency bands

- Basics of radio wave propagation

Wavelength and frequency

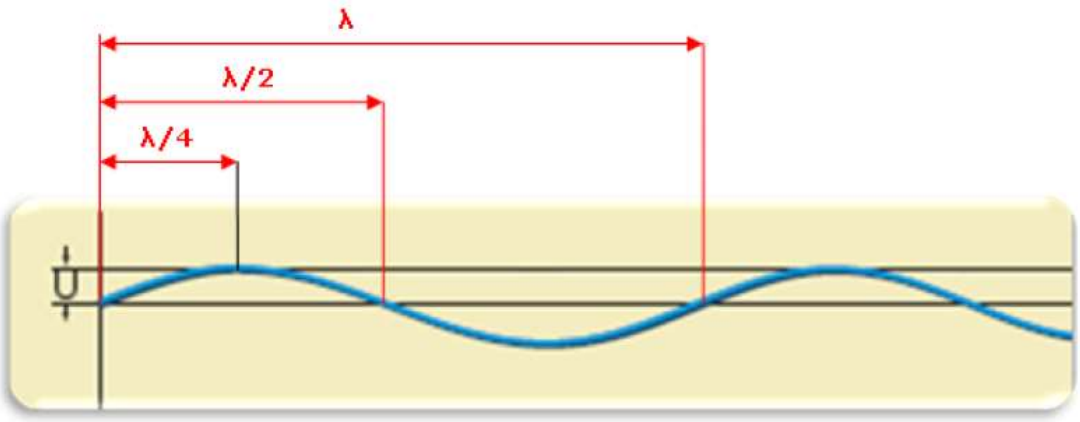
Radio waves radiate at the velocity of light, i.e., 300 x 106 m per second. The equivalence between the velocity of light (c), frequency (f) and the wavelength (λ) is demonstrated by the following formula:

$$\mathbf{f} = \frac{\boldsymbol{c}}{\boldsymbol{\lambda}}$$

where:

f = number of cycles per second
c = velocity of light 300 x 106 meters per second (300000 km per second)
λ = wavelength in meters

Thus, longer wavelength corresponds to lower frequency, while shorter wavelength to higher frequency.



Example of wavelength

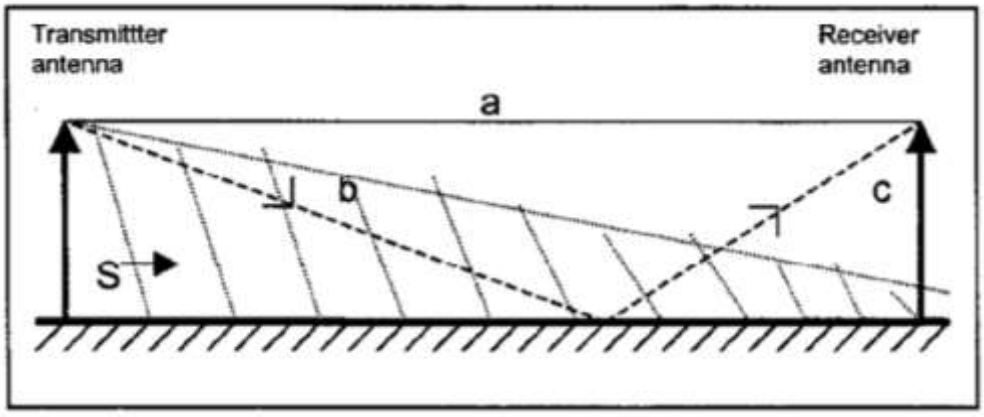
Subdivision of the most significant parts of radio spectrum used in Maritime Mobile Service (MMS)

Frequency Band	Description	Example for MMS
30 kHz – 300 kHz	Low Frequency (LF)	Weather Information
300 kHz – 4 MHz	Medium Frequency (MF)	NAVTEX, DSC
4 MHz – 30 MHz	High Frequency (HF)	NAVTEX, DSC, Voice, Telex and Data communication
30 MHz – 300 MHz	Very High Frequency (VHF)	DSC, Voice, Data communication
300 MHz – 3 GHz	Ultra High Frequency (UHF)	Voice communication, Satellite communication

Frequency ranges and their applications

Different antennas used for specific frequencies
Different types of antennas have to correspond with the different frequency ranges for which the antennas are used.

- Line of sight propagation



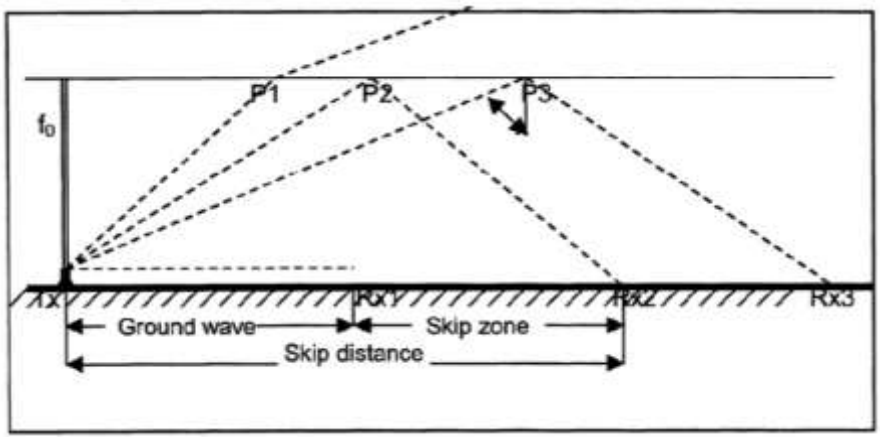
Line of sight propagation

Propagation is essentially by line-of-sight for frequency bands above 50MHz. This is accomplished, in the case of terrestrial radio, via the lower part of the atmosphere - termed the troposphere – and in the case of space communication via earth-orbiting satellites.

Line of sight propagation shows a stylised terrestrial radio link. In general, the received signal is the sum of a direct signal along path a, clear of the ground, and several reflected signals along paths such as b and c. Because a radio signal undergoes a phase reversal at the reflection point, the theoretical situation is that the direct and reflected signals should cancel out if the receiver antenna is at ground level.

Since land has poor ground conductivity, total cancellation does not occur in practice, as simple experiment with portable VHF FM receiver will show. However, the sea is a very good conductor, which means that maritime VHF antennas should be mounted well above the sea in order to avoid severe cancellation effects.

- Ground waves and sky waves



Ground waves and sky waves

In principle, a transmitting antenna sited at the earth's surface will set up a surface wave which follows the curvature of the earth. The distance, over which reliable communications can be achieved by the surface, or ground wave, depends on the frequency and the physical properties (i.e. ground conductivity and dielectric constant) of the earth along the transmission path. A ground wave can only be established with useful efficiency where the wavelength is greater than several tens of meters.

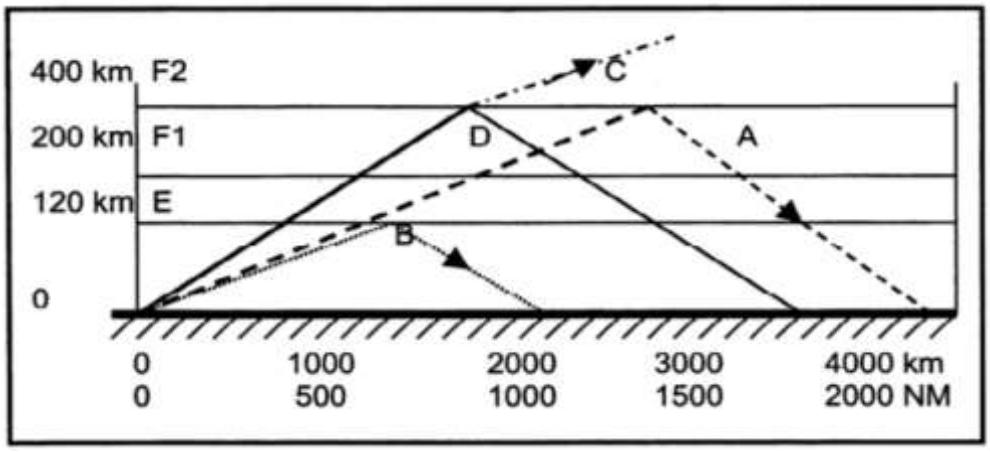
Seawater has the highest conductivity and will support the propagation of a ground wave, in much the same manner as a metal plate. At the other end of the scale, an arid desert provides very lossy ground conditions and will not support the efficient propagation on ground wave signal.

The significance of this for maritime communications is that long distance working is possible at medium to low frequencies using only modest transmitter power compared to those for broadcasting at similar frequencies over land.

Line of sight propagation also shows surface wave propagation over a terrestrial radio link. In principle, the received signal will be the sum of the line-of-sight signals and the surface wave. In practice, however, one or either of the two components will predominate depending on the transmission frequency and length of the radio link. Ground wave propagation predominates at MF, LF and VLF.

Within the frequency range of 1 – 30 MHz, ionospheric reflection is the controlling factor in achieving long-distance communications by radio waves.

- Ionosphere structure



Sky wave radio path

Because the ionization process in the upper atmosphere is responsible for this effect that is caused by the sun, it will be evident that the density of ionization will vary with the time of day and the season of the year. The sunspot cycle, which takes approximately 11 years, also has an effect. Ionospheric storms and other disturbances occur from time to time and – in extreme cases – can cause a communication black-out lasting for some days.

In general, to be able to communicate over a given distance, a higher frequency is necessary when the density of ionization is high and a lower frequency when the density of ionization falls.

Long-distance propagation of radio waves at HF is mainly the result of single or multiple reflections from ionized regions in the upper atmosphere known collectively as the ionosphere. These ionized regions are generated at heights of 100 – 40 (55–220 nm) as a result of partial ionization of the molecules making up the rare field upper regions by ultraviolet and soft (long wavelength x-ray solar radiation). The ionization process converts the molecules into plasma of ions and free electrons.

There is a complex variation in the degree of ionization with height such that distinct layers of more intense ionization are formed. The different layers result from different parts of the ultraviolet spectrum. The heights of these layers vary from day to night and with seasons. The most important layers for long-distance propagation of radio waves are:

- E–layer at 120 km
- F1–layer at 200 km
- F2–layer at 300 - 400km

At night and mid-winter the F1 and the F2 layers combine to form a single F-layer at approximately 250 km. This is a result of a gradual recombination of the ions and electrons back into the atmospheric gas molecules during night.

Below the E-layer is the D-layer, at a height of 50 – 90 km, which also has an influence on propagation, but more as an absorber of radio waves than as a reflecting layer. However, at VLF and LF frequencies the D-layer is sufficiently reflective to guide signals between the ground and the bottom of the D-layer for several thousand kilometers with little attenuation.

Ionospheric reflection may be simply described as the phenomenon whereby a wave appears to undergo reflection on reaching a suitable ionized region. Free electrons are set in motion so as to re-radiate the wave in a changed direction. As it passes through the ionized layers, the wave may eventually be reflected back to the earth.

On a simplified view the effect may be viewed as reflection from an area at what is termed as the mirror height. The effect is frequency-dependent, with a greater degree of ionization being necessary to cause reflection as the frequency is increased. Usually the higher layers wave the greater degree of ionization and therefore reflect the highest frequencies. Because of the greater mirror height, the communication Range achieved by a single reflection will also be greatest under these circumstances.

The solar radiation responsible for ionizing the atmosphere varies continuously from day to night and between the seasons. Sunspot activity also has a strong underlying effect on the degree of ionization. The level of sunspot activity varies over a cycle of around 11 years, with periods of maximum ionization occurring when the number of sunspots is at a maximum.

Normally, the variation is predictable enough for the best frequency bands to be selected for the intended communication path without difficulty. HF communications can, however, be disrupted by ionospheric storms for several days at a time when eruptions on the sun's surface emit a stream of high-energy charged particles which then obliterate the ionized layers – the F-region in particular.

Aurorally displays in the Polar Regions often accompany these events. Ionospheric storms are often preceded by sudden ionospheric disturbances (SIDs) when intensely strong bursts of ultraviolet radiation from the sun produce intense ionization of the low D-layer. When SIDs occur, waves are absorbed in the D-layer before reaching the higher layers or are reflected over much shorter distances than usual, resulting in the long-distance communications being blocked for hours at the time.

- UHF and VHF propagation

Above 50 MHz the predominant propagation mechanism is by straight-line paths, i.e., line-of sight.

For satellite communications an unobstructed view of the satellite is required, and the ship earth station antenna must be mounted to achieve the best view to the satellite possible.

For terrestrial communications the range depends upon the heights of both the transmitting and receiving antenna. Because of a slight bending effect on radio waves in the troposphere, caused mainly by water vapor, the radio horizon is in fact greater than the optical horizon by factor of 4/3.

Taking this factor into account, the maximum range at sea is given by the formula:

- Range in nm = 4 x [Tx (ft) + 4Rx (ft)]
- Range in nm = 2.22 x [Tx (m) + JRx (m)]
- Range in km = 4.12x [Tx (m) + Rx (m)]

Where Tx and Rx are the heights of the transmitting and receiving antenna above sea level, measured in feet or meters as indicated.

- MF propagation

Day Propagation

MF communications depend mainly on ground-wave propagation but with a further reduction in range because of the increased effect of attenuation by the earth. A coast station can achieve good ground wave coverage for voice

communications up to 550 km (300 nm). Ship stations, with less powerful transmitters and less elaborate antenna systems, can usually expect reliable ground wave communications up to 275 km (150 nm) for voice communications and 550 km (300 nm) for DSC/telex.

Night propagation

However, in addition to the ground wave propagation, sky wave propagation starts to become significant at MF, particularly at night, greatly extending the range. This can be a negative effect, however, owing to mutual interference between stations on the same frequency and interference fading caused by signals arriving at the receiver by different paths (ground wave and sky wave) from the transmitting station.

- HF propagation

In practice a good guide to establishing reliable communication at HF is to monitor the transmission of the appropriate coast station channels e.g. telex (NBDP), Voice transmissions (weather report, traffic list) on the more likely bands for the time of day and season and then call the station on whichever band provides a strong stable signal. If this is not successful, the other bands should be tried. The ionosphere can behave erratically at times, and on occasion, reception is better in the ship-to-shore direction than in the shore-to-ship direction or vice versa. Communication is frequently unreliable around sunrise and sunset.

The considerable variability of radio communication at HF is a consequence of signal propagation being predominately by sky wave, both day and night. A ground wave signal is still present but attenuates too rapidly to be of value for reliable commercial communications.

The D-layer of the ionosphere has little effect above 4 MHz and long-distance propagation is done by reflection from the E- or F-layers. In general terms, the higher the HF band used, the greater the range. This is because the higher the frequency, the further the wave has to pass into the ionosphere before it undergoes sufficient bending to be returned to earth. To a first approximation, therefore, the situation is that the higher the frequency, the greater will be the reflection (mirror) height and thus the greater will be the potential range.

Long-range propagation is also possible as a result of multiple reflections between the ground, the ionosphere and even between the layers of the ionosphere itself. However, these modes of transmission are very variable and would not be used intentionally for normal commercial communications.

The best policy for reliable HF communications is to use the highest frequency consistent with the length of the radio circuit using a single reflection. The angle at which a radio wave enters the ionosphere is also an important factor, with reflection occurring at a lower height for oblique incidence compared to vertical incidence (see Figure 15: Sky wave radio path)

The highest frequency which can be used to communicate between two fixed points by sky wave propagation is known as *the Maximum Usable Frequency* (MUF). Since this frequency puts the receiver on the edge of the ship distance, it is better to use the lower frequency of 0.85 x MUF, termed the *Optimum Traffic Frequency* (OTF), in order to improve reliability. Note, however, that the preferred choice of channel may already be in use.

For example, to establish communications with Kiel Mail Radio (Germany, HF e-mail) during daytime, the following would apply:

4 MHz = N. France
6 MHz = N. Spain
8 MHz = N. Africa

12 MHz = Ghana
16 MHz = Angola
22/25 MHz = South Africa

At night, due to changes in the ionosphere, the situation changes as the F1 and F2 layers merge and the heights of the E and F layers fall. The general result is that, to cover the same range at night it is necessary to halve the operating frequency; e.g., a link from Kiel Mail to Cape Town during daytime is possible on 22/25 MHz. During the night the 12 MHz bands would be the first choice.

When transmitting east—west, the signal may pass from daytime to night-time conditions, and it may be very difficult to establish effective communications. One strategy is to estimate the optimum transmission band according to the day / night conditions at the midpoint of the radio circuit. The best course of action may be to wait until the entire path between the two stations is in daylight or darkness/nighttime.

Maximal Usable Frequency (MUF)

The highest radio frequency which is reflected by the ionosphere over any particular path is known as the MUF. The MUF depends on:

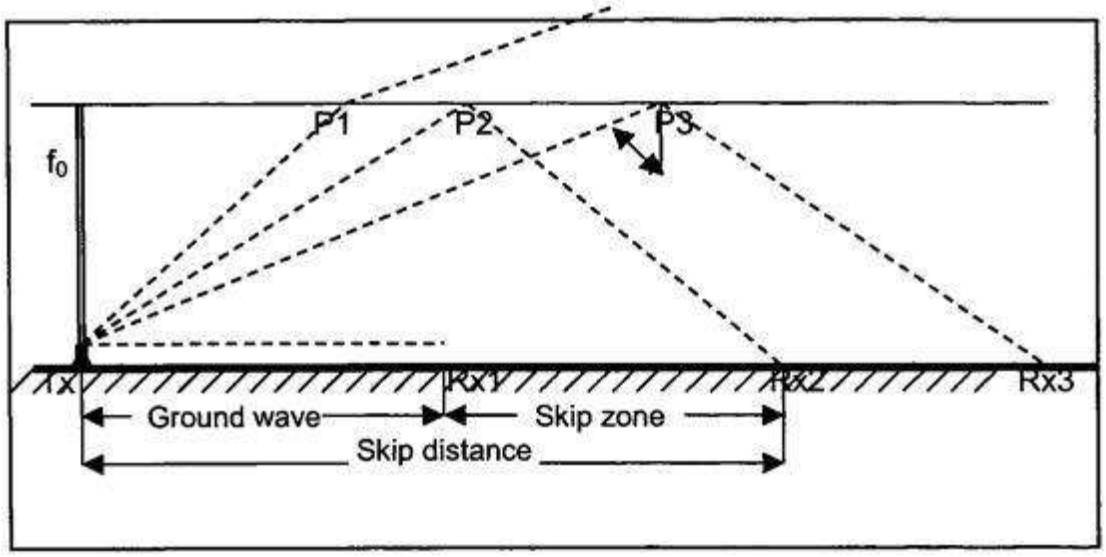
- the time of the day;
- season;
- latitude; and
- period of sunspot cycle.

The MUF varies according to which layer is responsible for reflection back to the earth. For each layer, the MUF is obtained when the ray path leaves the earth tangentially, so that the ray approaches the appropriate layer at as oblique an angle as possible. As shown in Figure 15: Sky wave radio path, this corresponds to an overall ground-to-ground distance of about 4000 km (2200 nm) for F2- layer propagation (path A); or 2500 km (1300 nm) for E-layer (path B). Any ray leaving the earth at a higher angle of elevation (path C) will penetrate the layer and not be reflected. To use such ray angles, with consequently shorter path, it is necessary to reduce the operating frequencies (path D).

In general, the strongest signals (i.e. those with least attenuation) will occur using frequencies just below the MUF, for the particular path distance and layer involved. When a wave is sent vertically upwards (see Figure 15: Sky wave radio path), the highest frequency for which reflection by any particular layer will occur is called the *critical frequency, fo.* This frequency is much lower than the MUF for oblique incidence, being related approximately by:

$$MUF = fo/\cos \alpha$$

where α is the angle of incidence of the ray to the layer. At frequencies higher than fo, the waves will penetrate the layer and be lost, but as the angle of radiation is progressively lowered, an angle will be reached where reflection occurs (termed as the critical wave angle). Signals can then be received at a great distance (receiver Rx2 in Figure 16: HF radio communication paths), and radiation at lower angles will be reflected to even greater distances (e.g., receiver Rx3).



HF radio communication paths

Receivers at Rx2 and Rx3 can receive signal by reflection from the ionosphere from points P2 and P3, respectively. The point P2 represents the location nearest the transmitter where reflection can take place at the frequency being used. The distance from the transmitter to Rx2 is termed the SKIP DISTANCE and represents the minimum distance where sky wave propagation will be effective at this frequency. At point P1 the level of ionization is not sufficient to return a signal to earth. The receiver Rx1 represents the point at which a signal can still be received by ground wave propagation from the transmitter. There will therefore be a region, known as the SKIP ZONE, where propagation by both ground wave and sky wave is very poor and little useful signal will be received.

When the frequency is less than the critical frequency fo there will, of course be no skip at all. This situation is often found for frequencies below 8 MHz. The critical wave angle for a particular layer depends on the operating frequency and decreases as the frequency increases. In consequence, the skip distance increases with frequency. The MUF therefore represents a limit, which must not be exceeded for the receiver to remain in the area of reception just beyond the skip zone. The result is that the skip distance extends towards the receiver as the operating frequency approaches the MUF. The reflecting layer also absorbs HF radiation, and this effect decreases significantly as the operating frequency approaches the MUF.

The combined effect is that, for any particular radio circuit, the optimum working frequency lies just below the MUF for the particular path. Any rise in operating frequency or fall in MUF will result in a sudden drop-out of received signals as the skip zone extends to include the reception point.

Lowest usable frequency (LUF)

As the operating frequency is reduced, the reflection will occur in the lower layers of the ionosphere. However, at lower altitudes, and in the D-layer especially, the energy in the wave is subject to increased absorption caused by collisions between air molecules and electrons which are set in motion by the radio waves. The effect increases at lower frequencies, and the limit for any particular path is reached at the LUF.

While the MUF is determined solely by the physical properties of the ionosphere, the LUF also has dependence on the radiated power and the receiver sensitivity over the circuit, and can be controlled to an extent by attenuation to optimizing equipment and antenna performance — hence the need to keep both equipment and antennas in good condition.

Optimum traffic frequency

Ionospheric absorption is much less at night than during the day and therefore the attenuation of the lower HF frequencies is very different from that of higher frequencies during the day. Since the MUF at night over a particular path will generally be less than half the daytime figure, this means that for night-time long distance communications it is possible to maintain considerably lower frequencies and still achieve good reliability. The MUF for a particular path is higher during summer months than in the winter months, but during ionospheric storms the MUF may become much lower for transmission in some directions but higher in others. In planning the optimum traffic (or working) frequency for any particular time, season, distance and direction, it is therefore necessary to take all of these variations into consideration.

At any particular time, a sky wave path is available on channels in a window below the MUF and above the LUF. The MUF is defined by the prevailing ionospheric conditions, but the LUF is set by a combination of path loss and equipment parameters such as transmitter power, noise and receiver/antenna performance. In practice, the first choice of working frequency for sustained circuit reliability would be around 85% of the MUF. The MUF can be predicted on a long-term average basis. The variations in MUF can be up to a third higher or lower on a "normal" day-to-day basis and, in disturbed conditions, the MUF can be less than half the predicted value. The LUF is typically about half the MUF for maritime HF equipment, but this can vary considerably. Under normal conditions, the window of available frequencies varies predictably as follows:

- daytime MUF is higher than night-time MUF;
- winter MUFs are both lower than and vary more than summer MUFs;
- radio circuits less than 1000 km (600 nm) normally use frequencies below 15 MHz;
- radio circuits greater than 1000 km normally use frequencies above 15 MHz; and
- MUFs are higher when the sunspot number is high

Single hop condition

An HF radio circuit can also be set up by multiple reflections between the ionosphere and the ground. Variability and absorption increase with each reflection (or hop), so the single-reflection (hop) path, as described above, is to be preferred for maximum circuit reliability.

To avoid multiple-hop conditions it is advisable to aim for the MUF for the highest ionospheric layer, in the expectation that this will normally exceed the MUF for the lower levels and thereby avoid multiple reflections involving the lower layers.

- VLF propagation

The radio wave follows the curvature of the earth's surface and is known as a ground wave. The range of a ground wave signal is governed by the rate of loss of energy into the ground, which in turn is governed by the value of ground conductivity. The attenuation of the ground wave is least over seawater and greatest over the rocky ground or deserts.

VLF signals are reflected well by the D-layer of the ionosphere, because the height of the D-layer is of the same order of wavelengths at VLF, the net effect is of a waveguide for VLF signals between the ground and the D- layer. The signal attenuation is very low under these conditions and transmission paths up to 22000 km (12000 nm) are possible.

Large antenna arrays are normally used at VLF with very high output transmitter powers (750 kW) to give virtually world-wide coverage. VLF transmissions are therefore only used in the shore to ship direction. VLF signals penetrate the sea to a depth of a few tens of meters, making them very effective for maintaining communications with submerged submarines.

- LF propagation

At LF, ground wave propagation predominates, as with VLF, and due to the higher frequency, the range is reduced, particularly over land, due to the relatively greater attenuation effect of poor ground conductivity as the wavelength is reduced. The waveguide effect between the ground and the D-layer still applies at LF, and conditions are in fact more stable than at VLF. There is also an improvement with regards to lower background noise levels at LF. However the path attenuation is higher. Ranges of one to 3600 km (2000 nm) are possible at LF but, again, large antennas and transmitter output powers are required.

5.2 Modulation basics

The simplest form of communication is Morse code, sent by switching the carrier frequency on and off in a sequence of "dots" and "dashes". But the rate of information is relatively low, 20 to 25 words per minute is a good communication rate. And to transmit information by using Morse code a special knowledge and ability is required.

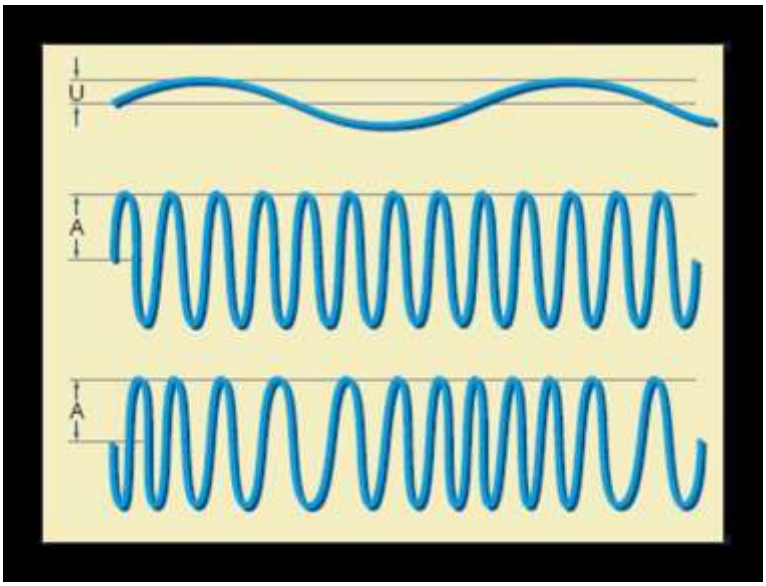
Modulation is the mechanism whereby a radio frequency carrier wave is used for the transmission of information. In doing so the carrier frequency is changed by a useful signal. Thereby it becomes possible to transmit a low frequency useful (DSB) signal on a high frequency. The transmitting signal covers a certain bandwidth which depends on the useful signal.

In AM the high-frequency amplitude is varied by a low-frequency useful signal. FM is a mechanism in which the carrier frequency is altered by the signal to be transmitted.

Narrow Band Direct Printing (NBDP) is a method for radiotelex. For this purpose, the telegraph signal shifts the frequency of the carrier between predetermined values. In the maritime context the type of information carried is mainly speech or data.

- Frequency modulation

In the telecommunications, *Frequency Modulation* (FM, code of emission: F3E) conveys information over a carrier wave by varying its instantaneous frequency. This contrasts with *Amplitude Modulation* (AM), in which the carrier is varied while the frequency remains constant.



Frequency modulation

In radiotelephony, frequency modulation is also known as *phase modulation* (code of emission: G3E) when the carrier phase modulation is in time integral of the FM signal. The ITU designates some VHF channels as F3Eand others as G3E but, as far as the operator is concerned, there is no difference because a change in frequency of the carrier also results in a corresponding change in the phase of the carrier, and vice versa.

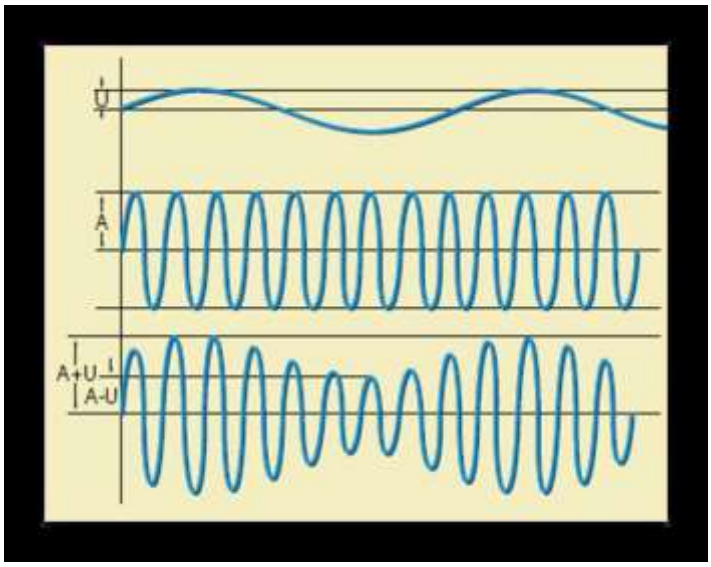
In *frequency shift keying* (FSK), which is used for NBDP, a frequency of 170 Hz is shifted about a certain centre frequency (e.g.1700 Hz) as "mark" and "space" tones, where:

mark = 1685 Hz; and space = 1785 Hz.

- Amplitude modulation

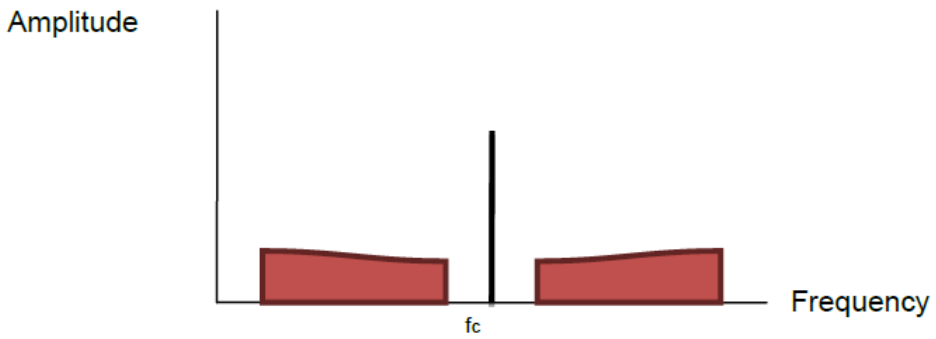
In AM, the information modulated on to the carrier wave appears as frequencies below and/or above the carrier frequency, known as sidebands of a certain bandwidth depending on the nature of information.

In radiotelephony, each sideband requires a bandwidth of 2.8 kHz for an acceptable speech communication. The upper and lower sidebands contain the same information. And a bandwidth around the carrier frequency is 5.6 kHz for the transmission of speech, although 2.8 kHz is sufficient.



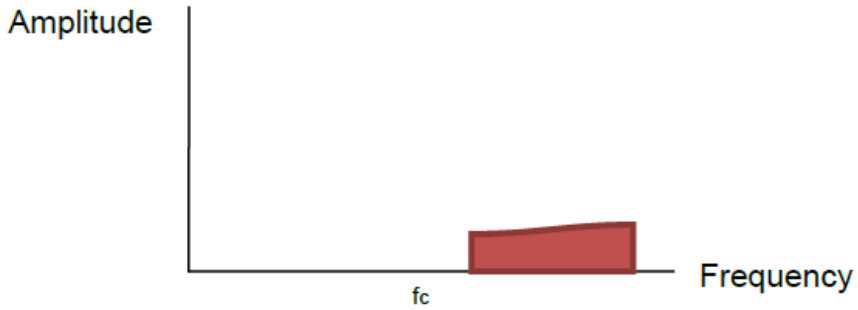
Amplitude modulation

In *double-sideband* (DSB) transmission method (code of emission: A3E) more than two thirds of the transmitter output power is contained in the carrier which contains no useful information signal. By eliminating the duplicated information in the lower sideband, along with the carrier, the transmitter efficiency is increased by the power which is necessary to transmit the lower sideband. The code of emission for *single sideband* (SSB) transmission with full carrier is H3E. In effect, the frequency space which was necessary to transmit two sidebands is now reduced by 50%, and so more stations can transmit.



A3E DSB Telephony (Commercial broadcast)

In the GMDSS all maritime voice communication will use SSB with suppressed carrier (code of emission: J3E). In this mode, nearly the full transmitter output power is spent to transmit the information signal.

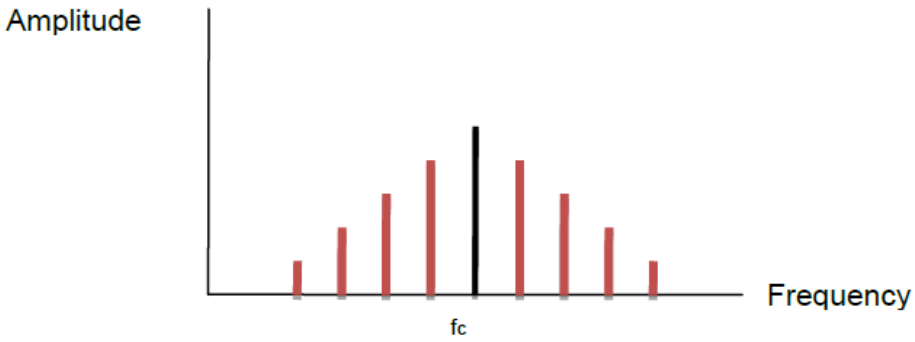


J3E SSB Telephony (suppressed carrier)

- Bandwidth of different types of modulation

The bandwidth for a given class of emission is the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under special conditions. For different types of communication, different values of bandwidth are required and necessary; on one hand not to interfere other radio services and on the other hand to minimize interference by statics and noise. If the bandwidth on the receiver's side is set too wide for the mode of transmission then more noise will be apparent. Also, greater interference from unwanted stations or adjacent frequencies will be received. This will reduce the receiving quality of the wanted station.

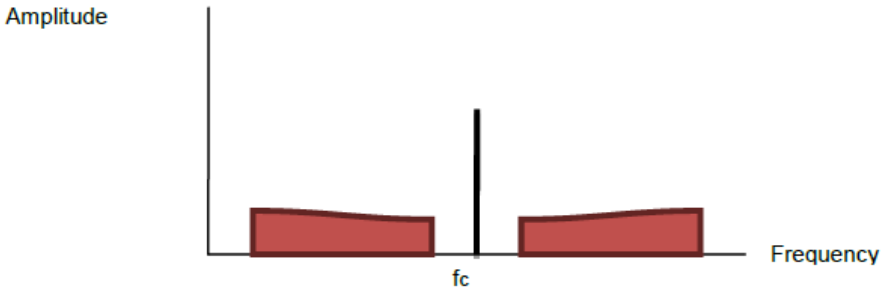
Frequency and phase modulation (F3E/G3E) generate several sidebands above and below the carrier for each modulation frequency which depends on the depth of modulation. Thus the occupied channel bandwidth for a frequency-modulated voice transmission is about 16 kHz.



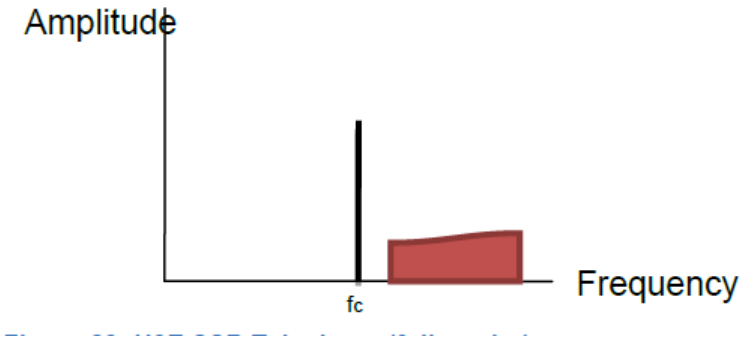
F3E Frequency modulated telephony (Sidebands for single tone are shown)

In amplitude modulation the bandwidth is much smaller than in FM. Because 2.8 kHz is necessary to transmit speech with a sufficient quality, the bandwidth for DSB transmission (H3) is 5.6 kHz.

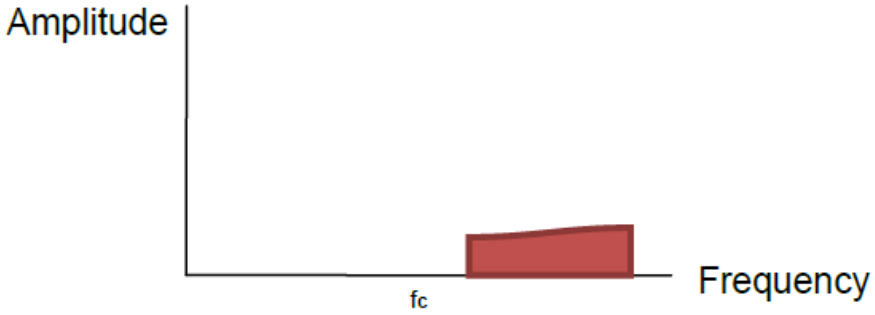
In the SSB mode it is 2.8 kHz, independently if it is H3E or J3E.



A3E DSB Telephony (Commercial Broadcast)

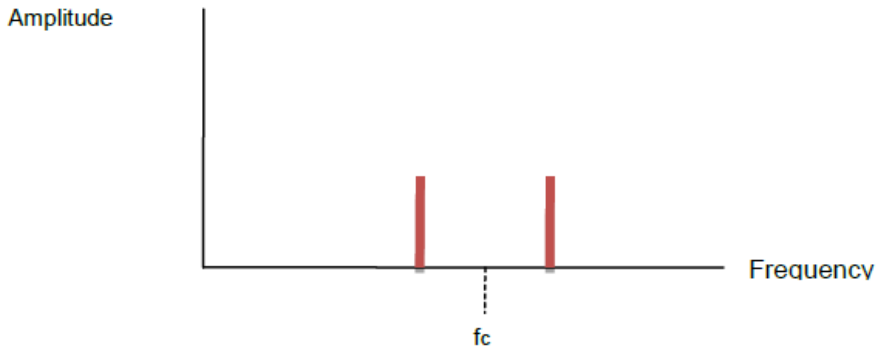


H3E SSB Telephony (full carrier)



J3E SSB Telephony (suppressed carrier)

Because of the frequency shift mode, which is used for NBDP transmissions, a comparably small bandwidth of 300 Hz only is required.



F1B Frequency modulated telex

- Carrier and assigned frequencies

The carrier frequency is a frequency which is necessary to convey information on HF. Thereby the carrier frequency is modulated by the content of information, either in FM or AM or FSK.

The assigned frequency is the centre of a frequency band assigned by an Administration to a station or service.

- Official designations of emission

ITU Radio Regulations classify and symbolize emissions according to their basic characteristics. The basic characteristics are:

First symbol:	Type of modulation of the carrier
Letter A	AM double sideband transmissions
Letter H	SB transmissions with full carrier
Letter F	Frequency modulation
Letter G	Phase modulation
Letter J	SSB transmissions with suppressed carrier

Second symbol:	Nature of signal(s) modulating the carrier
Figure 1	No modulating signal (e.g. Morse code)
Figure 2	A single channel containing quantized or digital information without the use of a modulating sub-carrier
Figure 3	A single channel containing analogue information
Figure 7	Two or more channels containing quantized or digital information

Third symbol:	Type of information to be transmitted
Letter A	Telegraphy for aural reception
Letter B	Telegraphy for automatic reception
Letter E	Telephony

In maritime radio communications, the following classes of emission are used:

A1A	Signaling by keying the carrier directly Morse code
A2A	DSB modulated Morse code
H3E	SSB full carrier radiotelephony (in older equipment for 2182 kHz only)
J3E	SSB suppressed carrier radiotelephony
F3E	FM radiotelephony
G3E	Phase modulation radiotelephony
F1B	Frequency shift keying, radiotelex (NBDP)
J2B	SSB telegraphy for automatic reception, radiotelex

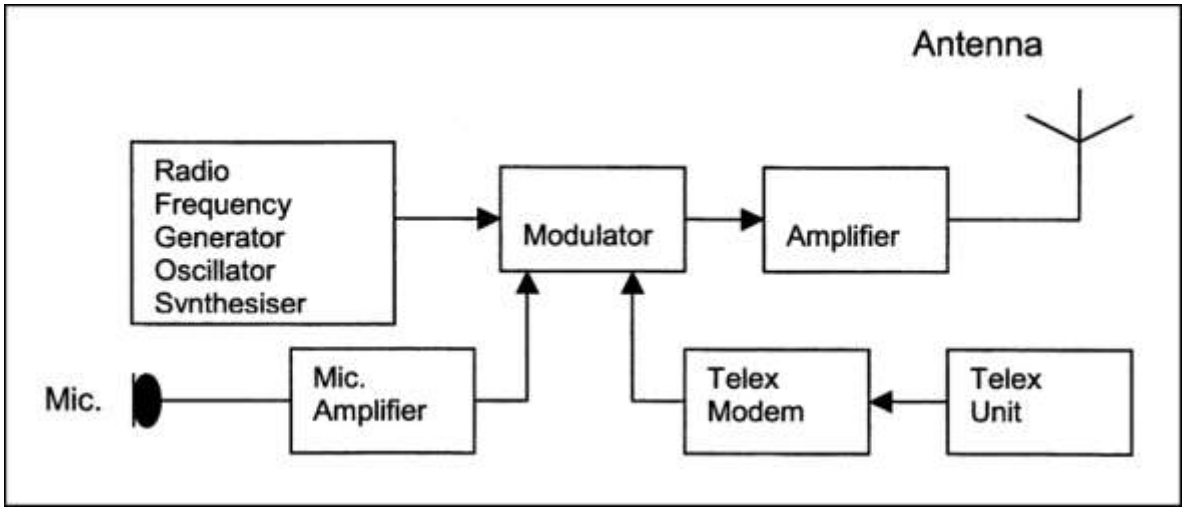
- Unofficial designations of emissions

Besides the above-mentioned ITU designated classes of emission, there are several unofficial designations for different transmissions.

AM	double side band telephony (commercial broadcast, A3)
SSB	single sideband, suppressed carrier (J3E)
CW	Morse code (A1A)
TLX	radiotelex in F1B mode

5.3 Transmitter and receiver basics

5.3.1 Transmitter structure



Basic transmitter block diagram

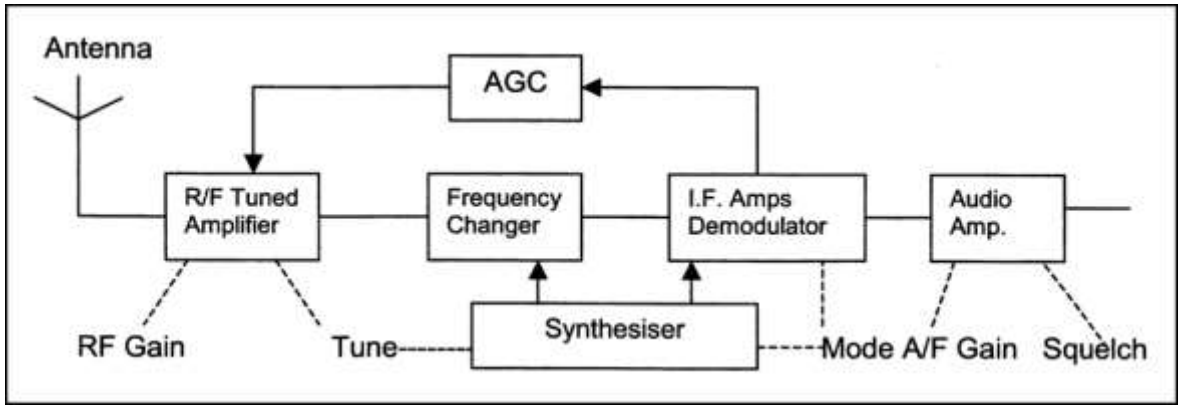
The radio frequency generator produces the carrier, i.e., the frequency on which a transmission will be carried out.

The modulator is used to combine the information signals from the microphone or the telex with the carrier. The type of modulation may be amplitude (AM) frequency (FM) or phase (PM). This modulated signal is then amplified within the transmitter and fed to the antenna.

The antenna requires tuning to the carrier frequency so that it will radiate efficiently. Antennas made from wire elements radiate most efficiently when they are one quarter of a wavelength long. It is not practicable to install an antenna on board ships, which is physically the ideal length covering all of the MF or HF bands. However, the electrical length of the antenna can be lengthened or shortened in respect to its physical length by the introduction of extra radio-frequency circuit elements, inductors and capacitors, in an *Antenna Tuning Unit* (ATU).
In most modern equipment, this is achieved automatically by pressing the <Tune> button before actual transmission. A signal strength meter, which measures antenna current, gives a visual indication of transmission. Most equipment allows for Manual tuning mode on 2182 kHz in case the automatic tuning fails. Individual manufacturer's manuals should be consulted for further details.

The default 2182 kHz setting need only be carried out upon installation or if the appropriate antenna is moved or changed.

5.3.2 Receiver structure



Basic receiver block diagram

The wanted signal is received by tuning the input to the receiver to the wanted frequency. Received signals vary greatly in strength due to a number of factors, e.g.:

- A local transmitter radiating high or low power.

- A distant station radiating high or medium power.
- Variations in the ionosphere, which may affect signals on MF at night or on HF at any time — polarization fading.
- Simultaneous reception by ground and sky waves on MF at night, which may constantly vary in strength or phase and interact with each other — interference fading.
- On the HF bands, signals can reach the receiver having taken different paths, again causing interference fading.

The radio frequency <Gain> or <Sensitivity> control allows manual adjustment of the input amplifier so as to set up the gain to suit conditions. Continual adjustment of the gain control may be necessary if fading occurs, in which case the *Automatic Gain Control* (AGC) can be switched, thereby taking over from manual control, i.e., the AGC holds the output at a nearly constant level even though the input may fluctuate widely.

Most GMDSS MF/HF receivers can be tuned into the Wanted Signal by more than one method, e.g., if paired HF frequencies are required you can simply select the ITU channel number. Alternatively, the actual frequency can be keyed in. If it becomes necessary to retune to a station only a few kHz away, then the up/down <Tune Arrows> can be used.

Fine-tuning is sometimes necessary, especially when it is required to 'clarify' reception of SSB speech transmissions (i.e., mode of emission = J3E). Selection of the <clarifier> allows tuning down to an accuracy of 10 Hz but it is normally used by listening to the output and tuning to the speech rather than to the actual frequency.

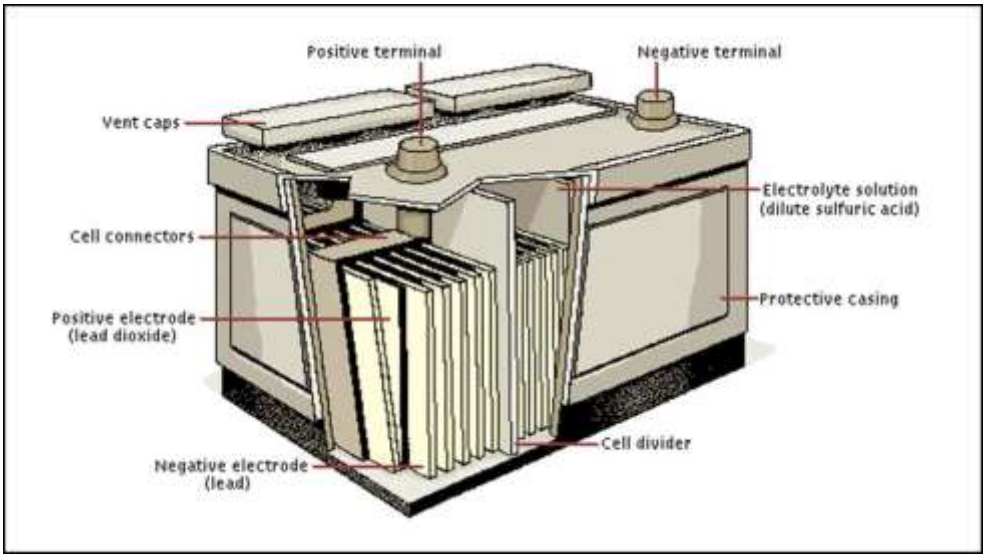
The <Volume> or <AF Gain> control simply varies the amount of signal passing to the loudspeaker, whilst the <squelch> or <mute> control turns off the loudspeaker when no signals are being received.

The setting of the <mode> control is dependent upon the type of modulated signal being received, i.e., on the mode of emission

5.4 Batteries

The GMDSS requires for the ships radio station among others a power supply by a rechargeable battery. Some equipment like EPIRBs, portable VHF-transceivers and SARTS are mainly powered by primary batteries.

Generally, battery cells provide electrical energy by means of an electro-chemical reaction involving the exchange of electrons between the positive and negative electrodes (anodes and cathodes) of the cell through an electrically conducting ion exchange medium, in liquid or paste form, called the electrolyte. When an external electrical load is connected, current is generated as electrons transfer from the cathode to the anode. While a cell delivers electrical energy, the chemical composition of the electrodes is changing. The capacity of the cell will decrease and eventually exhaust when no further chemical change is possible.



Lead acid battery

The defining characteristics of various types of cells are the cell (battery) voltage and the battery capacity. The cell voltage is open-circuit potential difference between the electrodes (also called *electromotive force* [emf]), depending resulting from the particular electrochemical reaction between the electrodes and the electrolyte.

The capacity of a battery of cells indicates the amount of energy which can be delivered over a standard discharging period. The measurement for battery capacity, at a temperature of 20°C is ampere-hour (AH). That means, that theoretically a battery of cells, in a good condition, rated at 140 AH can deliver 10 amperes for 10 hours.

- Different kinds of batteries

Generally batteries can be divided in two main groups:
- Primary cells/batteries
- Secondary cells/batteries

Primary batteries have a single lifespan. That means that it is impossible to recharge them and therefore they require periodic replacement. Although not rechargeable, primary batteries have compensation advantages in several applications where small size and long storage life are the main consideration. Over the smaller range of battery size, the ratio power output to weight or size is typically superior for primary cells.

UPS systems
For ships' radio stations, SOLAS requires three independent types of power supply:
- Ship's main source of energy
- Ship's emergency source of energy
- Reserve source of energy (for radio stations only)

In case of a breakdown of the ship's main power supply the ship's emergency source of energy must be able to supply all important loads of the ship with the necessary energy for the duration of 18 hours. The emergency source of energy can consist of a self-starting generator or a battery.

If the emergency source of energy is a generator it must connect automatically with the emergency switch board and take over all important loads within 45 seconds. On every ship a reserve source of energy must be available to conduct distress and safety radio traffic in case of a breakdown of the main and the emergency source of energy for at least one hour. To bridge the time from breakdown of ship's main source of energy until full acceptance of important loads by the emergency source of energy, the reserve source of energy will take over the energy supply of the radio station.

- Characteristics of different battery types

Primary batteries
- Zinc-carbon-cells – For many decades the zinc-carbon cell was the mass –market primary cell. The cells consist of a zinc cover as the negative electrode (cathode) and a bar of pressed carbon as the positive electrode (anode), which is beset with an electrolyte of an ammonium-chlorine solution. The electric tension of one zinc-carbon cell is 1.5 Volts.

  The disadvantage of zinc-carbon cells is that they are not leak proof. At a discharged cell, electrolyte can leak and hence destroy the battery contacts and printed circuit boards.

- Lithium batteries – Lithium batteries consist of an anode made of lithium and graphite and manganese dioxide cathode. Mostly propylene carbon or acetonitrile is used as electrolyte. The cell voltage ranges from 2.6 to 3.6 Volts. They are ideal for a high reliability. Nevertheless they should be replaced at most after three to five years. They are mostly used in EPIRBs and SARTs. Because they should be replaced after a certain time, the EPIRB's or SART's body is to be marked with the date of battery replacement.

Secondary batteries

- **Lead acid batteries –** The advantage of secondary cell batteries over primary batteries is the ability to recharge repeatedly. The 2 Volts cell lead-acid battery has been in widespread use for more than 150 years and is still the most commonly used type of secondary battery on board ships. Lead-acid accumulators consist of an acid-proof body and two lead plates with the function of positive and negative electrodes. The lead plates are beset with a 38% sulphuric acid ($H2SO_4$). PVC fence between the plates guarantee that the plates do not contact each other.

  In a discharged condition lead sulphate ($PBSO_4$) settles on both electrodes (Plates). In a charged condition the positive electrode consists of lead oxide (PbO_2) and the negative electrode of lead (Pb).The measure of the charging condition is the acid density, it is between 1.24 g/cm³ and 1.28 g/cm³. The acid density of a badly loaded battery is 1.1 g/cm³. But if the density is less than 1.18 g/cm³ the battery can be considered to be damaged, and it will not reach its full capacity.

- **Nickel-Iron or Nickel-Cadmium batteries –** Other types of batteries commonly used in marine installation are nickel-iron (NiFe) or nickel cadmium (Ni-Cad) batteries. These types are more robust and less dangerous than lead batteries.

  In contrast to lead batteries, the electrolyte of Ni-Fe or Ni-Cad does not consist of an acid but of a 20% caustic potash (KOH) with a specific gravity of 1.17 g/cm³ to 1.19 g/cm³ in charged condition. In Ni-Fe batteries the positive electrode (anode) consists of nickel and the negative electrode (cathode) of iron plates. In Ni-Cad batteries there are nickel-hydroxide-coated plates as anode and cadmium-Hydroxide-coated plates as cathode. Each cell of both types of batteries is able to deliver an output voltage between 1.2 Volts and 1.7 Volts when fully charged, but their output capacity increases with temperature.

  Unlike lead batteries, Ni-Fe and Ni-Cad batteries may be left discharged for a long period of time without deterioration. They exhibit a "memory effect" during the Charge/Discharge cycle and should be fully discharged before being charged or full capacity will not be achieved.

- **Lithium-Ion batteries –** Due to further development of primary lithium cells, usable rechargeable lithium-ion cells are available. Lithium-ion batteries have a high energy density and no memory effect. The cell voltage and the maximal charging and discharging current vary depending on the applied materials for the electrodes and the electrolyte. The durability of lithium-ion batteries deteriorates as well by employment as by the time, also without any employment.

  The nominal voltage of lithium cells is approximately 3.6 V, the charging voltage is between 4.0 V and 4.3 V. Deeply discharged batteries cause an irreversible damage. Lithium-ion batteries require a special and complicated charging circuit.

- **Charging batteries, battery charging methods**

Battery charging system

The GMDSS requires an automatic charging system if rechargeable batteries are used as reserve source of energy. The charging system must be capable of fully recharging the batteries within 10 hours to the required minimum capacity. The value of the average of the charging current should measure 10% of value of the battery's capacity.

Example:
Battery capacity = 140 Ah – average charging current = 14 A.

To determine the state of an open lead-acid cell it is usual to take readings of the specific gravity of the electrolyte by using a hydrometer. This is possible because the specific gravity rises and falls linearly during the charge and discharge process. The specific gravity of a fully charged battery differs between 1.24 g/cm³ and 1.28 g/cm³, depending on the battery's maker.

If the reserve source of energy consist of a sealed lead-acid battery it is impossible to determine the specific gravity of the acid. In this case a yearly capacity test of the reserve source of energy is necessary. At a reduced level of electrolyte in NiFe and NiCad cells are topped up with caustic potash.

- Maintenance and monitoring of batteries

A frequent maintenance is the basis for a reliable working condition of the battery. When working on batteries, effective safety precautions must be taken:

- Wear protective goggles and gloves
- Never use naked flames
- Do not wear metal articles, exercise extreme care when using metal tools
- Check fully charge on operation
- Avoid over-discharging below 2.1 Volts for any cell
- Do not leave a battery discharged or it will become difficult or impossible to charge
- Ensure electrolyte level is maintained, but do not overfill, 1 cm above plates is adequate
- Note specific gravity of each cell, large variations between cells usually mean that one or more cells no longer retain a charge and so warn of impending failure
- Keep cells top clean and dry, check ventilation holes, tighten terminals and coat with Vaseline
- Never put metal things on cells' tops

During the charging process in a lead-acid cell, explosive hydrogen gas is developed, hence the need to avoid naked flames or sparks which could cause ignition. During use, in lead-acid batteries the water evaporates from the battery electrolyte. It has to be replaced. When topping up the battery cells, distilled water has to be used to avoid introducing any extraneous chemicals into the electrolyte, which could block the chemistry of the charging/discharging process.

However, if in NiFe or NiCad batteries the level of liquid is reduced, the cells have to be topped up – not with distilled water but with caustic potash.

5.5. Antennas

An antenna is an element capable of radiating and intercepting radio waves. The radiation and reception of radio waves is most effective when the antenna is in resonance. Various resonant configurations can be achieved by antennas with dimensions of 1/4 or 1/2 wavelength or multiples thereof. It is more important for a transmitting antenna to be in resonance than for a receiving antenna, since transmitter performance can be badly degraded by a mismatched antenna. Older types of transmitter could be damaged, by feeding into poor antenna but modern designs usually incorporate automatic protection circuitry to shut down the transmitter or reduce power to a safe level if necessary.

- VHF antennas

As the wavelength in the maritime VHF-band (154-174 MHz) is around 2 meters, it is possible to use 1/4- and 1/2-wavelength antennas. The most basic design is the dipole, which consists of a split 1/2-wavelength element connected at the centre to a balanced feeder cable. The figure below shows some simple examples of VHF antennas, including the

artificial ground-plain antenna and the VHF rod antenna — typically a 1.5 m fiberglass pole contains a dipole antenna. As noted in section VHF propagation, it is important that VHF antennas are mounted as high as possible and in a position free from obstruction by the ship's superstructure.

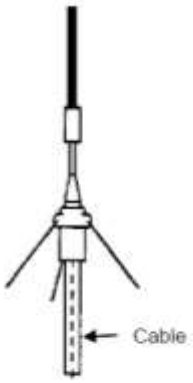


Figure 30: VHF ground plane antenna

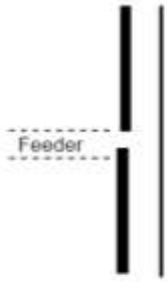


Figure 31: VHF dipol antenna

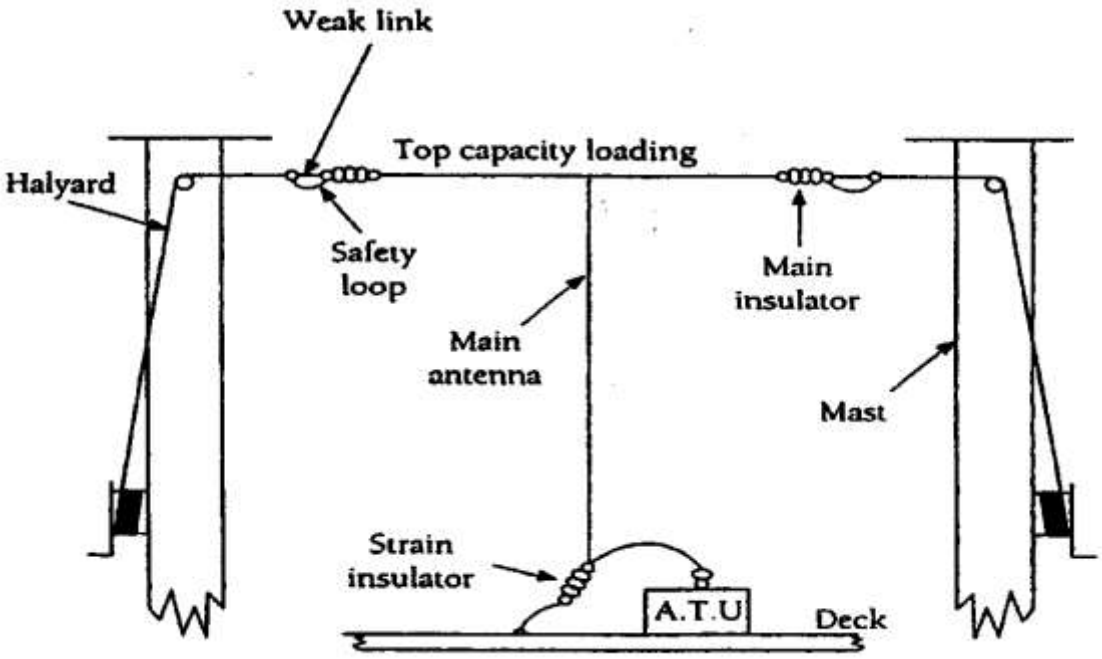
Figure 32: VHF rod antenna

- MF/HF antennas

In the MF/HF bands, however, wavelengths vary from 180 meters (1.650 kHz) to about 12 meters (26 MHz). Resonant λ1/4- or 1λ/2 antennas covering this entire frequency range are therefore not possible. The problem can be eased by using a number of separate antennas, each covering a single band or several harmonically related bands.

An ATU is usually used to "match" the transmitter output to the antenna over a wide range of frequencies. In effect, the ATU uses electrical components, i.e. coils (inductors) and capacitors, to achieve a resonant electrical length in combination with the actual physical length of the antenna. Nevertheless, it must be noted that the efficiency is still determined by the physical length of the antenna. Even if the ATU can match a very short antenna to the transmitter, for example, the overall efficiency will be poor.

Connections between the transceiver, the ATU and the main antenna should be kept as short as possible to ensure the efficient transfer of energy to the antenna.



T-type MF/HF wire antenna

If there is ample space between existing masts or to erect special antenna masts, then the main or emergency antenna may be a wire antenna. A wire antenna may be stretched between masts or between a mast and another elevated part of the ship's superstructure. An example is shown in Figure 33: T-type MF/HF wire antenna (today, whip-antennas are widely used), although inverted-L type antennas may be found.

However, because of lack of space on board many modern ships, most GMDSS fittings use vertical whip antennas for MF/HF transmissions. For example, the main HF transceiver may use an 8 m whip, the MF telephony device may use a 4 m whip and the NAVTEX receiver may use a 1 m whip. A separate 6 m whip is commonly used for the MF/HF DSC receiver.

- Satellite antennas

For the different Inmarsat standards, various antenna types are required.

Inmarsat-C

For Inmarsat standard C devices omnidirectional antennas are used. These antennas are comparatively of small dimensions because the signals to be exchanged do not need such high field strength and not a wide bandwidth than voice communications. The Inmarsat-C antenna must be installed in a position on the ship in which an omni-directed view to the satellite is possible.

Inmarsat- omnidirectional antenna

Inmarsat-B, Fleet, -M

Because of the need of more bandwidth for Inmarsat devices dealing with voice and *High Speed Data* (HSD) exchange, the antenna must be exactly spotted to the appropriate satellite. This requirement can be only fulfilled by parabolic follow up antennas.

Inmarsat-B parabolic follow up antenna

- Antenna maintenance

All antennas should be kept clean - salt deposits removed; and feeders, isolators and brackets checked regularly.

The various insulators must also be checked for cracks and must be cleaned regularly. The safety loop on a wire antenna prevents the antenna from falling if undue strain (e.g., from high winds or build-up of ice) is placed upon it; the weak link should break in the first instance rather than the antenna.

A spare wire antenna should be carried and should be stored in an easily accessible place so that it can rapidly be erected if necessary.

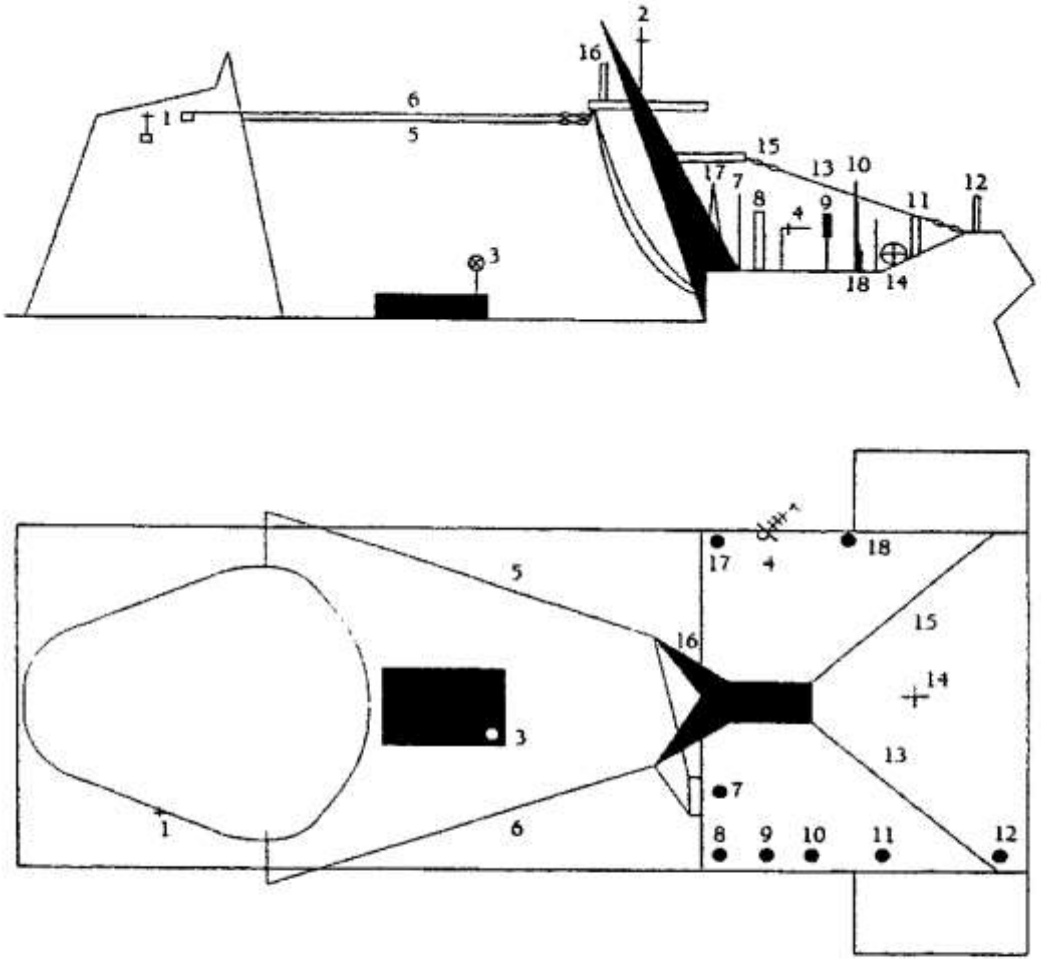
It should be remembered that dangerously high voltage and RF currents are present close to the main antenna. Ideally, the ATU and the link to the main antenna shall be protected to prevent any one touching the feeder.

Before doing any maintenance work on any antenna, ensure that power is removed from the equipment and that the main fuses are removed and kept in a safe place (a pocket is often the simplest and safest place).

As a further precaution, the antenna, where possible, should also be grounded, since RF energy can still be induced in the antenna from other antennas on board or on nearby ships. Even though a shock from an induced RF voltage may only startle rather than cause direct injury, an accident may still result through, for example, falling from a ladder, or dropping tools from a height.

An antenna rigging plan shall be available showing the positions of the various antennas.

Antenna installation on *King Orry*



1 Pay cellphone	10 2182 kHz Watch Rx
2 Radio Room cellphone	11 Bridge EM VHF
3 Ship TV	12 Bridge main VHF
4 RO's TV	13 Auto alarm
5 EM (500 kHz) Tx	14 DF
6 Main Tx	15 DF Sense
7 HF Tx/Rx	16 Radio Room VHF
8 Spare VHF	17 Radio Room main Rx
9 Decca Navigator	18 Radio Room EM Rx

Example antenna installation

5.6 DSC basics

Dot pattern	Phasing Sequence	Call content	Closing sequence		
Dot pattern	Phasing sequence	Format specifier	Address	Category	Self identification

Technical format of a call sequence (DX / RX)

The system is a synchronous system using characters composed from a ten-bit error detecting code. The phasing sequence provides information to the receiver to permit correct bit phasing. Apart from the phasing characters, each character is transmitted twice in a time spread mode; the first transmission (DX) of a specific character is followed by the transmission of four other characters before the re-transmission (RX) of that specific character takes place, allowing for a time-diversity reception interval of:

- 400 ms for HF and MF channels and
- 331/3 ms for VHF radio telephone channels

The phasing sequence consists of specific characters in the DX and RX positions transmitted alternatively. (ITU-R M 493) Six DX characters are transmitted.

The classes of emission, frequency shifts and modulation rates are as follows: F1B or J2B 170 Hz and 100 baud for use on HF and MF DSC calling channels.

When frequency-shift keying is effected by applying audio signals to the input of single-sideband transmitters (J2B), the centre of the audio-frequency spectrum offered to the transmitter is 1 700 Hz.

When a DSC call is transmitted on HF and MF working channels for public correspondence, the class of emission is J2B. In this case, audio tones with frequencies 1 700 Hz ??85 Hz and modulation rate 100 Bd are used in order for the DSC call to be transmitted.

The call content includes information about self- identification, address (if necessary), category of call frequency information and ships position information (in case of distress alerting).

The “end of sequence” (EOS) character is transmitted three times in the DX position and once in the RX position.

5.7. Radiotelex basics

The mode of emission for Radiotelex / NBDP is F1B.

In the F1B method telex signal codes are transmitted at MF/HF as a sequence of two audio tones. According to ITU recommendations, a frequency shift of 170 Hz about the centre frequency of 1700 Hz is used to send the “mark” and “space” tones. That means, that mark = 1615 Hz and space = 1785 Hz.

A narrower bandwidth for a transmitted signal means that less noise and interference (both man-made and natural) is apparent at the receiver, resulting from a relatively smaller masking effect on the wanted transmission. Furthermore the transmitter power is used more efficiently. The net effect is that, for the same transmitter power, the effective range of a transmission will be greatly extended by using a narrow bandwidth method of modulation such as SSB.

- Automatic request for repeat (ARQ)

ARQ is a mode for communication between two stations. In this mode the receiving telex station checks the incoming code groups representing the first three characters and if these are correctly received, it requests the sending telex station to send the next three characters. If a group is received incorrectly, the receiving telex station requests to repeat the last group.

- Forward Error Correction (FEC)

FEC is used for communication to "All Stations". It is sometimes known as broadcast FEC, or collective FEC. This mode would be used, e.g. for distress traffic and for NAVTEX broadcasts. The information is sent continuously with a continuous repeat of five characters later. The receiving telex station waits for each repeated character and providing one of the two characters confirms the correct code. The character is printed.

5.8 Fault location and service on GMDSS marine electronic equipment

It is important to remember the following:

- Familiarize with the use of manufacturer's documentation and users' handbooks to locate simple faults. Make sure trouble shooting is in accordance with the documentation of equipment.

- Control of the GMDSS equipment to make sure that a safe and correct working of the equipment is possible with sufficient knowledge of installations within the GMDSS equipment.

- Use built-in test measuring instruments. Indication in different switch positions and the appropriate desired values in each switch position, in accordance with manufacturers' handbooks. Read battery current in load condition.

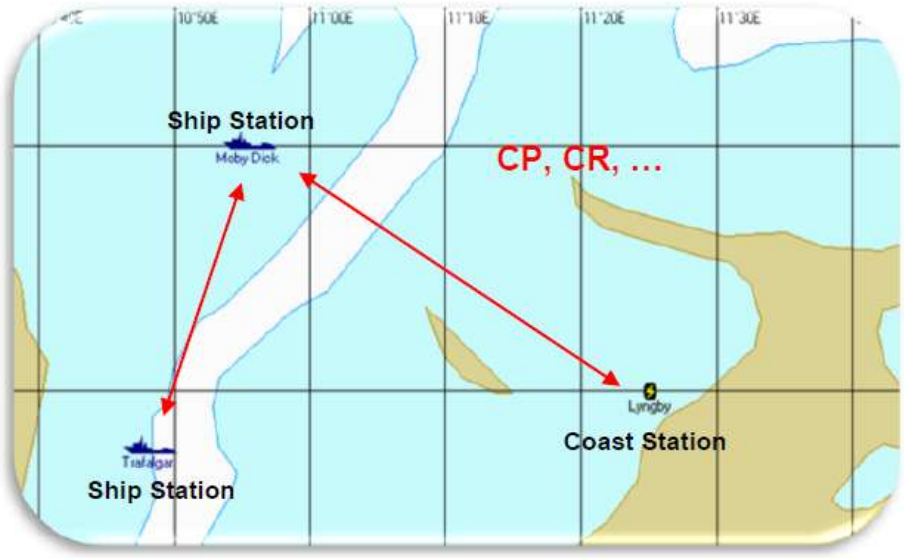
- Use of software in accordance with the equipment. An understanding of indications on displays and screens is critical and follow the instructions of the menu.

- Familiarize with the use of Ampere, Volt, Ohm meters and checking of main and battery voltage, battery acid or base by using a hydrometer as well as fuses and antenna isolation, where practical.

- Knowledge of elementary fault repair is important as well as knowledge of fuses' indication. Follow measures of precaution while undergoing repair work using the appropriate tools.

6. GMDSS components

6.1. General, including safety precautions



Communication possibilities

The maritime mobile service is a service between coast stations and ship stations, or between ship stations, or between associated on-board communication stations; survival craft stations and *Emergency Position Indicating Radio Beacon* (EPIRB) stations may also participate in this service.

A ***coast station*** is a land station in the maritime mobile service which is not intended to be used in motion.

A ***ship station*** is a mobile station in the maritime mobile service located on board a vessel which is not permanently moored, other than a survival craft station.

A ***survival craft station*** is a mobile station in the maritime mobile service or the aeronautical mobile service intended solely for survival purposes and located on any lifeboat, life raft or other survival equipment.

The ***public correspondence*** is any telecommunication except distress-, urgency- or safety communications, which the offices and stations must accept for exchange. A ship station open for public correspondence shall have an Accounting Authority Identification Code (AAIC), which guarantees the accounting of telecommunications.

Restricted public correspondence (CR) can be used by stations, which have a need for limited public correspondence only and have not concluded an accounting contract with an accounting authority.

The ***port operations service*** is a maritime mobile service in or near a port, between coast stations and ship stations, or between ship stations, in which messages are restricted to those relating to the operational handling, the movement and the safety of ships and, in emergency, to the safety of persons. Messages that are of a CP nature shall be excluded from this service.

The *ship movement service* is a safety service in the maritime mobile service other than a port operations service, between coast stations and ship stations, or between ship stations, in which messages are restricted to those relating to the movement of ships. Messages that are of a CP nature shall be excluded from this service.

In the terrestrial radio services UHF, VHF, MF and HF the first rule should always be:

Listen first – Then transmit

The ship station license and the radio operator's certificates have to be kept on board in original and have to be presented upon request of authorized persons.

The actual editions of service publications, edited by ITU are as follows:

- List of coast stations and special service stations
- List of ship stations and maritime mobile service identity assignments
- Manual for the maritime mobile and maritime mobile satellite service have to be kept on board

In communications between coast stations and ship stations, the ship station shall comply with the instructions given by the coast station in all questions relating to the order and time of transmission, to the choice of frequency, and to the duration and suspension of work.

In communications between ship stations, the station called controls the working in the manner indicated above.

However, if a coast station finds it necessary to intervene, the ship stations shall comply with the instructions given by the coast station. *(ITU, R M 541Section V. § 30 (1) – (3))*

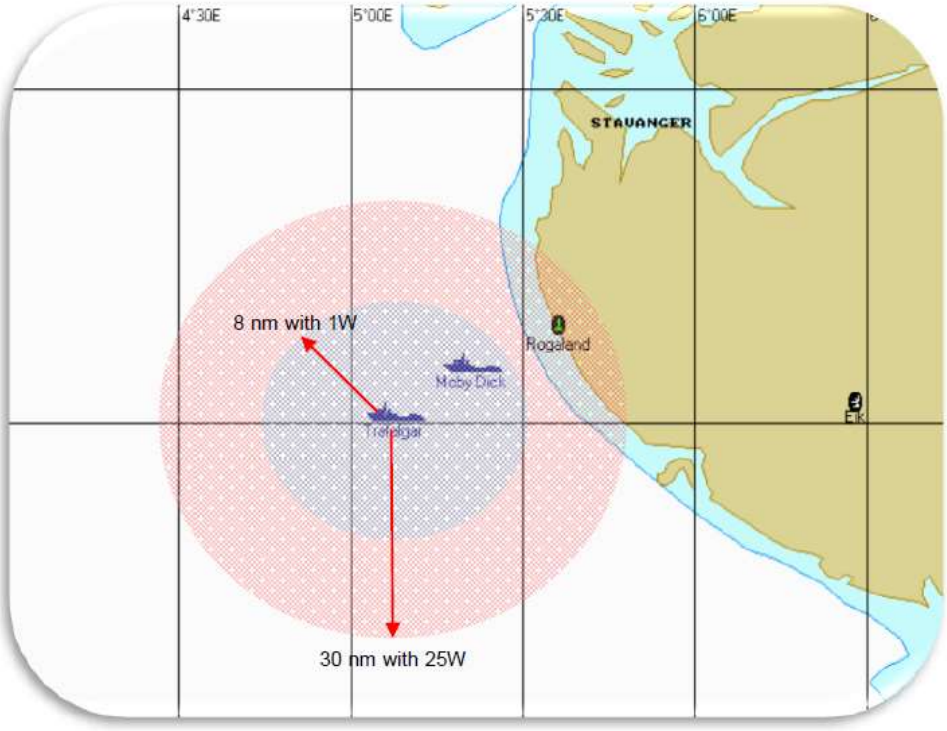
6.2 VHF DSC

- **Basics**

The propagation of VHF transmissions is a "line-in-sight" transmission. The range of VHF transmissions depends in the first instance on the height of the appropriate antenna, but also on the transmitting power of the transmitting station. Generally it can be assumed that the range of VHF transmissions is approximately 30 nautical miles. It has to be noted that the coverage range of DSC transmissions is higher than that of voice transmissions.

Every ship borne maritime VHF transmitter must be capable to vary its power output between high power and low power. The high power output must not fall below 6 Watt and not exceed 25 Watt. In the low power position the output power can vary between 0.5 Watt and 1.0 Watt.

To avoid interferences the lowest necessary output power shall be selected when installing VHF contacts. For establishing contacts to stations in a close distance to a transmitting station (see Figure 39: The range of VHF transmissions) mostly the "low power" output should be sufficient, while for contacts between stations in a farther distance to any other the "high power" transmitting position can be selected.

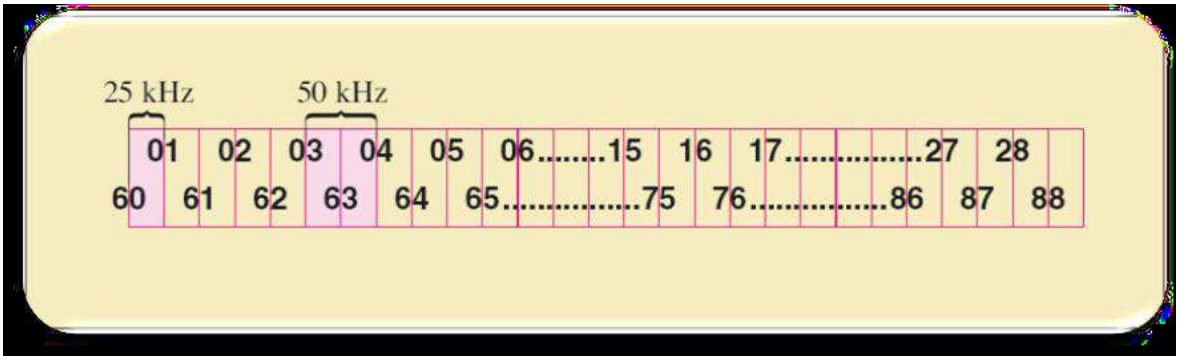


The range of VHF transmissions

The ITU allocated the frequency band 156 MHz to 174 MHz to the maritime mobile VHF service. Originally this range was divided into 28 channels, from channel 01 to channel 28. The distance between two channels was 50 kHz. Later, when more modern technical possibilities were available the channel spacing changed to 25 kHz.

The additional channels got the numbering from channel 60 to channel 88 so that the numbering of the already existing equipment needed not to be changed worldwide.

Regarding the frequency band channel 60 now is the first channel followed by channel 01 in a distance of 25 kHz followed by channel 61 in a distance of 25 kHz, etc.



VHF channeling

In the VHF band, simplex channels are used as well as duplex channels. Simplex operation is an operating method on one single frequency of a telecommunication channel in which transmission is alternately made possible in each direction, for example, by means of a manual control. Channel 16 is a simplex channel using TX frequency 156,8 MHz as well as RX frequency 156,8 MHz. Simplex channels are used for communications in ship to ship and in ship to shore and shore to ship (mostly port operation service).

Duplex operation is an operating method using a two-frequency telecommunication channel in which transmission is possible in both directions simultaneously. Channel 28 is a duplex channel using TX frequency 157,4 MHz and RX frequency 162,0 MHz.

Duplex channels are to be used for communications between ship- and coast stations. Semi-duplex operation is a method of occupying a two-frequency telecommunication channel on which has simplex operation at one end of the circuit and duplex operation at the other.

The most important VHF channels and their applications are shown below.

Channel	Description	Special
Ch 70	DSC distress alert, urgency, safety and routine announcement	May used also by aircraft stations
Ch 16	Voice distress, urgency, safety and routine calling	May used also by aircraft stations
Ch 06	Ship to ship SAR operation, safety related communication	May used also by aircraft stations
Ch 13	Communication for safety of navigation, ship movement and port operation service	
Ch 15+17	On board communication, power does not exceed 1W	
Ch 75+76	Navigation related communication (max 1W), AIS via Satellite	

Important VHF channels and their application

- Use and functions of the VHF radio station installation

VHF radio station

Controls

- Distress Button: This button is protected by a lid. To use, lift the Lid and Push the distress button to transmit a distress alert (without kind of distress).

- Volume: Adjust the volume

- Squelch: Pull and adjust silent when no station is received. This knob is also used to make sure before calling a coast station on a working channel that there is no traffic in progress.

- Control Buttons: Control the power (1W or 25W), switching between International or US channels, switch the Loudspeaker on or off, setting the light intensity.

- Menu Buttons: Switch between Tel Mode (Radiotelephone parameters are show) and DSC Mode (DSC Parameters are shown), Open the Address Book, Press "TX / Call" to start creating a DSC alert or announcement, Press "RX / LOG" to open received calls.

- Keyboard: Push the number buttons to key in a channel, press and hold the "Shift Button" to get access to the orange second functions (Dual Watch, Scan, Functions etc.).

- On / OFF Switch: Push to switch the device on or off.

- Loudspeaker: to influence the loudspeaker turn the Volume Switch or push the relevant Control Button.

- Indicator lamps: These lamps show the condition when lid for TX – transmitting, 1W – 1W transmission mode, CALL – DSC announcement is received, ALARM – an alarm call is received.

- Display: The display shows the current settings of Channel, Volume, Squelch, Transmitting power, Loudspeaker condition etc.

Selection of channels
To select any channel other than displayed, push the number buttons 0....9, e.g. to select channel 28 push first "2" then "8". For a quick change to channel 16 just press the "16" key.

Squelch
The sensitivity of receivers can be adjusted with "squelch" so that the basic noise, which is always present, is not quite audible. If this adjusted level exceeds a stronger signal the NF signal can pass and will become audible. Any missing signal or any signal which level is below the adjusted level then the receiver remains mute.

Dual watch
If it is necessary to observe channel 16 and another channel simultaneously press the shift button and then Dual Watch (DW). In the dual watch mode the receiver switches between a selected channel and channel 16 in very short intervals.

Selection of power
Push the power button to switch between 25W and 1W, depending on the distance to be covered.

Other features
In every case the operation instructions of this device has to be observed.

- DSC possibilities

In the maritime mobile service, VHF equipment of two different quality standards can be used. Class A/B covers VHF equipment which is obligatory for the use on board of ships which are applicable for SOLAS convention. Class D is mainly intended for the use on ships which do not apply to the SOLAS convention but voluntarily they can additional be used to the obligatory VHF equipment on board of SOLAS ships. The table below shows all features of Class A/B and Class D VHF equipment.

Type	Applicable to					
	Ships Class A/B		Ships Class D		Coast	
	TX	RX	TX	RX	TX	RX
Distress alerts						
RT	■	■	■	■	■	■
RLS	■	■	■	■	■	■
Distress acknowledgement						
RT	■	■	■	■	■	■
EPIRB	■	■	■	■	■	■
Distress relay individual						
RT	■	■	■	■	■	■
EPIRB	■	■	■	■	■	■
Distress relay geographic area						
RT	■	■	■	■	■	■
EPIRB	■	■	■	■	■	■
Distress relay all ships						
RT	■	■	■	■	■	■
EPIRB	■	■	■	■	■	■
Distress relay acknowledgement individual						
RT	■	■	■	■	■	■
EPIRB	■	■	■	■	■	■
Distress relay ackn all ships						
RT	■	■	■	■	■	■
EPIRB	■	■	■	■	■	■
Urgency and Safety all ships						
All modes RT	■	■	■	■	■	■
Duplex RT	■	■	■	■	■	■
Medical transport	■	■	■	■	■	■
Ships and aircraft (res.18)	■	■	■	■	■	■
Urgency/Safety individual						
All modes RT	■	■	■	■	■	■
Duplex RT	■	■	■	■	■	■
RT acknowledgement	■	■	■	■	■	■
Unable to comply acknowledgement	■	■	■	■	■	■
Position request	■	■	■	■	■	■
Position acknowledgement	■	■	■	■	■	■
Test	■	■	■	■	■	■
Test acknowledgement	■	■	■	■	■	■
Routine group calls						
All mode RT	■	■	■	■	■	■
Duplex RT	■	■	■	■	■	■
Routine individual calls and their acknowledgement						
All mode RT	■	■	■	■	■	■
Duplex RT	■	■	■	■	■	■
RT acknowledgement	■	■	■	■	■	■
Data	■	■	■	■	■	■
Data acknowledgement	■	■	■	■	■	■
Unable to comply acknowledgement	■	■	■	■	■	■
Polling	■	■	■	■	■	■
Polling acknowledgement	■	■	■	■	■	■
Semi/Auto VHF (optional)						
Request	■	■	■	■	■	■
Able to comply acknowledgement	■	■	■	■	■	■
Start of call						
Unable to comply acknowledgement	■	■	■	■	■	■
End of call request	■	■	■	■	■	■
End of call acknowledgement	■	■	■	■	■	■
■ = available ■ = not available						

VHF DSC possibility table

- Operational VHF DSC procedures in the GMDSS

DSC provides an automated access to coast stations and ships.

The message information is stored in the receiver and can be displayed or printed out following receiving. Four levels of priority — Distress, Urgency, Safety and Routine — are available for DSC calls. At all coast stations, ship-to-shore Distress calls receive priority handling and are routed to the nearest *Rescue Co-ordination Centre* (RCC). On board ship, DSC receivers sound an alarm when a Distress call is received.

DSC is a technique of transmitting digital codes, which allow suitably equipped stations to:

- Transmit and receive Distress alerts
- Transmit and receive Distress alert acknowledgements
- Relay Distress alerts
- Announce Urgency and Safety calls
- Initiate routine priority calls and set up working channels for subsequent general communications on *Radio Telephony* (R/T) or telex

The detailed DSC procedures are contained in the most recent version of Recommendation ITU-R M 541

The only VHF DSC channel is channel 70 (156.525 MHz).

All DSC calls automatically include phasing signals, error- checking signals and identity (MMSI number) of the calling station. The protocol includes an initial dot pattern, which is used to alert scanning receivers that a DSC call is imminent. Other information can be added, either manually or automatically. The actual information added is dependent upon the purpose of the call.

The DSC call is set up by entering information, using the command menu of the DSC controller that is attached to, or incorporated into, the transmitter.

Telecommand and traffic information

Telecomm and traffic information are features that are important for the handling of the subsequent information exchange.

Channel selection in call format

When calling another maritime mobile station the DSC call format should contain information about a working channel on which both stations subsequently exchange their information. On calling a coast station, do not propose a working channel in the DSC announcement because the coast station will inform each mobile station which working channel shall be used for communication with this coast station.

SC acknowledgement

DSC announcements to all stations or to a certain group of stations must not be acknowledged by any of the receiving stations. However, individual DSC announcements either to a coast station or another ship station should be acknowledged by the called station where ever possible.

DSC relay process

The only case in which DSC information are relayed can be cases of distress.

Test transmissions

The number and duration of test transmissions shall be kept to a minimum. They should be coordinated with a competent authority or a coast station, as necessary, and, wherever practicable, be carried out on artificial antennas or with reduced power.

However, testing on the distress and safety calling frequencies should be avoided, but where this is unavoidable, it should be indicated that these are test transmissions.

- Alerting and announcement

Alerting

An *alert* is a digital selective call (DSC) using a distress call format, in the bands used for terrestrial radio communication, or a distress message format, in which case it is relayed through space stations.

The *distress alert relay* is a DSC transmission on behalf of another station.

Announcement

An *announcemen*t is a digital selective call using urgency, safety or routine call format in the bands used for terrestrial radio communication, or urgency, safety or routine message format, in which case it is relayed through space stations.

Call

A *call* is the initial voice or text procedure.

Distress alert

The DSC equipment should be capable of being pre-set to transmit the distress alert on channel 70.

The distress alert shall be composed by entering the ship's position information, the time at which it was taken and the nature of distress. Normally the actual ships position is taken from a suitable navigation indicating receiver. If the position of the ship cannot be entered, the position information will be replaced as the digit 9 transmitted ten times. If the time cannot be included, then the time information will be transmitted automatically as the digit 8 repeated four times.

Activate the distress alert attempt by a dedicated distress button.

A distress alert attempt will be transmitted as 5 consecutive calls on channel 70. To avoid call collision and the loss of acknowledgements, this call attempt may be transmitted on the same frequency again after a random delay of between 3 ½ and 4 ½ min from the beginning of the initial call. This allows acknowledgements arriving randomly to be received without being blocked by retransmission. The random delay will be generated automatically for each repeated transmission; however it will be possible to override the automatic repeat manually.

The DSC equipment should be capable of maintaining a reliable watch on a 24-hours basis on channel 70.

If time permits, key in or select on the DSC equipment keyboard the following:
– Nature of distress
– Ship's last known position (latitude and longitude)
– Time (in *Universal Co-ordinated Time* (UTC)) the position was valid

– Type of subsequent distress communication (telephony)

DSC Acknowledgements of distress alerts should be initiated manually.
Acknowledgements should be transmitted on the same frequency as the distress alert was received.
Distress alerts shall normally be acknowledged by DSC by appropriate coast stations only. Acknowledgements by coast stations on VHF will be transmitted as soon as practicable.

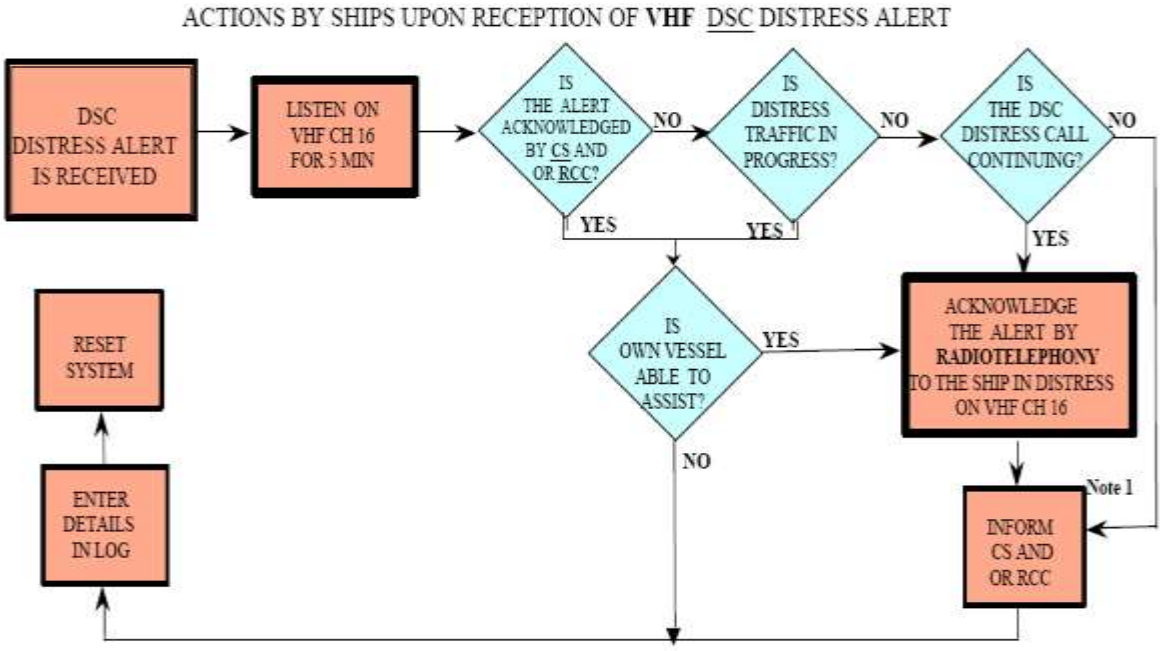
The acknowledgement of a distress alert consists of a single DSC acknowledgement which shall be addressed to "all ships" and include the identification of the ship, its position and the time the position was valid and if possible, the nature of distress, which is being acknowledged.

In areas where reliable communications with one or more coast stations are practicable, ship stations on receiving a distress alert or a distress call from another vessel should defer acknowledgement for a short interval of time, so that a coast station may make the first acknowledgement.

Ships receiving a DSC distress alert from another ship should set watch on channel 16 and acknowledge the call by radiotelephony when they are able to render help.

If a ship station continues to receive a DSC distress alert on VHF channel 70, a DSC acknowledgement should be transmitted to terminate the call only after consulting with a Rescue Coordination Centre or a Coast Station and being directed to do so. The automatic repetition of a distress alert attempt should be terminated automatically on receipt of a DSC distress acknowledgement.

An inadvertent DSC distress alert shall be cancelled by DSC, if the DSC equipment is so capable. However in all cases, cancellations shall also be transmitted by radiotelephony.



REMARKS:

Note1 : Appropriate or relevant RCC and/or Coast Station shall be informed accordingly. If further DSC alerts are received from the same source and the ship in distress is beyond doubt in the vicinity, a DSC acknowledgement may, after consultation with an RCC or Coast Station, be sent to terminate the call.

Note 2: In no case is a ship permitted to transmit a DSC distress relay call on receipt of a DSC distress alert on VHF channel 70.

CS = Coast Station RCC = Rescue Co-ordination Center

Handling of a received VHF DSC distress alert

Distress alert relay

Radio personnel serving on ships should be made aware of the consequences of transmitting a distress relay call and of routing a DSC distress alert relay to other than *coast stations* (CS).

The number of unintended activations of DSC distress alerts and DSC distress alert relays creates an extra work load and confusion to (M)RCCs and also causes delay in the response-time. The original distress alert from a ship in distress should not be disrupted by other ships, by transmitting a DSC distress alert relay.

Recommendation ITU-R M.541-9 on Operational procedures for the use of DSC equipment in the Maritime Mobile Service identifies only two situations in which a ship would transmit a distress relay call (distress alert relay):

- On receiving a distress alert on VHF channel 70, which is not acknowledged by a coast station after a suitable time. The distress alert relay should be addressed to the appropriate coast station, where ever possible; and
- On knowing that another ship in distress is not able to transmit the distress alert itself and the master of the transmitting ship considers that further help is necessary. The distress alert relay and call should be addressed to "all ships" or to the appropriate coast station.

Under no circumstances is a ship permitted to transmit a DSC distress alert relay purely on receipt of a DSC distress alert on either VHF or MF channels.

Key in or select on the DSC equipment keyboard the following:

- Distress relay
- All Ships or the 9-digit identity of the appropriate coast station
- 9-digit identity of the ship in distress, if known
- Nature of distress
- Latest position of the ship in distress, if known
- Time (in UTC) the position was valid (if known)
- Type of subsequent distress communication (telephony)

Coast stations, after having received and acknowledged a DSC distress alert, may, if necessary, retransmit the information received as a DSC distress alert relay, addressed to all ships or a specific ship.

Ships receiving a distress alert relay transmitted by a coast station shall not use DSC to acknowledge the alert, but should acknowledge the receipt of the alert by radiotelephony on channel 16.

Announcements for all ships (distress, urgency, safety)

The announcement is carried out by transmission of a DSC urgency/safety announcement on the DSC distress and calling channel 70.

The DSC urgency/safety announcement may be addressed to all stations at or to a specific station. The channel on which the urgency/safety message will be transmitted shall be included in the DSC urgency/ safety announcement.

Key in or select on the DSC equipment keyboard the following:

- Appropriate calling format on the DSC equipment (all ships)
- Category of the call (urgency/safety)
- Channel on which the urgency/safety message will be transmitted
- Type of communication in which the urgency/safety message will be given (radiotelephony), transmit the DSC urgency/safety call

Ship stations in receipt of an urgency/safety all ships announcement shall monitor the frequency or channel indicated for the message for at least five minutes.

However, in the maritime mobile service, after the DSC announcement the urgency message shall be transmitted on a working frequency:

- in the case of a long message or a medical call; or
- in areas of heavy traffic when the message is being repeated.

After the DSC announcement the safety message shall be transmitted on a working channel.

In the maritime mobile service, the safety message shall, where practicable, be transmitted on a working channel. A suitable indication to this effect shall be made in the DSC announcement. In the case that no other option is practicable, the safety message may be sent by radiotelephony on VHF channel 16 (frequency 156.8 MHz).

Announcement to individual station (urgency, safety, routine)

The VHF DSC channel 70 is used for DSC for distress and safety purposes as well as for DSC for public correspondence.

Key in or select on the DSC equipment keyboard for ship calling the following:

- Appropriate calling format on the DSC equipment (individual)
- Individual or group MMSI
- Category of the call (urgency/safety/routine)
- Channel on which the urgency/safety/routine message will be transmitted
- Type of communication in which the urgency/safety/routine message will be given (radiotelephony), transmit the DSC urgency/safety/routine call

A DSC announcement for an individual coast station is transmitted as follows:

Key in or select on the DSC equipment keyboard the following:

- Appropriate calling format on the DSC equipment (individual)
- Individual coast station MMSI
- Category of the call (urgency/safety/routine)
- Type of the subsequent communication (normally radiotelephony), transmit the DSC call

A DSC call for public correspondence may be repeated on channel 70, if no acknowledgement is received within 5 min. Further call attempts should be delayed at least 15 min, if acknowledgement is still not received.

The acknowledgement of a routine DSC announcement from a coast station contains a VHF channel on which the subsequent traffic shall be carried out.

Group announcement (urgency, safety, routine)

The purpose of group announcements is to inform a certain group of ships or coast stations of an event that could be of interest for that group of stations only.

Key in or select on the DSC equipment keyboard the following:

- Appropriate calling format on the DSC equipment (group)
- Group MMSI
- Category of the call (urgency/safety/routine)
- Channel on which the urgency/safety/routine message will be transmitted
- Type of communication in which the urgency/safety/routine message will be given (radiotelephony), transmit the DSC urgency/safety/routine group announcement

Polling and position request

The purpose of polling is to assert that the called station is in the range of the calling station and if it is operational. Position request is selected when a station wants to get position details from a called station.

Key in or select on the DSC equipment keyboard the following:

- Appropriate calling format on the DSC equipment (polling/ position request)
- Individual MMSI
- Category of the call (urgency/safety), transmit the DSC urgency/safety polling/position request announcement

The polling acknowledgement does not contain any special information. The fact that an acknowledgment has been received from the called station shows that the called ship is within the range and its VHF equipment is in operation.

Automatic/Semi-automatic service with coast stations

A couple of coast stations offer the possibility for a direct dialing to land subscribers without any operator's involvement.

A DSC announcement for an individual coast station automatic service call transmitted as follows:

Key in or select on the DSC equipment keyboard the following:

- Appropriate calling format on the DSC equipment (individual)
- Individual coast station MMSI
- Country code, area code and telephone number of subscribe
- Category of the call (urgency/safety/routine)
- Type of the subsequent communication (normally radiotelephony), transmit the DSC announcement

6.3 MF/HF-DSC

- **Basics**

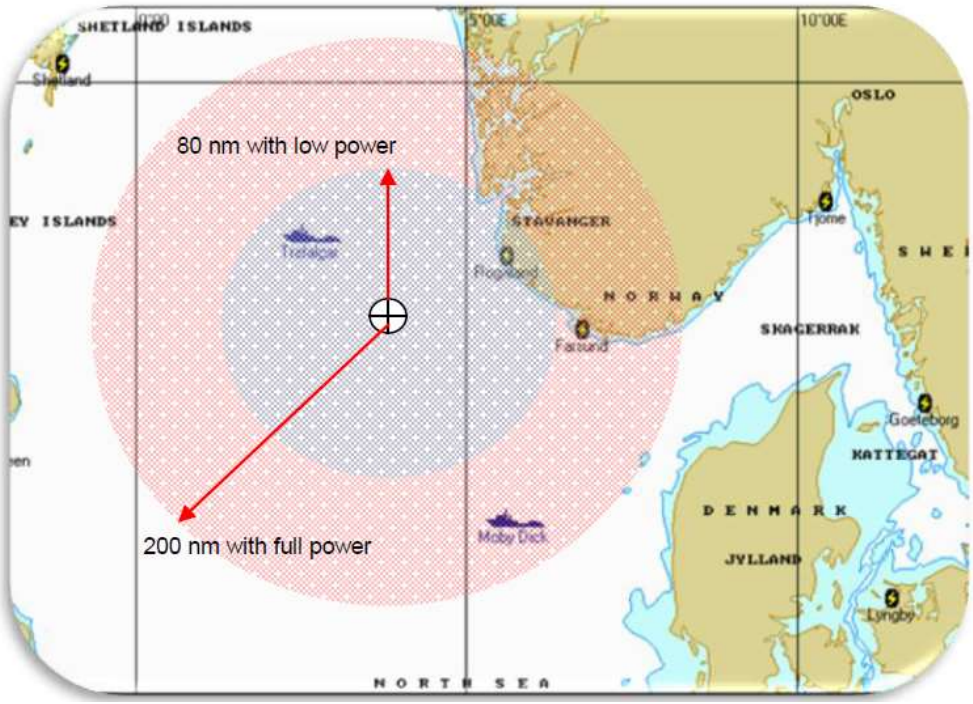
The range of MF transmitter does not only depend on its output power but also on an optimal matching of the transmitter to the transmitting antenna. It depends also on the time of day. For the propagation during daylight hours the ground wave is mostly used.

Note that a DSC transmission can generally cover a higher range than an analogue voice transmission.

On most MF transmitters, the output power can be varied in several steps from low power to high power in accordance with IMO performance standards.

To avoid any interference, the lowest necessary output power shall be selected for establishing contacts.

To avoid interferences the lowest necessary output power shall be selected when installing MF/HF contacts. For establishing contacts to stations within a close distance to the transmitting station, the use of the "low power" output should be sufficient, whilst contacting stations at a greater distance, the use of the "high power" transmitting position can be selected.



Range of MF transmitter

Direction	Receive(kHz)	Transmit (kHz)
Distress ship to ship, ship to coast station, all stations individual station, geographic area announcement	2187,5	2187,5
Urgency ship to ship, ship to coast station, all stations individual station, geographic area announcement	2187,5	2187,5
Safety ship to ship, ship to coast station, all stations individual station, geographic area announcement	2187,5	2187,5
Routine ship to ship, individual station, geographic area announcement	2177,0	2177,0
Routine ship to coast station	2177,0	2189,5

International MF DSC frequencies

- Use and functions of the MF/HF radio station installation

MF/HF radio station

Controls

- Distress Button: This button is protected by a lid. To use, lift the Lid and Push the distress button to transmit a distress alert (without kind of distress).
- Volume: Adjust the volume
- Control knob: Pull and adjust frequency or RF-Gain
- Control buttons: Switch between channel or frequency, switch between transmitter- or receiver frequency, changing the class of emission, tuning the receiver or switch to RF-Gain.
- Menu buttons: Switch between Tel Mode (Radiotelephone parameters are show) and DSC Mode (DSC Parameters are shown, must be selected if DSC routine frequencies should be watched additionally), Open the Address Book, Press "TX /Call" to start creating a DSC alert or announcement, Press "RX / LOG" to open received calls.
- Keyboard: Push the number buttons to key in a channel or frequency, press and hold the "Shift button" to get access to the orange second functions (Power, Scan or additional functions)
- On / OFF Switch: Push to switch the device on or off
- Loudspeaker: to influence the loudspeaker turn the Volume Switch or push the relevant Control Button.
- Indicator lamps: These lamps show the condition when lid for TX – transmitting, transmission mode, CALL – DSC announcement is received, ALARM – an alarm call is received.

- Display: The display shows the current settings of Channel/Frequency, Volume, Kind of emission, Transmitting power etc.

Selecting the RX (receive) and TX (transmit) frequency

The actual RX and TX frequencies can be keyed in. If it becomes necessary to retune to a station, with only a small Hertz frequency difference, then the up/down <Tune Arrows> can be used (RX).

Selecting ITU channel number

GMDSS MF/HF receivers can be tuned to the Wanted Signal by more than one method, i.e., if paired HF frequencies are required, then it is possible to simply select the ITU channel number

Using of clarifier or RX (receiver) fine tuning

Fine-tuning is sometimes necessary, especially when it is required to "clarify' reception of single-sideband (SSB) speech transmissions (i.e., mode of emission = J3E). Selection of the <clarifier> allows tuning down to an accuracy of 10 Hz but it is normally used by listening to the output and tuning to the speech rather than to the actual frequency.

Selecting the class of emission

As there are different classes of emission for voice, NBDP (telex) or data transmissions it is absolutely necessary to select the correct class of emission in order to receive a suitable desired signal.

The setting of the <mode> control is dependent upon the type of modulated signal 2 being received/transmitted, i.e., on the mode of emission

Using volume control and squelch

The Volume or AF gain control simply varies the amount of signal passing to the loudspeaker, whilst the squelch control turns off the loudspeaker when no signals are being received.

Controlling RF gain and using automatic gain control

The radio frequency <Gain> or <Sensitivity> control allows manual adjustment of the input amplifier so as to set up the gain to suit conditions. Continual adjustment of the gain control may be necessary if fading occurs, in which case the AGC can be switched, thereby taking over from manual control, i.e., the AGC holds the output at a nearly constant level even though the input may fluctuate widely.

Using 2182 kHz instant selector

The purpose of the 2182 kHz instant key is to adjust receiver and transmitter frequency to 2182 kHz, to the appropriate class of emission to voice communication and to maximum power output in order to avoid time consuming manual tuning.

Transmitting power

The MF/HF transmitters offer the possibility to vary output power.

Selection of transmitter power level

For establishing contacts to stations in a close distance to a transmitting station (see Range of MF transmitter) the range of MF/HF transmissions mostly the “low power” output should be sufficient, while for contacts between stations in a farer distance to any other stations the “high power” transmitting position can be selected.

Transmitter tuning

To guarantee an optimal emission of the required frequency (wavelength) via the antenna it is necessary to match the antenna length to the wavelength. This will be done by an ATU, either manually or automatically when pressing the PTT key.

- DSC possibilities

Regarding VHF equipment, MF/HF equipment is also divided into two different quality standards. Class A/B covers MF/HF equipment which is obligatory for the use on board of ships which are applicable for SOLAS convention. Class E is mainly intended for the use on ships which do not apply to the SOLAS convention but voluntarily they can be used additionally to the obligatory MF/HF equipment on board of SOLAS ships.
The table below shows all features of Class A/B and Class E MF/HF equipment.

Type	Applicable to					
	Ships Class A/B		Ships Class E		Coast	
	TX	RX	TX	RX	TX	RX
Distress alerts						
RT	■	■	■	■	■	■
CED	■	■	■	■	■	■
Distress acknowledgement						

RT (MF)	■	■	■	■	■	■
FEC (MF)	■	■	■	■	■	■
RT (HF)	■	■	■	■	■	■
FEC (HF)	■	■	■	■	■	■
Distress relay individual						
RT	■	■	■	■	■	■
FEC	■	■	■	■	■	■
Distress relay geographic area						
RT	■	■	■	■	■	■
FEC	■	■	■	■	■	■
Distress relay all ships						
RT	■	■	■	■	■	■
FEC	■	■	■	■	■	■
Distress relay acknowledgement individual						
RT	■	■	■	■	■	■
FEC	■	■	■	■	■	■
Distress relay ackn all ships						
RT	■	■	■	■	■	■
FEC	■	■	■	■	■	■
Urgency and Safety all ships						
J3E RT	■	■	■	■	■	■
F1B FEC	■	■	■	■	■	■
Urgency and Safety geographic area						
J3E RT	■	■	■	■	■	■
F1B FEC	■	■	■	■	■	■
Medical transport	■	■	■	■	■	■
Ships and aircraft (res.18)	■	■	■	■	■	■
Urgency/Safety individual and their acknowledgement						
J3E RT	■	■	■	■	■	■
J3E RT with pos number	■	■	■	■	■	■
J3E RT acknowledgement	■	■	■	■	■	■
F1B FEC or ARQ	■	■	■	■	■	■
F1B FEC or ARQ with pos number	■	■	■	■	■	■
F1B FEC or ARQ acknowledgement	■	■	■	■	■	■
Unable to comply acknowledgement	■	■	■	■	■	■
Position request	■	■	■	■	■	■
Positon requenst acknowledgement	■	■	■	■	■	■
Test	■	■	■	■	■	■
Test acknowledgement	■	■	■	■	■	■
Routine group calls						
J3E RT	■	■	■	■	■	■
F!B FEC	■	■	■	■	■	■

Routine individual calls and their acknowledgement						
J3E RT	■	■	■	■	■	■
J§E RT with pos number	■	■	■	■	■	■
J3E acknowledgement	■	■	■	■	■	■
F1B FEC, ARQ or Data	■	■	■	■	■	■
F1B FEC, ARQ or Data with pos number	■	■	■	■	■	■
F1B FEC, ARQ or Data acknowledgement	■	■	■	■	■	■
Unable to comply	■	■	■	■	■	■
Polling	■	■	■	■	■	■
..Polling acknowledgement	■	■	■	■	■	■
Semi/Auto MF/HF (optional) J3E RT, F!B FEC, ARQ						
Request coast station	■	■	■	■	■	■
Request ship station	■	■	■	■	■	■
Able to comply acknowledgement	■	■	■	■	■	■
Signal strength test by ship on working channel	■	■	■	■	■	■
Coast station ackn. with new working frequency	■	■	■	■	■	■
Coast station ackn. with same working frequency	■	■	■	■	■	■
Unable to comply	■	■	■	■	■	■
End of call request on working channel	■	■	■	■	■	■
End of call acknowledgement on working channel	■	■	■	■	■	■
■ = available ■= not available						

MF/HF DSC possibility table

- Operational MF/HF DSC procedures in the GMDSS

DSC provides automated access to coast stations and ship stations. In general the DSC procedures on MF and HF are the same than described under the operational VHF DSC procedures. However there are some differences between VHF DSC and MF/HF DSC:

On MF/HF equipment no “all ships” announcement is available.

- There is a possibility to transmit a multi frequency distress alert in all MF/HF bands.
- Each band between 2MHz (MF) to 16 MHz (HF) has one DSC distress alerting and urgency/safety announcement frequency available which is used in both directions, ship to shore, shore to ship and ship to ship (simplex). See MF DSC frequencies.
- Additionally, in the bands between 2 MHz and 26 MHz, there are several routine DSC announcement frequencies available for both, international and national announcements. In the 2 MHz band the frequency 2177,0 kHz is used for DSC routine announcements in the direction ship to ship (simplex). For routine DSC announcements in direction ship to shore and shore to ship in the bands between 2 MHz and 26 MHz duplex frequencies are applicable.

Telecommand and traffic information

Telecommand and traffic information’s are features as there is frequency information, class of emission, position information, which are also important for the handling of the subsequent information exchange.

Frequency selection in call format

When calling another maritime mobile station the DSC call format shall contain working frequency information on which both stations subsequently exchange their information. At calling a coast station no working channel should be purposed in the DSC announcement because the coast station will inform the mobile station on which free working frequency has to be conducted.

Acknowledgement

DSC announcements to a geographic area or to a certain group of stations must not be acknowledged in any case by any other receiving station. Individual DSC announcements either to a coast stations or another ship station should be acknowledged by the called station where ever possible.

Distress alert relay

The only cases in which DSC information are relayed are in cases of distress.

Use of frequencies

- DSC watchkeeping – Due to the fact that in the MF and HF bands different DSC frequencies are available MF/HF equipment offers the possibility that the communication receiver can either be used as a scan receiver for the observation of DSC routine frequencies or for normal traffic exchange. Additionally a second DSC receiver, which is always part of the MF/HF equipment, is used as a scan receiver for the DSC distress alerting frequencies in the bands between 2 MHz and 16 MHz.

- Intership frequencies (Simplex) – Ship to ship traffic should be conducted as simplex communications, although duplex communications are permitted under certain conditions.

- Coast station frequencies (Duplex) – Ship to shore traffic is mostly duplex communications. HF coast station frequencies are normally paired frequencies which are indicated by a channel numbers. It is possible to enter the RX and TX frequencies of a certain channel manually or enter the channel number so that the RX and TX frequencies tuned automatically.

Test transmissions

Testing on the exclusive DSC distress and safety frequencies should be avoided as far as possible by using other methods. MF and HF test calls can be carried out with the category “urgency” or “safety” and the announcement may be automatically acknowledged by the called coast station. Normally there would be no further communication between the two stations involved.

- Alerting and announcement

Distress alert

The DSC equipment shall be capable of being preset to transmit the distress alert on 2187,5 kHz or one of the HF DSC distress frequencies between 4MHz and 16 MHz. The distress alert shall be composed by entering the ship’s position information, the time it was valid and the nature of distress. Normally the actual ships position is taken from a suitable navigation indicating receiver. If the position of the ship cannot be entered, the position information will be replaced as the digit 9 transmitted ten times. If the time cannot be included, then the time information will be transmitted automatically as the digit 8 repeated four times.

Activate the distress alert attempt by a dedicated distress button.

A distress alert attempt will be transmitted as 5 consecutive alerts on the selected DSC distress frequency. To avoid alert collision and the loss of acknowledgements, this call attempt may be transmitted on the same frequency again after a random delay of between 3 ½ and 4 ½ min from the beginning of the initial call. This allows acknowledgements arriving randomly to be received without being blocked by retransmission. The random delay will be generated automatically for each repeated transmission; however it will be possible to override the automatic repeat manually.

The DSC equipment should be capable of maintaining a reliable watch on a 24-hour basis on all DSC .MF/HF distress frequencies.

The DSC distress alert on MF should be transmitted to all stations, on HF to an individual coast station.

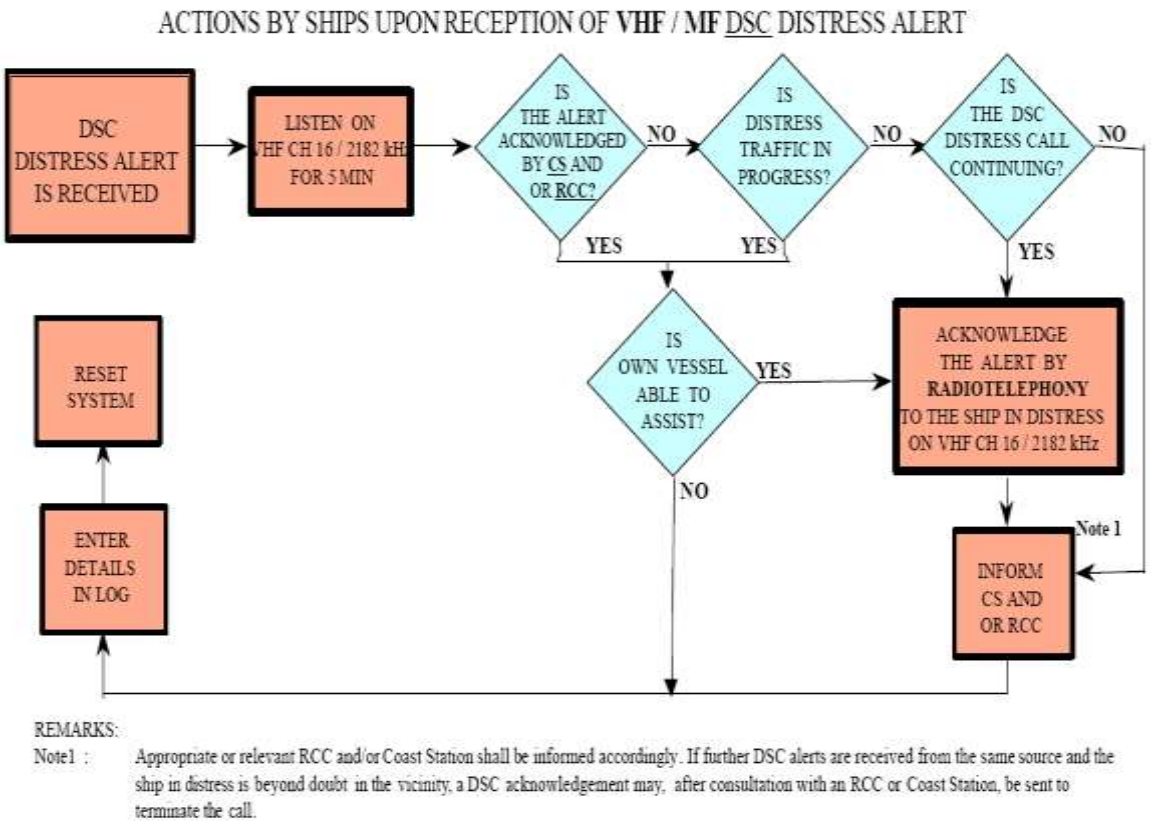
If time permits, key in or select on the DSC equipment keyboard the following:

- Coast station MMSI (only HF)
- Nature of distress
- Ship's last known position (latitude and longitude)
- Time (in UTC) the position was valid
- Type of subsequent distress communication (telephony or NBDP)

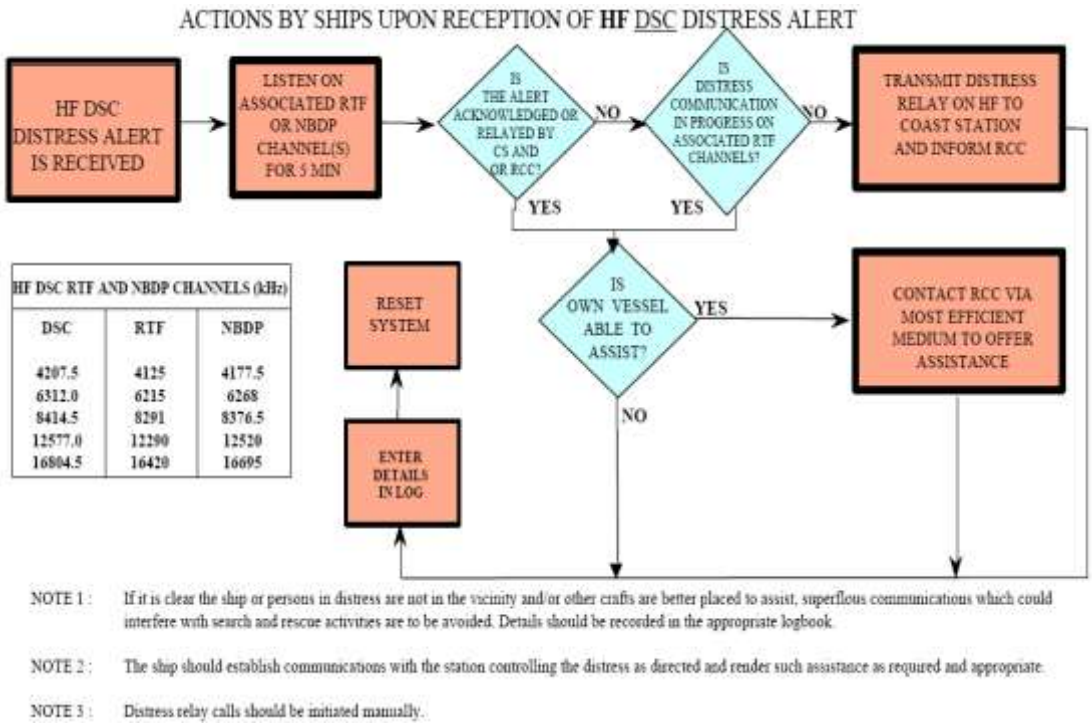
DSC distress alerts may be sent on a number of HF bands in two different ways.

The automatic repetition of a distress alert attempt should be terminated automatically on receipt of a DSC distress acknowledgement.

An inadvertent DSC distress alert shall be cancelled by DSC, if the DSC equipment is so capable. However in all cases, cancellations shall also be transmitted by radiotelephony or radiotelex depending on where and with which mode of communication the DSC alert was transmitted.



Handling of a received VHF/MF DSC distress alert



Handling of a received HF DSC distress alert

Distress alert relay

In case it is considered appropriate to transmit a DSC distress alert relay. Distress alerts relay on HF should be initiated manually; If the master realizes that another ship in distress is not able to transmit the distress alert itself and further help is necessary, then he can transmit a DSC distress alert relay. This distress alert relay and call should be addressed to all ships in a geographic area or to the appropriate coast station.

Key in or select on the DSC equipment keyboard the following:

- Distress relay
- 9-digit identity of the appropriate coast station
- 9-digit identity of the ship in distress, if known
- Nature of distress
- Latest position of the ship in distress, if known
- Time (in UTC) the position was valid (if known)
- Type of subsequent distress communication (telephony)

Transmit the distress alert relay.

Coast stations, after having received and acknowledged a DSC distress alert, may if necessary, retransmit the information received as a DSC distress alert relay, addressed to all ships in a geographic area or a specific ship.

Ships receiving a distress alert relay transmitted by a coast station shall not use DSC to acknowledge the alert, but should acknowledge the receipt of the alert by radiotelephony or radiotelex.

Ships receiving a DSC distress alert relay from a coast station on HF, addressed to all ships within a specified area, should NOT acknowledge the receipt of the relay alert by DSC, but by radiotelephony or radiotelex on the telephony or telex distress traffic frequency in the same band(s) in which the DSC distress relay call was received.

Announcement to individual station (urgency, safety, routine)

Urgency and safety announcements to individual stations should be carried out on a suitable DSC distress frequency.

Key in or select on the DSC equipment keyboard for urgent or safety the following:

- Appropriate calling format on the DSC equipment (individual)
- Individual ship or coast station 9 digit identity
- Category of the call (urgency/safety)
- Frequency (ship to ship only)on which the urgency/safety message will be transmitted
- Type of communication in which the urgency/safety message will be given (radiotelephony/radiotelex)
- DSC distress frequency band must correspond with the frequency band for the message transmission

Transmit the DSC urgency/safety announcement.

Routine announcements will be carried out on a DSC routine frequency.

Key in or select on the DSC equipment keyboard for routine the following:

- Appropriate calling format on the DSC equipment (individual)
- Individual ship or coast station 9 digit identity
- Category of the call (routine)
- Frequency (ship to ship only)on which the routine message will be transmitted
- Type of communication in which the routine message will be given (radiotelephony/radiotelex)
- DSC routine frequency band must correspond with the frequency band for the message transmission, A DSC announcement for an individual coast station is transmitted as follows

Key in or select on the DSC equipment keyboard the following:

- Appropriate calling format on the DSC equipment (individual)
- Individual coast station 9 digit identity
- Category of the call (urgency/safety/routine)
- Type of the subsequent communication (normally radiotelephony/ radiotelex)
- DSC distress or routine frequency band must correspond with the frequency band for the message transmission

Transmit the announcement.

The acknowledgement of an urgency/safety/routine DSC announcement from a coast station contains the working frequency or channel on which the subsequent traffic shall be carried out.

Geographic area announcement (urgency, safety)

The announcement is carried out by a transmission of a DSC urgency/safety announcement on the DSC distress and announcement frequency in the band in which it is assumed that the transmission will be received.

The DSC urgency/safety announcement may be addressed to all stations in a geographic area or to a specific station (see Figure 47: Example of a rectangular geographic area). The frequency on which the urgency/safety message will be transmitted shall be included in the DSC urgency/safety announcement.

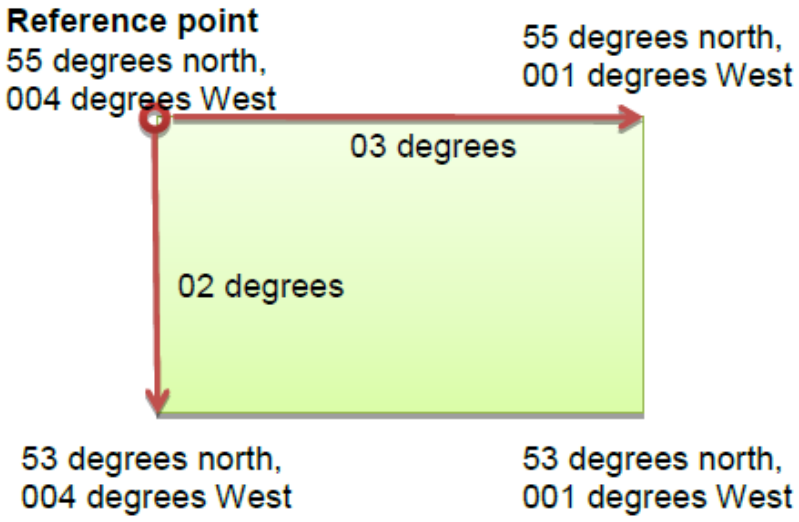
Key in or select on the DSC equipment keyboard the following:

- Appropriate calling format on the DSC equipment (geographic area)
- Category of the call (urgency/safety)

- Frequency on which the urgency/safety message will be transmitted
- Type of communication in which the urgency/safety message will be given (radiotelephony/radiotelex)
- DSC distress frequency band must correspond with the frequency band for the message transmission

Transmit the DSC geographic area urgency/safety announcement. Ship stations in receipt of an urgency/safety geographic area announcement shall monitor the frequency or channel indicated for the message for at least five minutes.

However, in the maritime mobile service, after the DSC announcement the urgency/safety message shall be transmitted on a working frequency in radiotelephony or radiotelex.



Example of a rectangular geographic area

Group announcement (distress, urgency, safety, routine)

- All coast stations call – Recommendation ITU-R M.493 on DSC systems for use in the Maritime Mobile Service provides for "group calls" an address consisting of the characters corresponding to the station's MMSI and a number of Administrations have already assigned a "group call" MMSI to their coast stations in addition to the coast stations individual MMSI.

  By multilateral agreements, a "group call" MMSI could be assigned to all coast stations of a specific region, e.g., an RCC area and could comply with IMO's requirement without need of introducing further modifications to GMDSS equipment.

  An alternative method to implement an "all coast stations" call without the need to modify Recommendation ITU-R M.493 could be to define one MMSI world-wide as an address for all coast stations. However, this solution would also require a modification of the setup at each coast station participating in the GMDSS.

  The purpose of group announcements is to inform a certain group of ships- or coast stations of an event which could be of interest to that group of stations only.

  Key in or select on the DSC equipment keyboard the following:
  - Appropriate calling format on the DSC equipment (group)
  - Group 9 digit identity
  - Category of the call (urgency/safety/routine)
  - Channel on which the urgency/safety/routine message will be transmitted
  - Type of communication in which the urgency/safety/routine message will be given (radio telephony, radiotelex)
  - DSC distress or routine frequency band must correspond with the frequency band for the message transmission. Transmit the DSC group announcement.

Polling and position request
The purpose of polling is to assert that the called station is in the range of the calling station and if it is operational. Position request is selected when a station wants to get position details of a called station.

Key in or select on the DSC equipment keyboard the following:
- Appropriate calling format on the DSC equipment (polling/ position request)
- Individual 9 digit identity
- Category of the call (urgency/safety)
- DSC distress frequency in the band in which a reply can be awaited

Transmit the DSC urgency/safety polling/position request announcement.

The polling acknowledgement does not contain any special information. The fact of receiving the acknowledgment from the called station indicates that the called ship is in the range and its MF/HF equipment is operational.

The position request acknowledgement contains the called ships position and points to the fact that the MF/HF equipment is in range of the calling station and operational.

Automatic service with coast stations
A couple of coast stations offer the possibility for a direct dealing to land subscribers without any operator's involvement.

A DSC announcement for an individual coast station automatic telephone service call transmitted as follows.

Key in or select on the DSC equipment keyboard the following:
- Appropriate calling format on the DSC equipment (individual)
- Individual coast station 9 digit identity
- Country code, area code and telephone number of subscriber
- Category of the call (urgency/safety/routine)
- Type of the subsequent communication (normally radiotelephony)
- DSC distress or routine frequency in the band in which the call shall be carried out

Transmit the DSC announcement.

For automatic telex service communications will not be established via DSC but with the telex equipment only.

6.4. VHF/MF/HF voice procedure

6.4.1 Distress procedure

Distress communications rely on the use of terrestrial MF, HF and VHF radio communications and communications using satellite techniques. Distress communications shall have absolute priority over all other transmissions. The following terms apply:

- **Distress alert** – a digital selective call (DSC) using a distress call format, in the bands used for terrestrial radio communication, or a distress message format, in which case it is relayed through space stations
- **Distress call –** the initial voice or text procedure
- **Distress message** – the subsequent voice or text procedure.
- **Distress alert relay** – a DSC transmission on behalf of another station.
- **Distress call relay** – the initial voice or text procedure for a station not itself in distress

Distress call

The distress call shall be sent on the distress and safety frequencies designated in the MF, HF and VHF bands for radiotelephony. The distress alert or call and subsequent messages shall be sent only on the authority of the person responsible for the ship, aircraft or other vehicle carrying the mobile station or the mobile earth station. It shall be transmitted with full carrier power (VHF - 25W, MF/HF – full power) Transmissions by radiotelephony shall be made slowly and distinctly, each word being clearly pronounced to facilitate transcription. The phonetic alphabet and figure code in appendix 14 of the RR and the abbreviations and signals in accordance with the most recent version of Recommendation ITU-R M.1172 should be used where applicable.

Ship-to-ship distress alerts are used to alert other ships in the vicinity of the ship in distress and are based on the use of DSC in the VHF and MF bands. Additionally, the HF band may be used. Ship stations equipped for DSC procedures may transmit a distress call and distress message immediately following the distress alert in order to attract attention from as many ship stations as possible. Ship stations not equipped for DSC procedures shall, where practical, initiate the distress communications by transmitting a radio telephony distress call and message on the frequency 156.8 MHz (VHF channel 16).

The radiotelephone distress signal consists of the word MAYDAY. The distress call sent on the frequency 156.8 MHz (VHF channel 16) or on MF/HF shall be given in the following form:

MAYDAY MAYDAY MAYDAY
THIS IS
SHIP'S NAME SHIP'S NAME SHIP'S NAME
CALL SIGN
MMSI

The distress message that follows the distress call should be given in the following form:

MAYDAY; SHIP'S NAME; CALL SIGN; MMSI

- the position, given as the latitude and longitude, or if the latitude and longitude are not known or if time is insufficient, in relation to a known geographical location;
- the nature of the distress;
- the kind of assistance required;
- any other useful information

Distress relay

A station in the mobile or mobile-satellite service which learns that a mobile unit is in distress (for example, by a radio call or by observation) shall initiate and transmit a distress alert relay and/or a distress call relay on behalf of the mobile unit in distress once it has ascertained that any of the following circumstances apply:

- on receiving a distress alert or call which is not acknowledged by a coast station or another vessel within five minutes
- on learning that the mobile unit in distress is otherwise unable or incapable of participating in distress communications, if the master or other person responsible for the mobile unit not in distress considers that further help is necessary

However, a ship shall not transmit a distress alert relay to all ships by DSC on the VHF or MF distress frequencies following receipt of a distress alert sent by DSC by the ship in distress.

When an aural watch is being maintained on shore and reliable ship-to-shore communications can be established by radiotelephony, a distress call relay is sent by radiotelephony and addressed to the relevant coast station or rescue coordination centre on the appropriate frequency.

The distress call relay sent by radiotelephony should be given in the following form:

MAYDAY RELAY MAYDAY RELAY MAYDAY RELAY
ALL STATIONS ALL STATIONS ALL STATIONS
THIS IS
SHIP'S NAME SHIP'S NAME SHIP'S NAME
CALL SIGN
MMSI

(All identifications of the relaying vessel)

This call can be addressed to all stations or to an individual station. This call shall be followed by a distress message which shall, as far as possible, repeat the information contained in the original distress alert or message or the observations done by the relaying station:

Following received on Channel 16 at time in UTC
MAYDAY; SHIP'S NAME; CALL SIGN;MMSI
(All identifications of the vessel in distress)

- the position, given as the latitude and longitude, or if the latitude and longitude are not known or if time is insufficient, in relation to a known geographical location;
- the nature of the distress;
- the kind of assistance required;
- any other useful information

or:

Following observed
MAYDAY
(Only MAYDAY, if the vessel in distress is not known)

- the observed position, given as the latitude and longitude, or if the latitude and longitude are not known or if time is insufficient, in
- relation to a known geographical location;
- the nature of the distress;
- the kind of assistance required;
- any other useful information

Acknowledgement

Acknowledgement of receipt of a distress alert, including a distress alert relay, shall be made in the manner appropriate to the method of transmission of the alert and within the time-scale appropriate to the role of the station in receipt of the alert.

When acknowledging receipt of a distress alert sent by DSC, the acknowledgement in the terrestrial services shall be made by DSC, radiotelephony or narrow-band direct-printing telegraphy as appropriate to the circumstances, on the associated distress and safety frequency in the same band in which the distress alert was received, taking due account of the directions given in the most recent versions of the RR Art.32.

In areas where reliable communications with one or more coast stations are practicable, ship stations in receipt of a distress alert or a distress call from another vessel should defer acknowledgement for a short interval so that a coast station may acknowledge receipt in the first instance.
When acknowledging by radiotelephony the receipt of a distress alert or a distress call from a ship station or a ship earth station, the acknowledgement should be given in the following form:

MAYDAY
SHIP'S NAME and CALL SIGN or MMSI
(of the vessel in distress)
THIS IS
SHIP'S NAME and CALL SIGN
(of the acknowledging vessel)
RECEIVED MAYDAY

Ship stations in receipt of a distress call sent by radiotelephony on the frequency 156.8 MHz (VHF channel 16) shall, if the call is not acknowledged by a coast station or another vessel within five minutes, acknowledge receipt to the vessel in distress and use any means available to relay the distress call to an appropriate coast station or coast earth station.

However in order to avoid making unnecessary or confusing transmissions in response, a ship station, which may be at a considerable distance from the incident, receiving an HF distress alert, shall not acknowledge it but shall observe the distress frequency in the band in which the distress alert was sent and shall, if the distress alert is not acknowledged by a coast station within five minutes, relay the distress alert, but only to an appropriate coast station or coast earth station.

A ship station acknowledging receipt of a distress alert sent by DSC should, in accordance with the following:

- In the first instance, acknowledge receipt of the distress alert by using radiotelephony on the distress and safety traffic frequency in the band used for the alert, taking into account any instructions which may be issued by a responding coast station.
- If acknowledgement by radiotelephony of the distress alert received on the MF or VHF distress alerting frequency is unsuccessful, acknowledge receipt of the distress alert by responding with a digital selective call on the appropriate frequency.

However, unless instructed to do so by a coast station or a rescue coordination centre, a ship station may only send an acknowledgement by DSC in the event that:

- no acknowledgement by DSC from a coast station has been observed; and
- no other communication by radiotelephony or narrow-band direct-printing telegraphy to or from the vessel in distress has been observed; and
- at least five minutes have elapsed and the distress alert by DSC has been repeated.

A ship station in receipt of a shore-to-ship distress alert relay or distress call relay should establish communication as directed and render such assistance as required and appropriate.

Distress Traffic and on scene communication

On receipt of a distress alert or a distress call, ship stations and coast stations shall set watch on the radiotelephone distress and safety traffic frequency associated with the distress and safety calling frequency on which the distress alert was received.

Distress traffic consists of all messages relating to the immediate assistance required by the ship in distress, including search and rescue communications and on-scene communications. The distress traffic shall as far as possible be on the frequencies contained in the RR Article 31.

For distress traffic by radiotelephony, when establishing communications, calls shall be prefixed by the distress signal MAYDAY.

The rescue coordination centre responsible for controlling a search and rescue operation shall also coordinate the distress traffic relating to the incident or may appoint another station to do so.

On-scene communications are those between the mobile unit in distress and assisting mobile units, and between the mobile units and the unit co-ordinatingsearch and rescue operations. Control of on-scene communications is the responsibility of the unit co-ordinating search and rescue operations. Simplex communications shall be used so that all on-scene mobile stations may share relevant information concerning the distress incident. If direct-printing telegraphy is used, it shall be in the forward error-correcting mode.

The preferred frequencies in radiotelephony for on-scene communications are 156.8 MHz and 2182 kHz. The frequency 2174.5 kHz may also be used for ship-to-ship onscene communications using narrow-band direct-printing telegraphy in the forward error correcting mode. In addition to 156.8 MHz and 2182 kHz, the frequencies 3023 kHz, 4125 kHz, 5680 kHz, 123.1 MHz and 156.3 MHz may be used for ship-to-aircraft on-scene communications.

The selection or designation of on-scene frequencies is the responsibility of the unit co-ordinating search and rescue operations. Normally, once an on-scene frequency is established, a continuous aural or teleprinter watch is maintained by all participating on-scene mobile units on the selected frequency.

MAYDAY
SHIP'S NAME and CALL SIGN
(for example vessel in distress)
THIS IS
SHIP'S NAME and CALL SIGN
(assisting vessel)
Calling reason

The rescue coordination centre co-ordinating distress traffic, the unit co-ordinating search and rescue operations or the coast station involved may impose silence on stations which interfere with that traffic. This instruction shall be addressed to all stations or to one station only, according to circumstances. In either case, the following shall be used:

In radiotelephony, the signal

SEELONCE MAYDAY
SHIP'S NAME, CALL SIGN or ALL STATIONS
SEELONCE MAYDAY

Until they receive the message indicating that normal working may be resumed, all stations which are aware of the distress traffic, and which are not taking part in it, and which are not in distress, are forbidden to transmit on the frequencies in which the distress traffic is taking place.

When distress traffic has ceased on frequencies which have been used for distress traffic, the station controlling the search and rescue operation shall initiate a message for transmission on these frequencies indicating that distress traffic has finished.

In radiotelephony, the message should consist of:

MAYDAY
ALL STATIONS ALL STATIONS ALL STATIONS
THIS IS
SHIP'SNAME SHIP'S NAME SHIP'S NAME
CALL SIGN
MMSI
the time of handing in of the message in UTC
SHIP'S NAME, CALL SIGN and MMSI
(of the mobile station which was in distress)
SEELONCE FEENEE
False Alert

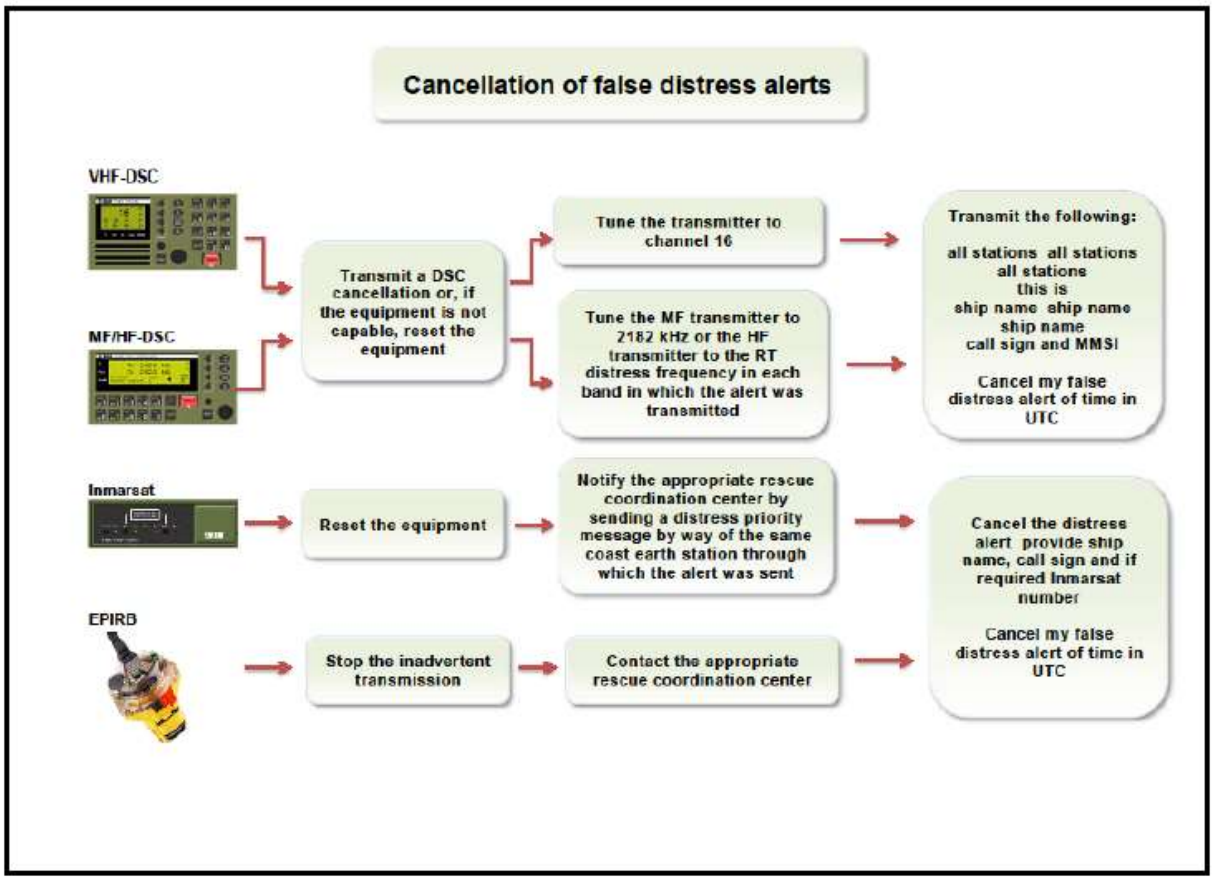
A station transmitting an inadvertent distress alert or call shall cancel the transmission.

An inadvertent DSC alert shall be cancelled by DSC, if the DSC equipment is so capable. The cancellation should be in accordance with the most recent version of Recommendation ITU R M.493. In all cases, cancellations shall also be transmitted by radiotelephony.

An inadvertent distress call shall be cancelled by radiotelephony in accordance with the procedure described below.

Inadvertent distress transmissions shall be cancelled orally on the associated distress and safety frequency in the same band on which the distress transmission was sent, using the following procedure:

ALL STATIONS ALL STATIONS ALL STATIONS
THIS IS
SHIP'S NAME SHIP'S NAME SHIP'S NAME
CALL SIGN
MMSI
PLEASE CANCEL MY DISTRESS ALERT OF time in UTC.



Cancellation of false distress alerts

6.4.2 Urgency procedure

Urgency communication include:

- Medico- and medical transport calls;
- Urgent communication relating extreme weather conditions; and
- Support communications for search and rescue operations.

Urgency communications shall have priority over all other communications, except distress.

The following terms apply:

- Urgency announcement – a digital selective call using an urgency call format in the bands used for terrestrial radio communication, or an urgency message format, in which case it is relayed through space stations
- Urgency call – the initial voice or text procedure
- Urgency message – the subsequent voice or text procedure

In a terrestrial system, urgency communications consist of an announcement, transmitted using DSC, followed by the urgency call and message transmitted using radiotelephony. The announcement of the urgency message shall be made on one or more of the distress and safety calling frequencies specified in the RRs, using both DSC and the urgency call format, or if not available, radio telephony procedures and the urgency signal. Announcements using DSC should use the technical structure and content set forth in the most recent version of Recommendations ITU-R M.493 and ITU-R M.541.

Ship stations not equipped for DSC procedures may announce an urgency call and message by transmitting the urgency signal by radiotelephony on the frequency 156.8 MHz (channel 16), while taking into account that other stations outside VHF range may not receive the announcement.

In the maritime mobile service, urgency communications may be addressed either to all stations or to a particular station. When using DSC techniques, the urgency announcement shall indicate which frequency is to be used to send the subsequent message and, in the case of a message to all stations, shall use the "All Ships" format setting.

Urgency announcements from a coast station may also be directed to a group of vessels or to vessels in a defined geographical area.

The urgency call and message shall be transmitted on one or more of the distress and safety traffic frequencies. However, in the maritime mobile service, the urgency message shall be transmitted on a working frequency:

- in the case of a long message or a medical call; or
- In areas of heavy traffic when the message is being repeated.

An indication to this effect shall be included in the urgency announcement or call. The urgency signal consists of the words PAN PAN. The urgency call format and the urgency signal indicate that the calling station has a very urgent message to transmit concerning the safety of a mobile unit or a person. Communications concerning medical advice may be preceded by the urgency signal. Mobile stations requiring medical advice may obtain it through any of the land stations shown in the List of Coast Stations and Special Service Stations.

Urgency communications to support search and rescue operations need not be preceded by the urgency signal.

The urgency call should consist of:

PAN PAN PAN PAN PAN PAN
ALL STATIONS ALL STATIONS ALL STATIONS
THIS IS
SHIP'S NAME SHIP'S NAME SHIP'S NAME
(or coast station name)
CALL SIGN
MMSI
followed by the urgency message or followed by the details of the channel to be used for the message in the case where a working channel is to be used.

In radiotelephony, on the selected working frequency, the urgency call and message consists of:

PAN PAN PAN PAN PAN PAN
ALL STATIONS ALL STATIONS ALL STATIONS
THIS IS
SHIP'S NAME SHIP'S NAME SHIP'S NAME
(or coast station name)
CALL SIGN
MMSI
the text of the urgency message

The urgency call format or urgency signal shall be sent only on the authority of the person responsible for the ship, aircraft or other vehicle carrying the mobile station or mobile earth station. The urgency call format or the urgency signal may be transmitted by a land station or a coast earth station with the approval of the responsible authority.

Ship stations in receipt of an urgency announcement or call addressed to all stations shall not acknowledge. Ship stations in receipt of an urgency announcement or call of an urgency message shall monitor the frequency or channel indicated for the message for at least five minutes. If, at the end of the five-minute monitoring period, no urgency message has been received, a coast station should, if possible, be notified of the missing message. Thereafter, normal working may be resumed.
Coast and ship stations which are in communication on frequencies other than those used for the transmission of the urgency signal or the subsequent message may continue their normal work without interruption, provided that the urgency message is not addressed to them nor broadcast to all stations.

When an urgency announcement or call and message was transmitted to more than one station and action is no longer required, an urgency cancellation should be sent by the station responsible for its transmission.

The urgency cancellation should consist of:

PAN PAN PAN PAN PAN PAN
ALL STATIONS ALL STATIONS ALL STATIONS
THIS IS
SHIP'S NAME SHIP'S NAME SHIP'S NAME
(or coast station name)
CALL SIGN
MMSI
PLEASE CANCEL URGENCY MESSAGE OF time in UTC

Medical transport
The term "medical transport", as defined in the 1949 Geneva Conventions and Additional Protocols, refers to any means of transportation by land, water or air, whether military or civilian, permanent or temporary, assigned exclusively to medical transportation and under the control of a competent authority of a party to a conflict or of neutral States and of other States not parties to an armed conflict, when these ships, craft and aircraft assist the wounded, the sick and the shipwrecked.

For the purpose of announcing and identifying medical transports that are protected under the above-mentioned Conventions, the procedure of urgency announcement, call and message is obligatory. The urgency call shall be followed by the addition of the single word MAY-DEE-CAL, in radiotelephony.

When using DSC techniques, the urgency announcement on the appropriate DSC distress and safety frequencies shall always be addressed to all stations on VHF and to a specified geographical area on MF and HF and shall indicate "Medical transport" in accordance with the most recent version of Recommendations ITU-R M.493 and ITU-R M.541.

Medical transports may use one or more of the distress and safety traffic frequencies for the purpose of self-identification and to establish communications. As soon as practicable, communications shall be transferred to an appropriate working frequency.

The use of the signals described above indicates that the message that follows concerns a protected medical transport. The message shall convey the following data:

- call sign or other recognized means of identification of the medical transport;
- position of the medical transport;
- number and type of vehicles in the medical transport;
- intended route;

- estimated time en route and of departure and arrival, as appropriate;
- any other information, such as flight altitude, radio frequencies guarded, languages used and secondary surveillance radar modes and codes.

The use of radio communications for announcing and identifying medical transports is optional; however, if they are used, the provisions of the RRs and particularly of the Articles 30-33 shall apply.

6.4.3 Safety procedure

Safety communications include:

- avigational and meteorological warnings;
- urgent information;
- ship-to-ship safety of navigation communications;
- communications relating to the navigation, movements and needs of ships; and
- weather observation messages destined for an official meteorological service.

Safety communications shall have priority over all other communications, except distress and urgency

The following terms apply:

- **Safety announcement** – a digital selective call using a safety call format in the bands used for terrestrial radio communication or a safety message format, in which case it is relayed through space stations
- **Safety call** – the initial voice or text procedure
- **Safety message** – the subsequent voice or text procedure

In a terrestrial system, safety communications consist of a safety announcement, transmitted using DSC, followed by the safety call and message transmitted using radiotelephony, narrow-band direct-printing or data. The announcement of the safety message shall be made on one or more of the distress and safety calling frequencies using either DSC techniques and the safety call format, or radiotelephony procedures and the safety signal.

However, in order to avoid unnecessary loading of the distress and safety calling frequencies specified for use with DSC techniques:

- safety messages transmitted by coast stations in accordance with a predefined timetable should not be announced by DSC techniques; and
- safety messages which only concern vessels sailing in the vicinity should be announced using radiotelephony procedures.

In addition, ship stations not equipped for DSC procedures may announce a safety message by transmitting the safety call by radiotelephony. In such cases the announcement shall be made using the frequency 156.8 MHz (VHF channel 16), while taking into account that other stations outside VHF range may not receive the announcement.

In the maritime mobile service, safety messages shall generally be addressed to all stations. In some cases, however, they may be addressed to a particular station. When using DSC techniques, the safety announcement shall indicate which frequency is to be used to send the subsequent message and, in the case of a message to all stations, shall use the “All Ships” format setting.

In the maritime mobile service, the safety message shall, where practicable, be transmitted on a working frequency in the same band(s) as those used for the safety announcement or call. A suitable indication to this effect shall be made at

the end of the safety call. In the case that no other option is practicable, the safety message may be sent by radiotelephony on the frequency 156.8 MHz (VHF channel 16).

The safety signal consists of the word SECURITE.

The safety call format or the safety signal indicates that the calling station has an important navigational or meteorological warning to transmit. Messages from ship stations containing information concerning the presence of cyclones shall be transmitted, with the least possible delay, to other mobile stations in the vicinity and to the appropriate authorities through a coast station, or through a rescue coordination centre via a coast station or an appropriate coast earth station. These transmissions shall be preceded by the safety announcement or call. Messages from ship stations, containing information on the presence of dangerous ice, dangerous wrecks, or any other imminent danger to marine navigation, shall be transmitted as soon as possible to other ships in the vicinity, and to the appropriate authorities through a coast station, or through a rescue coordination centre via a coast station or an appropriate coast earth station. These transmissions shall be preceded by the safety announcement or call

The complete safety call should consist of:

SECURITE SECURITE SECURITE
ALL STATIONS ALL STATIONS ALL STATIONS
(or individual called station, three times)
THIS IS
SHIP'S NAME SHIP'S NAME SHIP'S NAME
(or coast station name)
CALL SIGN
MMSI

followed by the safety message or
followed by the details of the channel to be used for the message
in the case where a working channel is to be used

In radiotelephony, on the selected working frequency, the safety call and message should consist of:

SECURITE SECURITE SECURITE
ALL STATIONS ALL STATIONS ALL STATIONS
(or individual called station, three times)
THIS IS
SHIP'S NAME SHIP'S NAME SHIP'S NAME
(or coast station name)
CALL SIGN
MMSI
the text of the safety message

Ship stations in receipt of a safety announcement using DSC techniques and the "All Ships" format setting, or otherwise addressed to all stations, shall not acknowledge.

Ship stations in receipt of a safety announcement or safety call and message shall monitor the frequency or channel indicated for the message and shall listen until they are satisfied that the message is of no concern to them. They shall not make any transmission likely to interfere with the message.

Intership navigation safety communications

Intership navigation safety communications are those VHF radiotelephone communications conducted between ships for the purpose of contributing to the safe movement of ships. The frequency 156.650 MHz is used for intership navigation safety communications (see also RR appendix 15*J*.

6.4.4 Port operation and ship movement communication

Radio traffic belonging port operation and ship movement service is a radio traffic regarding the safety of navigation. Calls for this service do not contain the safety signal, e.g.:

Hamburg Pilot
this is
Moby Dick / TFKA
I will arrive at your position in about two hours
Over
Use of other frequencies for safety

Radio communications for safety purposes concerning ship reporting communications, communications relating to the navigation, movements and needs of ships and weather observation messages may be conducted on any appropriate communications frequency, including those used for public correspondence. In terrestrial systems, the bands 415-535 kHz (see RR Article 52), 1606.5-4000 kHz (see RR Article 52), 4000-27500 kHz (see RR appendix 17), and 156-174 MHz (see RR appendix 18) are used for this function. In the maritime mobile-satellite service, frequencies in the bands 1530-1544 MHz and 1626.5-1645.5 MHz are used for this function as well as for distress alerting purposes.

6.4.5 Routine communication

Routine communications are communications that do not require any priority.

Calling a subscriber (ship to shore)

After announcing the coast station by DSC and receiving their acknowledgement including the working frequencies, the coast station will call the ship station as soon as possible on the specified frequency like, e.g.:

Moby Dick / TKFA 251 725 110
this is
Lyngby Radio
How do you read me?

The ship station replies and supplies the coast stations with the necessary details:

Lyngby Radio
this is
Moby Dick / TKFA 251 725 110
I read you loud and clear. I have a phone call to Hamburg
country code 49
area code 40
telephone number 2006570

my accounting code (AAIC) is IS01
over

The coast station replies as follows:

Moby Dick / TKFA
this is
Lyngby Radio
I understood, I shall call your party

When the subscriber ashore is on the line, the coast station will inform the ship station to start talking:

Moby Dick / TKFA
this is
Lyngby Radio
your party is on the line, go ahead please

After finishing the conversation the coast station will inform the ship station about the appropriate duration to be paid:

Moby Dick / TKFA
this is
Lyngby Radio
It was a 5 minutes call. I have no more traffic for you.
6.4.5.2. Phone call from ashore (shore to ship)

After receiving a DSC announcement from a coast station the ship station has to acknowledge the receipt by DSC as soon as possible and tune to the working frequencies which were given in the coast stations announcement. Then the coast station will call the ship station on the mentioned working frequency:

Moby Dick / TKFA 251 725 110
this is
Lyngby Radio
How do you read me?

The ship station replies to the coast station:

Lyngby Radio
this is
Moby Dick / TKFA 251 725 110
I read you loud and clear.
Over

The coast station will inform the ship station as follows, e.g.:

Moby Dick / TKFA
this is
Lyngby Radio
I have a phone call from Hamburg for the master, stand by I will connect you

When the subscriber ashore is on the line, the coast station will inform the ship station to start talking:

Moby Dick / TKFA
this is
Lyngby Radio
your party is on the line, go ahead please

Transmission of a telegram
The contact installation for the transmission of a radio telegram via DSC is the same procedure as described under 0

Phone call from ashore (shore to ship)
After receiving the acknowledgement from the called station, the transmission of the following telegram will be carried out in radiotelephony as follows:

Preamble:	**Moby Dick / TKFA 4 13/12 12 0930 IS01 =**
Prefix	**Urgent =**
Address	**Halo Hamburg =**
Text	**Eta Rotterdam 15.03.0700lt stop require cash usd 5000 =**
Signature	**Master +**

Sample of a telegram

The telegram begins:

MOBY DICK I repeat and spell Mike Oskar Bravo Yankee ....call sign Tango Kilo Foxtrot Alfa, number 4 with 13 slash (/) 12 words of 12th at 0930 accounting code India Sierra 01
Prefix:
URGENT
Address:
Halo I repeat and spell Hotel Alpha Lima Oskar, Hamburg I repeat and spell Hotel Alpha Mike Bravo Uniform Romeo Golf
Text:
ETA ROTTERDAM I repeat and spell Romeo Oskar Tango Tango Echo Romeo Delta Alpha Mike it follows a mixed code group, I spell 15 point 03 point 0700 Lima Tango STOP REQUIRE CASH it follows a group of letters Uniform Sierra Delta it follows a group of figures 5000
Signature:

MASTER
End of telegram, over

6.4.6 Intership communication

The main purpose of intership communication is the exchange of information regarding the safety of navigation, weather information etc. The exchange of private information should be kept as short as possible. Intership communication on VHF takes always place on simplex channels, on MF/HF it should normally carry out also on simplex frequencies. But it is possible to use duplex frequencies where permitted, duplex communication should be avoided wherever possible (save frequency space).

The ship to ship announcement by DSC must contain the priority, the mode of operation, and the channel or frequency on which the subsequent communications shall be exchanged. The vessel announcing ship to ship communications has to wait for an acknowledgement from the called vessel before both ships can start their information exchange as described below:

Tina / DILD 211 327 000
this is
Moby Dick / TKFA 251 725 110
I have information, how do you read me?
over

The called station replies:

Moby Dick / TKFA 251 725 110
this is
Tina / DILD 211 327 000
I read you loud and clear, go ahead please
Over

The calling station starts the information exchange. During further communication it is not necessary to exchange the MMSI verbally:

Tina / DILD
this is
Moby Dick / TKFA
My position is....
over

6.4.7 On board communication

The purpose of on board communications is the exchange of information regarding the operation of the own vessel on VHF or/and UHF channels. The power output is limited on VHF to 1W, on UHF to 2W.

The on board communication covers:

- Internal Communication on the vessel
- Communication between the parent ship and its live saving appliances
- Communication between the parent ship and its pram
- Communication while towing or mooring the vessel

The identification of the controlling station (bridge) is the ships name followed by the word "control". The identity of the first participating station (handheld) is the ships name followed by the word Alpha, for the second station it is ships name followed by the word Bravo etc.

The voice procedure, for example:

Moby Dick Charly
this is
Moby Dick Control
What is the distance to the pier?
Over

6.5 Radiotelex

In Sea area A4, NBDP is the only means of communications in which written information on MF/HF regarding safety of navigation can be exchanged. For ships operating in Sea area A4, radiotelex equipment is compulsory.

- **Basics**

The purpose of radiotelex (NBDP) in the maritime mobile service is the exchange of information in direction ship to shore, shore to ship, ship to ship and broadcast to all stations.

Two modes of operation are used dependent upon the message destination, i.e., whether the message is addressed to one specific station or to all stations.

ARQ: This is the mode for communication between two stations to transmit and receive information during a certain connection. At the end of the own transmission the signals GA+? (Go Ahead) have to be keyed in to inform the receiving station that it now can start with its reply. The "+?" effects that the transmission permit has changed from one station to the other.

FEC: This is the mode for communication broadcasting to all stations or to transmit to an individual station in one direction only during a certain connection.

This mode would be used, for example, for distress traffic or for NAVTEX broadcasts.

- **Numbering**

In the maritime mobile service there are three different identification numbers available to call other radiotelex stations:

- Coast station telex number consist of four digits, e.g. 3220
- Ship station telex number consists of five digit, e.g. 32456
- MMSI consists of 9 digit, e.g. 211 234 500

Answerbacks are used to ensure that two communicating stations are connected to the subscriber they wanted to communicate with. The answerback consists of:

- Telex number
- Chosen abbreviation
- Country code

The answerback of a subscriber ashore consists of:

- His telex number without country code
- Chosen abbreviation (might be companies name)
- Country code (letters)

Answerback description (land subscriber)

The answerback of a ship station consists of:

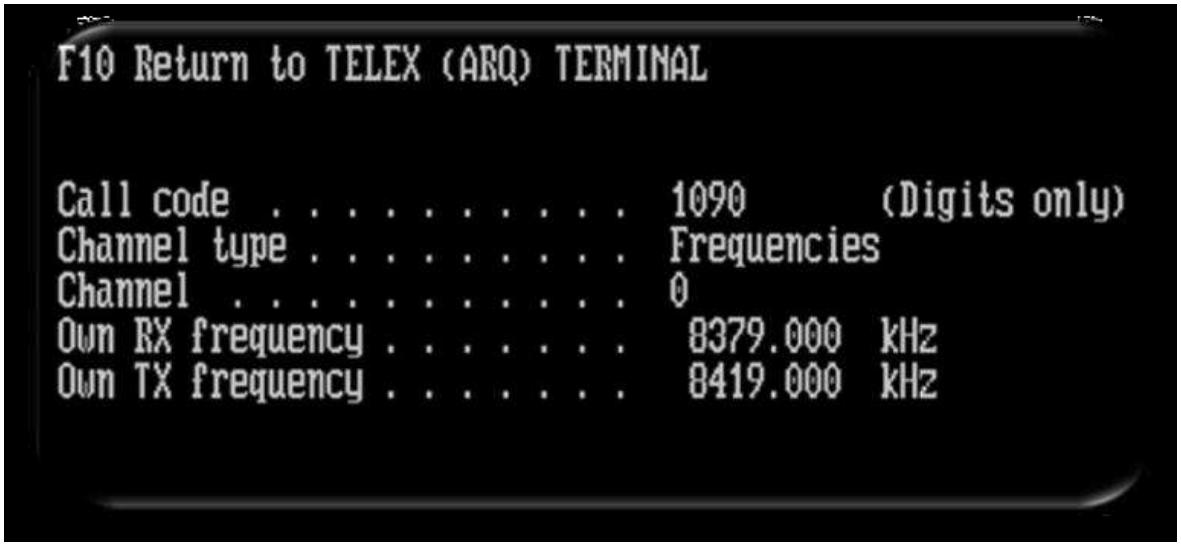
- Its telex number
- Chosen abbreviation (might be the call sign)
- X (indicates a mobile station)

Answerback description (ship subscriber)

In addition to the above mentioned telex identities, it must be possible to maritime telex stations also by using their MMSI.

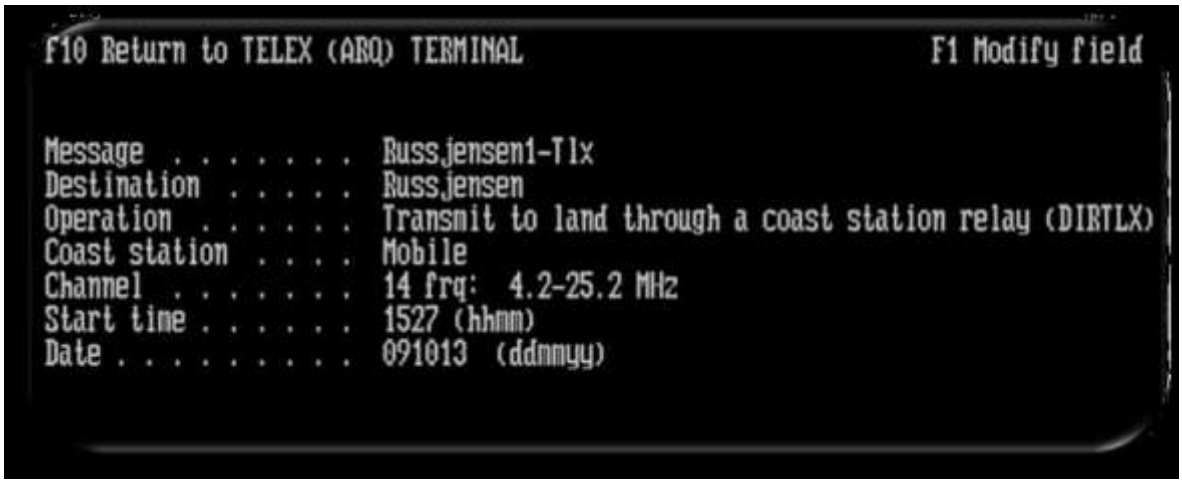
- Automatic and manual calling

Radiotelex calls to coast stations can be made manually by entering its telex number and then entering the receiving and transmitting frequencies or the appropriate ITU channel for HF telex operation which will be used for traffic.



Manual telex calling of a coast station

Fully automatic calls can also be made when the operator selects the already prepared message, the destination (land subscriber), type of operation (dirtlx), coast station from a pre-programmed list, and then the transmission time. The equipment then chooses the most appropriate free channel and sends the message.



Automatic telex calling procedure to a land subscriber

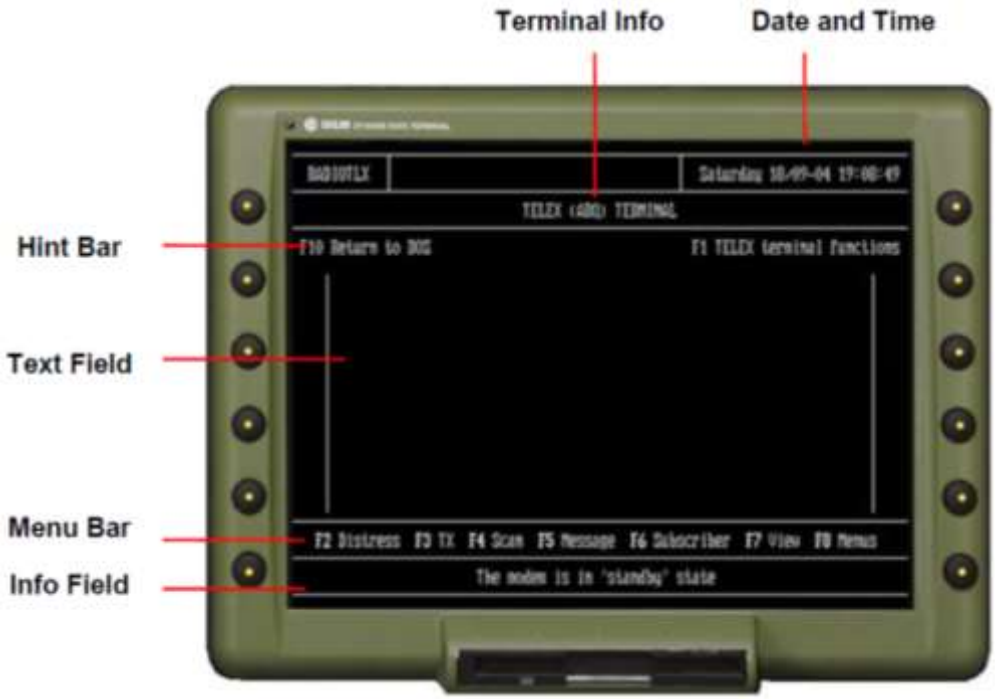
When communication has been established, various command codes can be used dependent upon the purpose of the call or the service required.

- Radiotelex equipment

The Radiotelex terminal consists of:

- Screen and keyboard
- MF/HF transceiver including modem
- Printer

Screen and keyboard



Radioltelex terminal

- **Terminal info –** shows the current Terminal function (ARQ, FEC or distress mode)
- **Date and Time –** shows Date and Time
- **Hint bar** – gives some hints for using functions
- **Text field –** key in the text of telex
- **Menu bar** – shows the current available function menus
- **Info field** – gives information about the status of the terminal

MF/HF transceiver including modem

The task of the transceiver is to transmit and to receive the appropriate telex signals. The task of the modem is to modulate the signals to be transmitted and to demodulate the received signals.

Printer

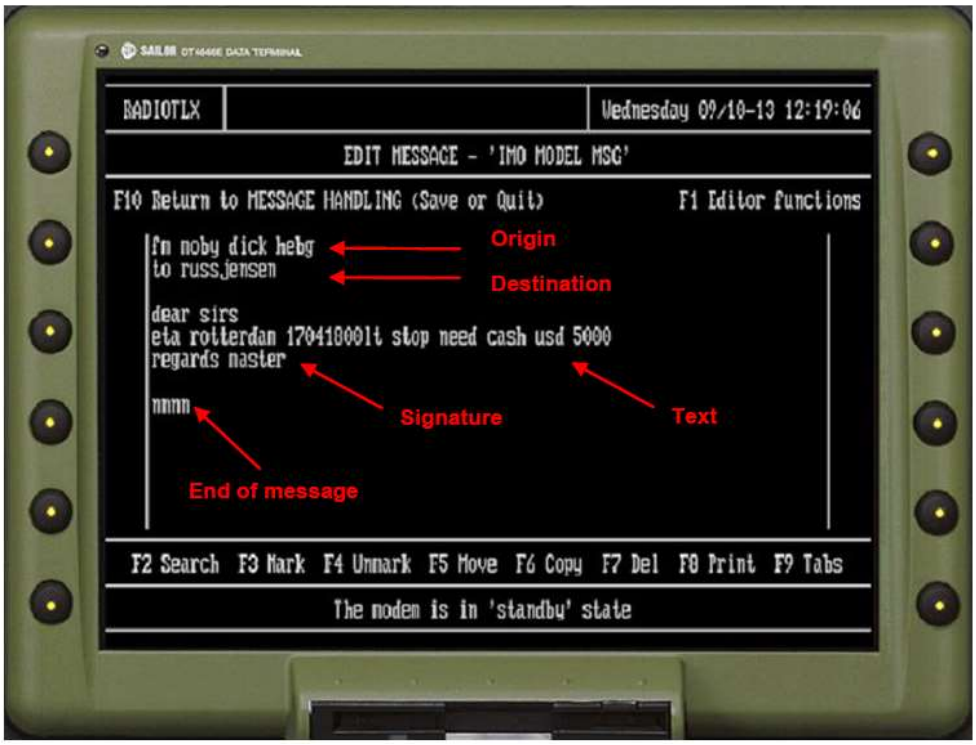
The printer records all transmitted and received messages and commands that are necessary for telex communications.

- **Details of a telex message**

If possible, the telex message should be prepared in advance by typing it into memory, with the telex terminal in local mode. This allows editing of the message before transmission.

The telex message format should generally be in accordance with the relevant ITU-T Recommendation and include the following information:

- Origin
- Destination
- Text of message
- Signature
- End of message indicator nnnn



Example telex to land subscriber

- Operational MF/HF radiotelex procedures in the GMDSS

The procedures for radiotelex priority traffic (distress, urgency, safety) are comparable to the appropriate procedures in radio telephony.

When using radiotelex, the words “this is” used in radio telephony, will be replaced by the letters “DE”, the word “received” will be replaced by the letters “RRR” and “all stations” will be replaced by the letters “CQ”. Mostly, the ship’s name will be replaced by the call sign of the vessel because the call sign is shorter than the ship’s name. Any Information transmitted to all stations shall be preceded by a DSC alert or announcement.

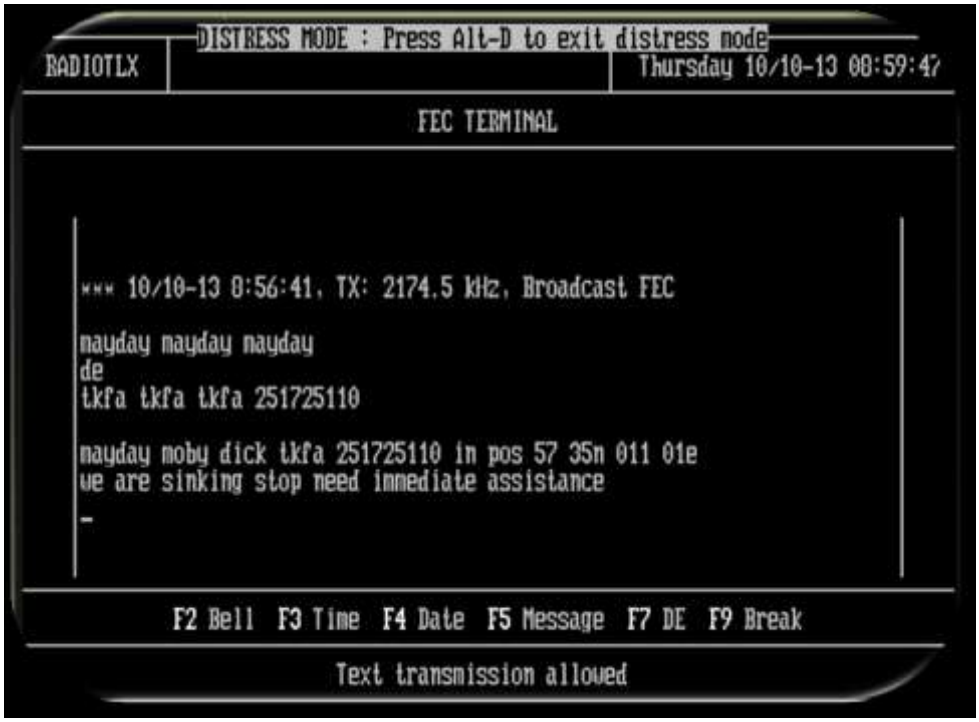
Distress procedure

Coast stations and ship stations with narrow-band direct-printing equipment shall set watch on the narrow-band direct-printing frequency associated with the distress alert if it indicates that narrow-band direct-printing is to be used for subsequent distress communications. If practicable, they should additionally set watch on the radiotelephone frequency associated with the distress alert frequency.

Distress communications by direct-printing telegraphy should normally be established by the ship in distress and should be in the broadcast (forward error correction) mode. The ARQ mode may subsequently be used when it is advantageous to do so.

The frequency 2174.5 kHz may also be used for ship-to-ship on-scene communications using narrow-band direct-printing telegraphy in the forward error correcting mode.

After a DSC distress alert on a suitable alerting frequency the subsequent distress traffic begins, as shown in the example below (Alert on 2187,5 kHz, Transmission on 2174,5 kHz), on a telex frequency associated with the appropriate alerting frequency.



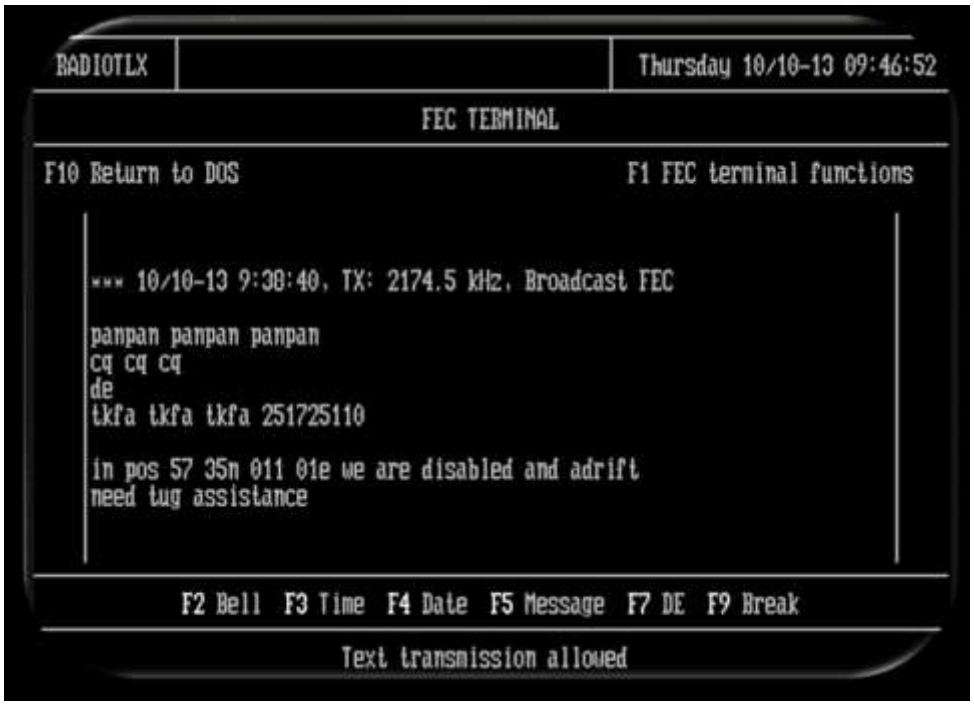
Example distress telex transmission

Urgency procedure

Error correction techniques in accordance with relevant ITU-R Recommendations shall be used for urgency messages by direct-printing telegraphy. All messages shall be preceded by the urgency signal PAN PAN.

Urgency communications by direct-printing telegraphy addressed to all stations should be transmitted in the FEC broadcast mode. The ARQ mode can be used for urgency communications in direction ship to coast station.

After a DSC urgency announcement on a suitable alerting frequency the subsequent urgency traffic begins, as shown in the example below (Announcement on 2187,5 kHz, Transmission on 2174,5 kHz), on a telex frequency associated with the appropriate alerting frequency.



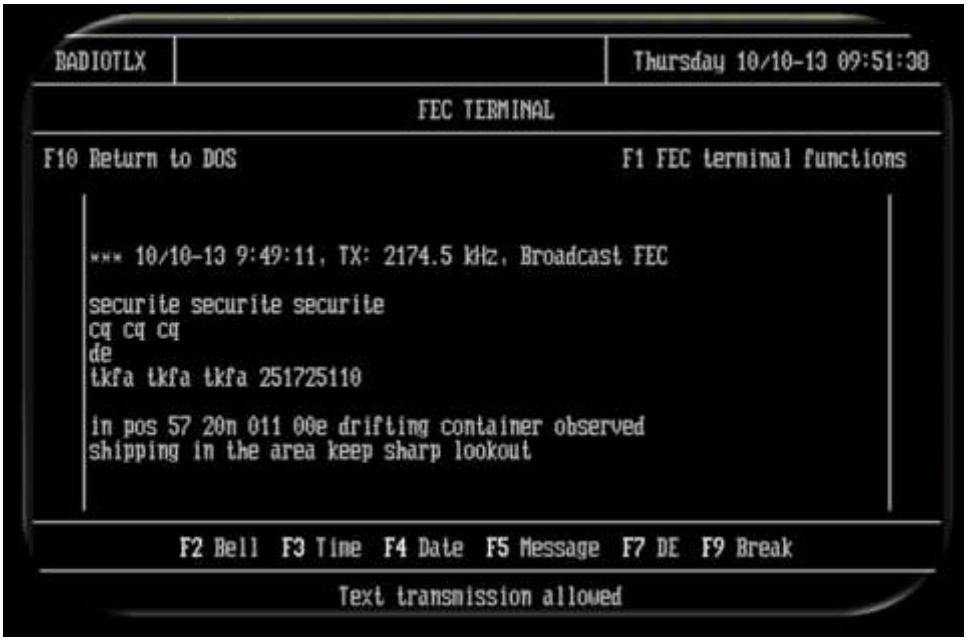
Example urgency telex transmission

Safety procedure

Safety communications by direct-printing telegraphy addressed to all stations should be transmitted in the FEC broadcast mode. The ARQ mode can be used for safety communications in direction ship to coast station.

MSI is transmitted by means of narrow-band direct-printing telegraphy with forward error correction using the frequencies 4210 kHz, 6314 kHz, 8416.5 kHz, 12579 kHz, 16806.5 kHz, 19680.5 kHz, 22376 kHz and 26100.5 kHz.

After a DSC safety announcement on a suitable alerting frequency the subsequent safety traffic begins, as shown in the example below (Announcement on 2187,5 kHz, Transmission on 2174,5 kHz), on a telex frequency associated with the appropriate alerting frequency.



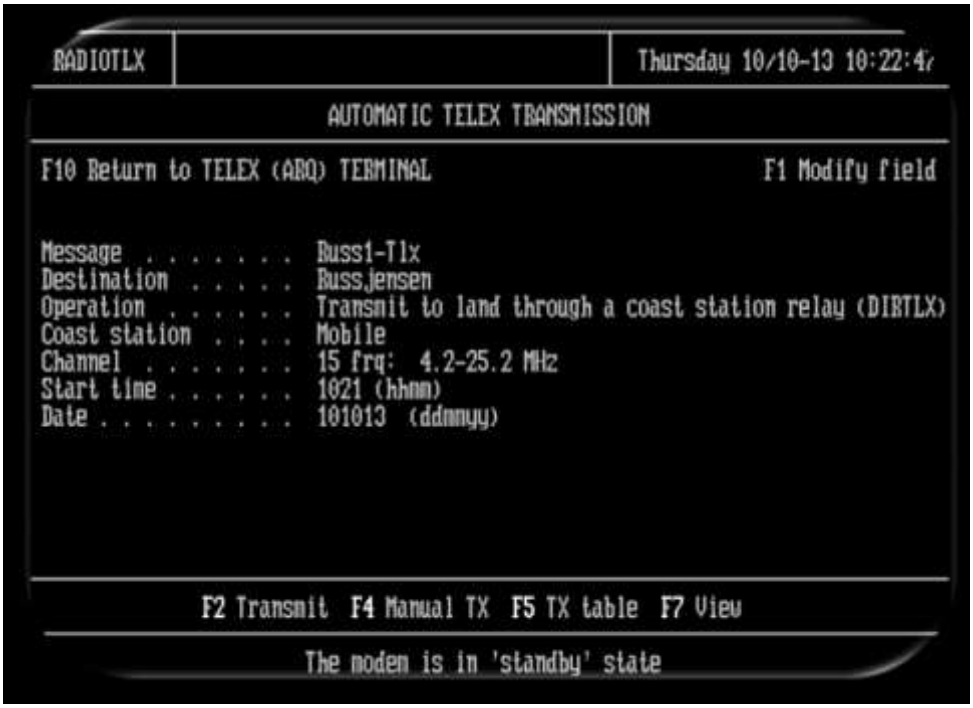
Example safety telex transmission

Routine procedure

Routine communication by direct-printing telegraphy is generally addressed to an individual station (Ship- or Coast station) and should be transmitted in the ARQ mode. The FEC selective mode can also be used for routine communications in one direction – ship to ship and ship to shore.

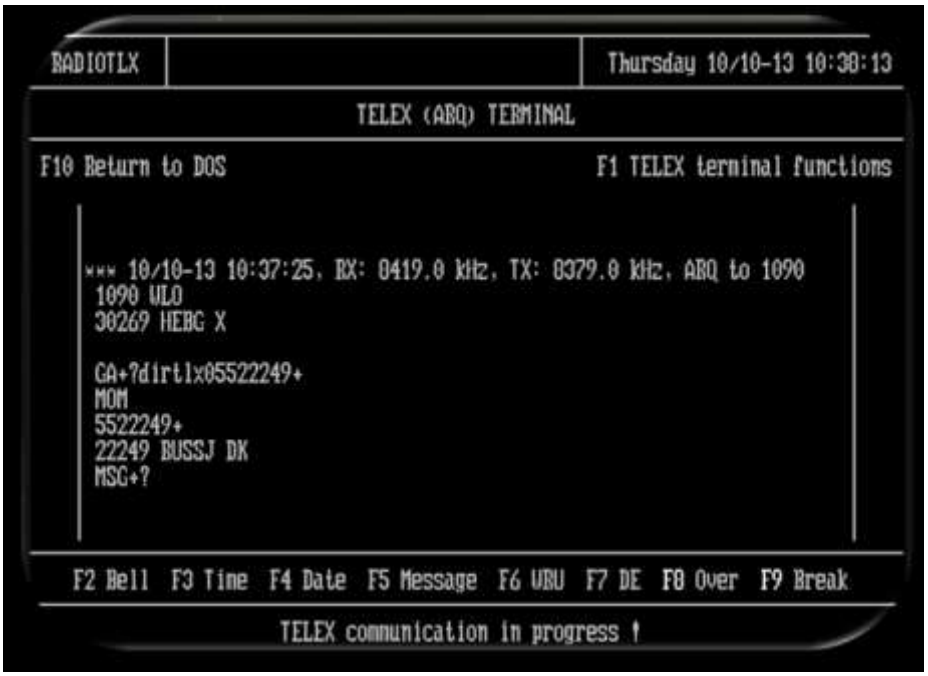
Working with coast stations:

In the following example it is planned to transmit an already prepared and stored message (Russ1-TLX) via Mobile Radio to the land subscriber “Russjensen”. This message will be sent to the land subscriber in “dirtlx mode” which means that the message will be conveyed direct while the entire connection.



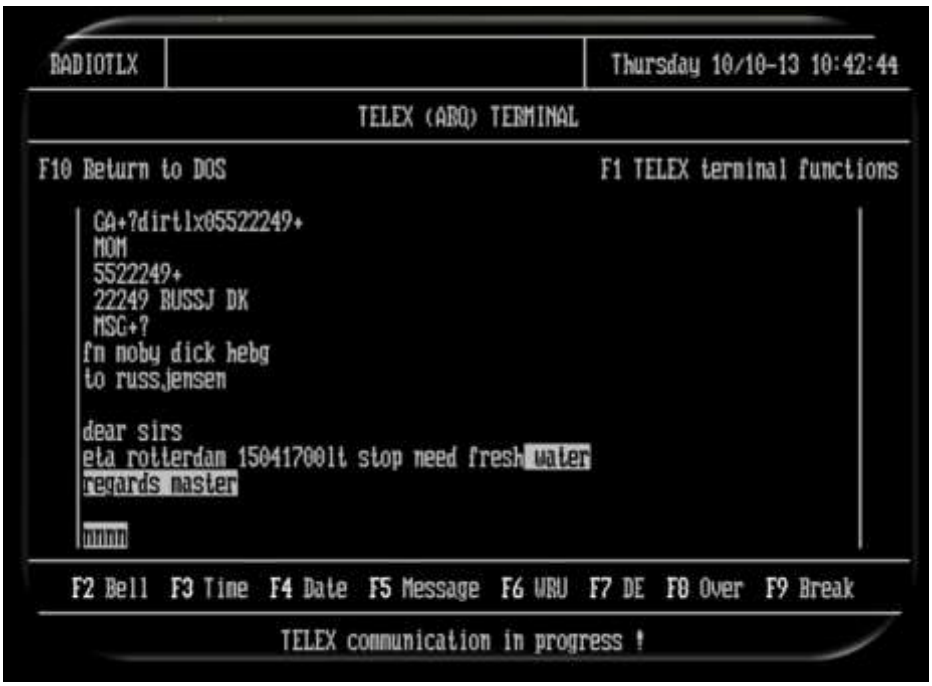
Example routine telex transmission to a land subscriber

- The **first line** indicates the start time, the RX and TX frequencies which are used with the coast station, the operation mode ARQ and the telex number of coast station.
- The **second line** shows the answerback of the coast station.
- The **third line** indicates the ships own answerback.
- In the **fourth line** the coast station asks with the signals (GA+?) for the land subscribers telex number. After changing the transmission permit the ship station automatically sends the expression “dirtx” (direct telex) followed by the land subscribers country code and telex number.
- The coast station replies with the code “MOM” (stand by for a moment).
- The coast station dials the mentioned telex number.
- The **seventh line** shows the land subscribers answerback which indicates that the connection is installed.
- “MSG+?” indicates that the land subscriber is able to receive the message.



Example link connection

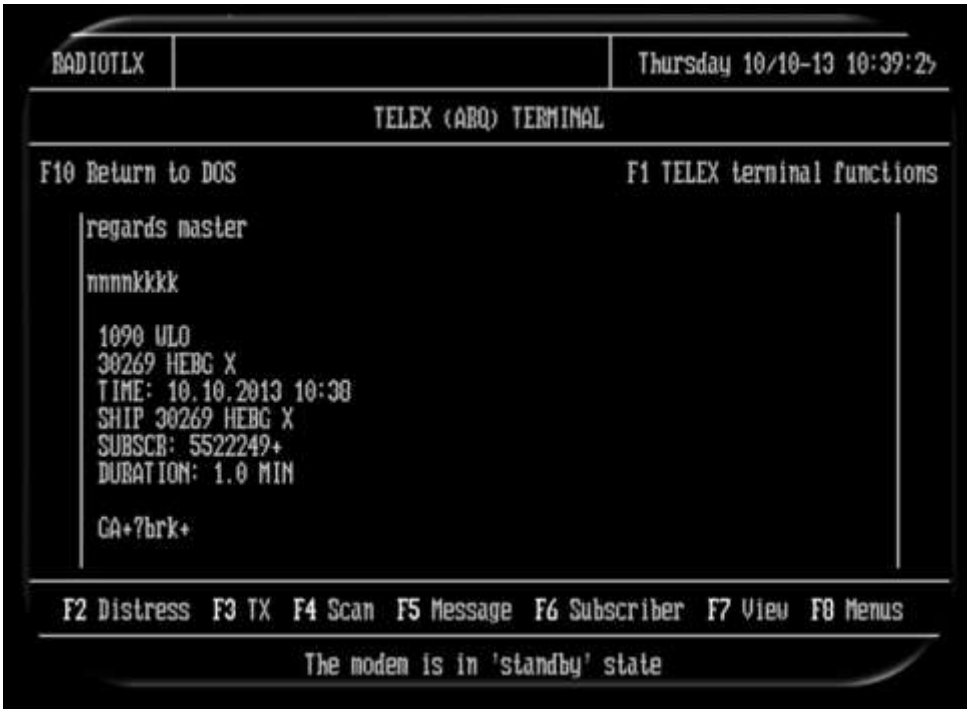
After an exchange of answerbacks, and upon receipt of the message code “MSG+?”, the ship sends its traffic. The next picture show that message transmitting is going on. The white shimming letters have not yet been transmitted.



Example running telex transmission

To disconnect the link to the shore-based subscriber, the telex system keys automatically the message code “KKKK”. The coast station then responds with a date/time group and the call duration, followed by an invitation to continue, i.e., “GA+?”

To close the link with the coast station, the system keys automatically the code “BRK+” (break) and return the telex terminal to the "STANDBY" condition.

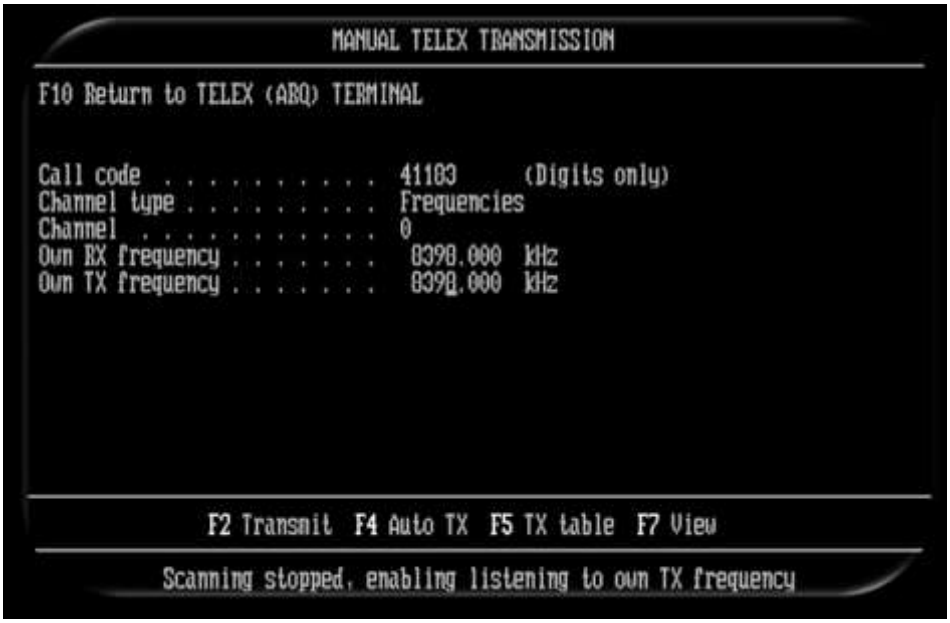


Example details of connection

Working with ship stations:

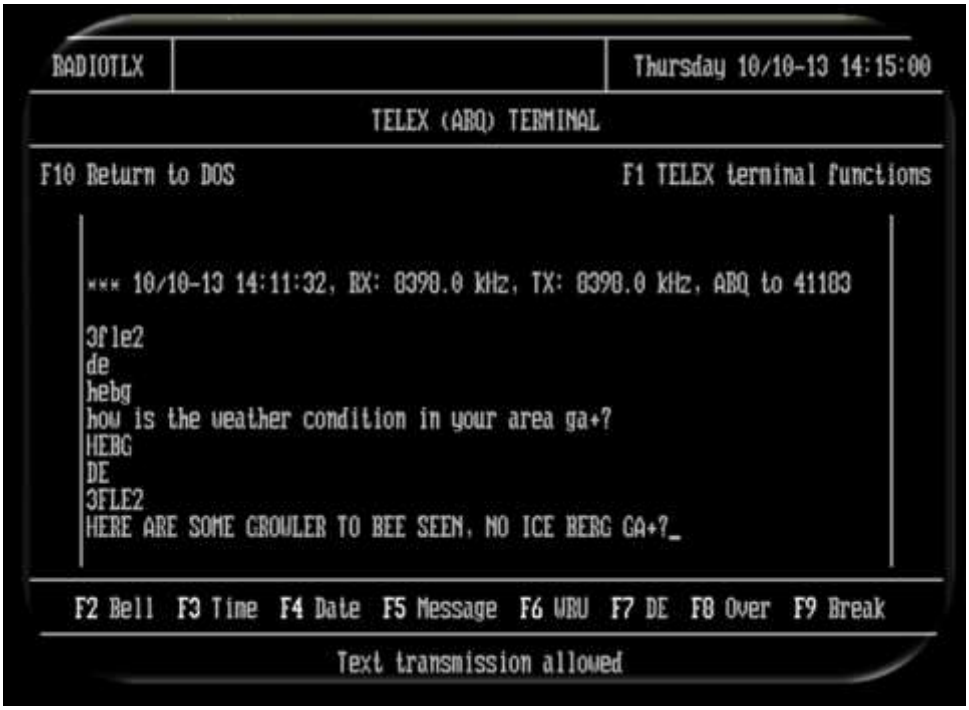
The following example describes a connection between two ship stations for conversation in ARQ mode on the frequency 8398 kHz.

Before the telex link can be installed the station that wants to contact the other has to announce the attention to get in contact via telex. This DSC announcement contains the priority (safety), the class of emission (telex, F1B) and the working frequency on which the subsequent telex communication shall be conducted.



Example manual ship to ship connection

The following picture shows the exchanged telex communications. All information printed in small letters are outgoing from the calling station, information printed in capital letters indicate the response of the called station.



Example running ship to ship connection

6.6 Inmarsat

- Basics

The Inmarsat structure consists of a space segment and a ground segment.

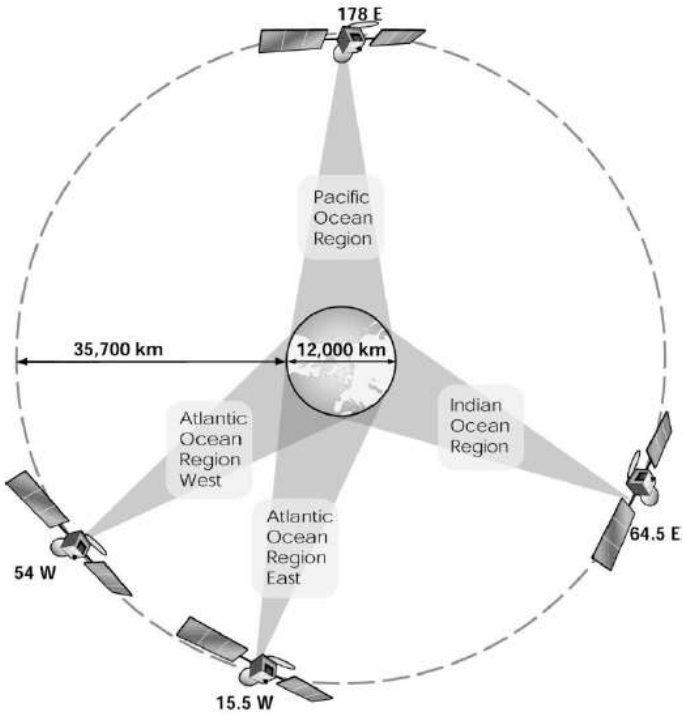
Inmarsat space segment

The Inmarsat communications structure comprises of three major components:

- Space segment
- Ground segment
- Ship earth stations

The space segment is provided by Inmarsat and consists of four geostationary communications satellites, with backup satellites in orbit ready to be used if necessary.

Geostationary communications satellites are launched into the *geostationary orbit* (GSO), which is circular orbit 35 700 km (19270 nm) above the equator and lying in the plane of the equator. Satellites in the GSO orbit the earth at exactly the same rate as the earth rotates about its axis and therefore appear to be stationary above a fixed point on the earth's equator, thus eliminating the need to track the satellite from fixed earth stations.



Inmarsat satellite positions

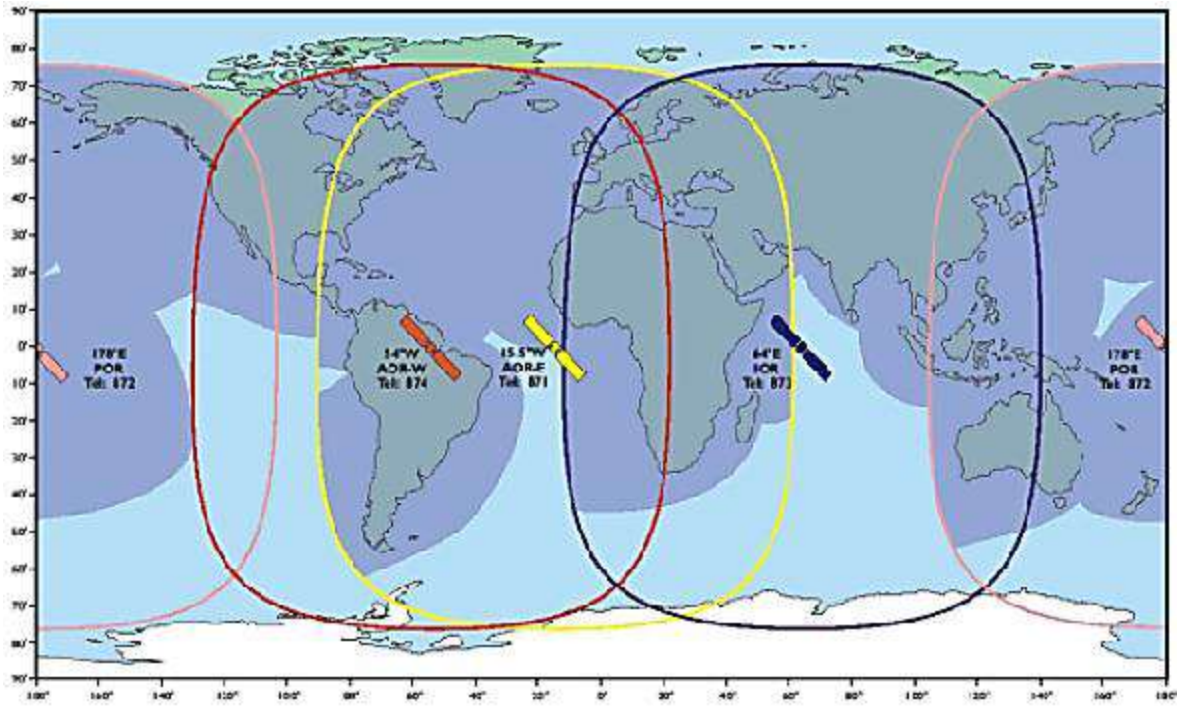
The use of the GSO to achieve virtually worldwide coverage by radio from space with a minimum of three equally spaced satellites was first proposed in 1945. Solar panels provide communications satellites with their electrical power requirements and hydrazine gas motors provide the means to perform minor positional corrections in orbit.

The Inmarsat satellites are controlled from the *Satellite Control Centre* (SCC) based in the Inmarsat Headquarters in London, United Kingdom.

Extent of global coverage

The coverage area of each satellite (also known as "the footprint") is defined as the area on the earth's surface (sea and/or land) within which a mobile or fixed antenna can obtain reliable line-of-sight communications with the satellite.

Each Inmarsat satellite is engineered to provide complete coverage of the visible face of the earth. The line-of-sight is not, however, satisfied over the Polar Regions, and communications start to become unreliable for locations above the 76° north or south



Inmarsat coverage map (I 3)

<u>Ocean Regions</u>
The four Inmarsat satellites, corresponding to the four ocean regions, provide overlapping coverage (see Figure 65 and Figure 66) and are positioned thus:

Atlantic Ocean Region – East (AOR-E) orbital location at 15.5° W

Pacific Ocean Region (POR) orbital location at 178° E

Indian Ocean Region (IOR) orbital location at 64° E

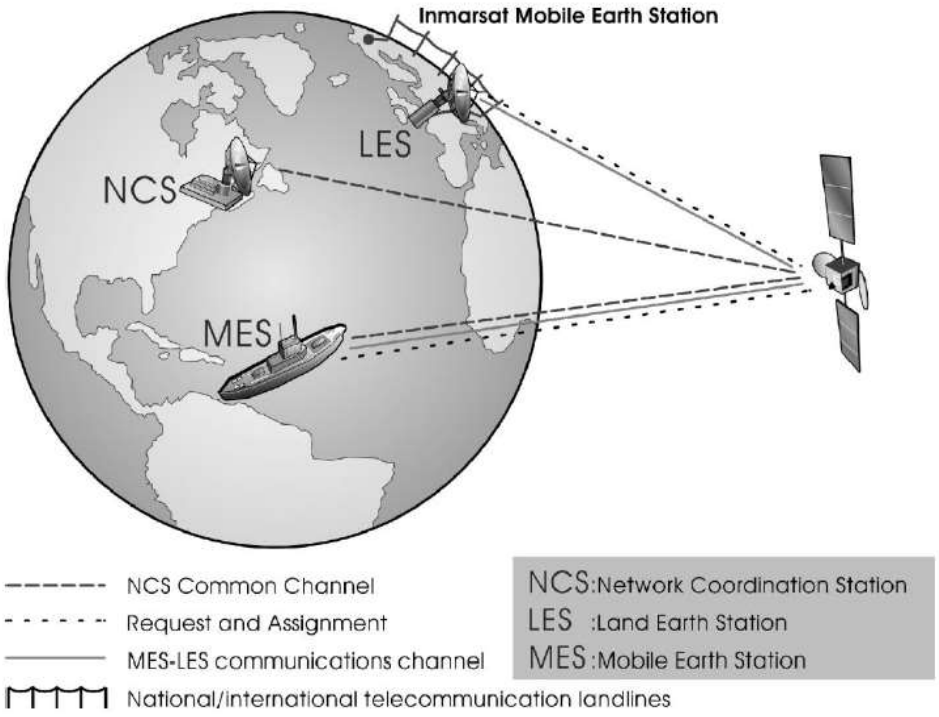
Atlantic Ocean Region – West (AOR-W) orbital location at 54° W

In order to call a SES in one of the four ocean regions, the following telex and telephone access codes, corresponding to the international country codes in the public telex and telephone networks, should be used: Telex Telephone 580 870

Inmarsat ground segment
The ground segment comprises a global network of *Coast Earth Stations* (CESs) or rather a *Land Earth Station* (LES), *Network Co-ordination Stations* (NCSs), and a *Network Operations Centre* (NOC). Each CES provides a link between the satellites and the national/international communications network. The large antennas used by the CESs to communicate with the satellite for its ocean region are capable of handling many calls simultaneously to and from the SESs.

A CES operator is typically a large telecommunications company, which can provide a wide range of communications services to the SESs communicating through the CES. Each of the Inmarsat communications systems has its own network of CESs.

For each Inmarsat system a separate NCS is located within each ocean region, to monitor and control its communications traffic. Each NCS communicates with the CESs in its ocean region, and with the other NCSs, as well as with the NOC located in the Inmarsat headquarters, making possible the transfer of information throughout the system. The NCSs are involved in setting up calls to and from SESs by assigning a channel, which both the SES and CES use for the call.

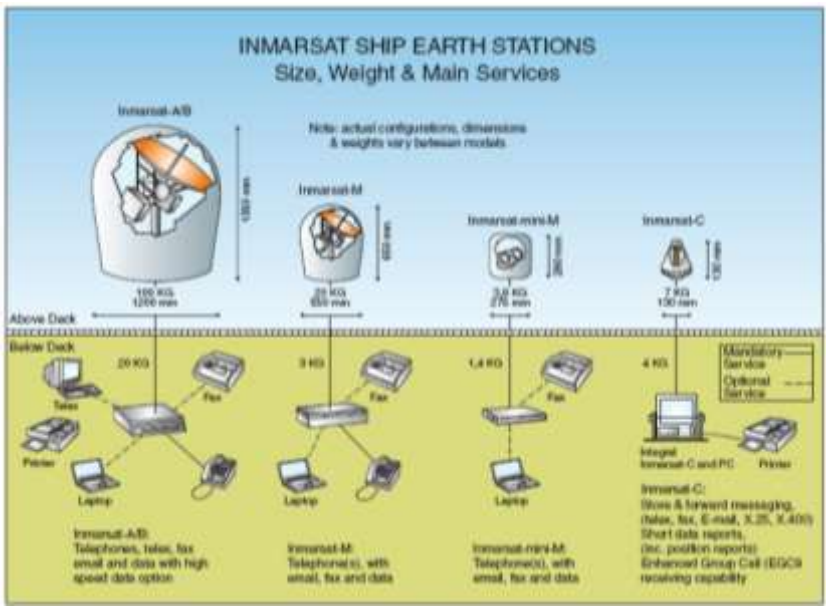


Allocation of a communication channel

An SES is a device installed on a ship (or a fixed installation in a maritime environment) to enable the user to communicate to and from shore-based subscribers, via a selected satellite and CES. Inmarsat does not manufacture SESs, but permits independent manufacturers to produce models, which meet type approval standards, set by Inmarsat for the particular Inmarsat system, Inmarsat-B, -C, -M. or Fleet 77. Only type-approved SESs are permitted to communicate over the Inmarsat satellites.

6.6.1 Different Inmarsat systems and their functions

Different Inmarsat types are compared by the size, the weight and the extent of their equipment above and below deck.



Different Inmarsat types in comparison

Service of different Inmarsat types as shown below indicates the features of different types of Inmarsat systems and their compliance with the GMDSS.

Features	INMARSAT B	INMARSAT F77	INMARSAT M	INMARSAT C
	Employs digital communications	Smaller than the M-type equipment, but still enabling use of data communication at maximum speeds of 64/128 kbps.	Employs digital communications the same as B-type equipment, with a compact antenna	You cannot make telephone calls from this equipment, but the antenna is even more compact than the one for M-type terminals, and communications charges are the most inexpensive.
World coverage	Global	Global	Global	Global
Overall Weight	100 kg	70 kg	25 kg	10 kg
Size of Antenna (diameter & height)	Approx. 0,9 m	Approx. 0,4 m – 1,2 m	Approx. 0,5 m	Approx. 0,3 m
Antenna type & means of tracking	Parabolic antenna, mechanically steered & gyro stabilized against vessel motion	Parabolic antenna, mechanically steered & gyro stabilized against vessel motion	Parabolic antenna, mechanically steered & gyro stabilized against vessel motion	Small omni-directional antenna with no moving parts does not need to be steered or stabilized
Communications type	Real time (immediate)	Real time (immediate)	Real time (immediate)	Store & forward
SERVICES				
Telephone	yes	yes	yes	no
Fax	yes	yes	yes	yes[1]
Telex	yes	no	no	yes
Data communication	yes	yes	yes	yes
Internet Email	no	no	no	yes
Data transmission speed (Fax speed)	9600 bps	9600 bps	2400 bps	Employs the stored switching system (takes 5 - 10 minutes for the message to arrive)
X-25 (dedicated data channel)	yes	yes	yes	yes
X-400 (electronic mail)	yes	yes	yes	yes
High speed data	56/64 kbps	64/128 kbps	no	no
Full motion store and forward video	yes		no	no
Short data position	no	no	no	yes
GROUP CALL	yes	yes	yes	yes
SafetyNET™	Yes, if Inmarsat-C/EGC Receiver installed	Yes, if Inmarsat-C/EGC Receiver installed	Yes, if Inmarsat-C/EGC Receiver installed	yes
FleetNET™	Yes, if Inmarsat-C/EGC Receiver installed	Yes, if Inmarsat-C/EGC Receiver installed	Yes, if Inmarsat-C/EGC Receiver installed	yes
DISTRESS & SAFETY				
GMDSS Compliant	Yes, if property installed (see Inmarsat design and installation guidelines)	Yes, if property installed (see Inmarsat design and installation guidelines)	no	Yes, if property installed (see Inmarsat design and installation guidelines)
Distress Button	yes	yes	yes	yes

[1] You can send messages (in alphanumeric) to land-based fax terminals from INMARSAT C equipment's. It is not possible, however, to send from the fax terminal back to the INMARSAT C terminal.

Service of different Inmarsat types in comparison

6.6.2 Inmarsat-B system

The Inmarsat-B system was introduced in 1994 and uses digital technology to provide high quality telephone, fax, telex, e-mail and data communications, with the antenna size and weight being approximately the same as for the older Inmarsat-A.

Inmarsat-B is capable of high-speed data communications (at up to 64 Kbit), making it especially suitable for data-intensive users such as oil and seismological companies which need to exchange large amounts of data on a regular basis

Use of the Inmarsat-B system

Following successful installation and commissioning, lnmarsat-B maritime terminals can be used to access the full range of Inmarsat services, including access to the GMDSS infrastructure.

lnmarsat-B offers similar services to the passed Inmarsat-A and is generally envisaged as the digital successor to the analogue-based Inmarsat-A. lnmarsat-B offers users dedicated digital facsimile and data services at a speed of 9600 bits/s.

Inmarsat-M terminals are intended for telephone and low- speed (2400 bits/s) facsimile and voice-band services.

Note, however, that lnmarsat-M maritime terminals are not accepted for use in the GMDSS, because there is no provision for a direct printing (i.e., telex) facility. They do, however, have a Distress-alerting button and can be used at sea where GMDSS compliance is not required, or to supplement a ship's GMDSS equipment.

Both Inmarsat-B and Inmarsat-M are digital systems, which allow the user to send information using minimal bandwidth and satellite power, thus reducing operating costs. To function, all terminals must be switched on and allowed to warm up as recommended in the manufacturer's instructions.

Components of an Inmarsat-B ship earth station

In general, Inmarsat-B equipment consist of a parabolic antenna, a power supply unit, a transceiver, a monitor, a keyboard a printer and a control unit. The control unit contains a display, control buttons, and a handset.

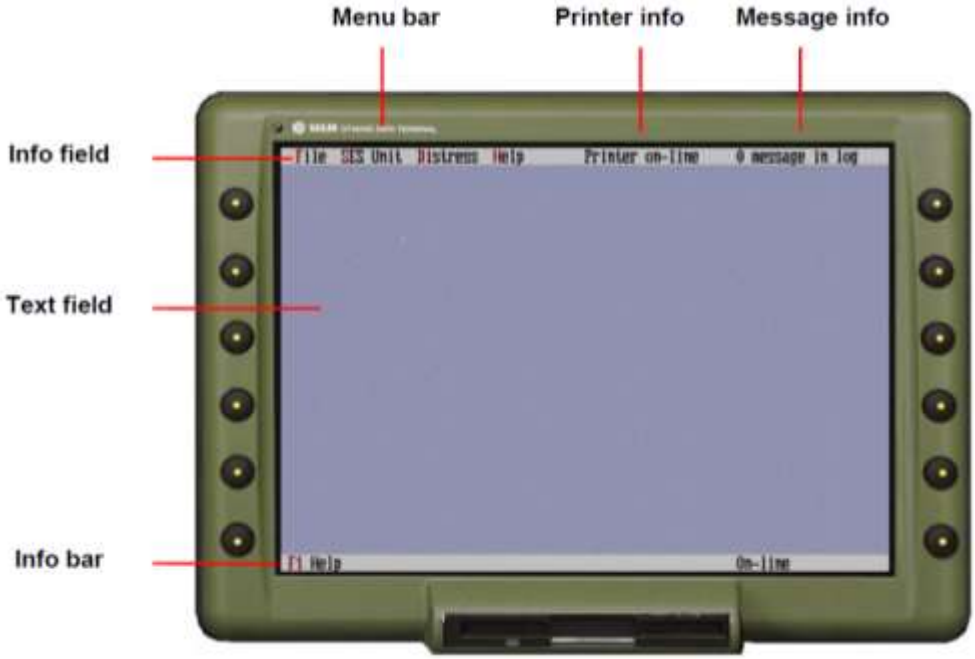
Inmarsat B equipment

The purpose of the parabolic antenna is to spot and track any desired satellite. Generally maritime satellite antennas are generally protected against weather influences e.g. rain, hail, snow etc., dirt and salt from the sea.

Handling of an Inmarsat-B SES

Inmarsat B cradle

- Display – shows information about status or menu info
- Indicator lamps – gives info about the power, call or in use status
- Cursor key – Allows navigating in menus
- Shift key – push that key to be able to get access to second level
- Loudspeaker – the loudspeaker can be switched on or off
- On/OFF Switch – to switch the handset on or off
- Signal level – indicates the signal strength
- Menu keys – get access to the address book, answering machine and ocean region menu
- Hook off key – push this key to hook on or off
- Key pad – use to enter telephone numbers or insert letters
- Select key – push to select something
- Distress button – push to transmit a distress alert and distress voice call



Inmarsat B telex screen

- Menu bar – shows information about current available menus
- Printer info – shows details about the connected printer
- Message info – shows received messages
- Text field – you may type in a telex or fax text
- Info bar – shows the current Sat Status and Help function

Acquiring a satellite connection

The Inmarsat-B system works mainly automatically. The equipment should be connected to a *Global Navigational Satellite System* (GNSS) receiver (e.g. GPS). This ensures that the equipment will direct the antenna automatically to the correct azimuth and elevation angel of the most suitable satellite and will log in.

Inmarsat-B log in satellite *Inmarsat B antenna*

The Inmarsat-B equipment offers the possibility to change the satellite manually.

Inmarsat-B manual selection of satellite

Use of 2-digit code service via Inmarsat-B

With the two digit code SESs have access to special services via Telephony and/or telex which are offered by certain institutions ashore. It should be noted, that some services required by two-digit code are liable to pay costs.

The code ”32” e.g. is used to obtain medical advice without pay. Some CESs has direct connections with local hospitals for use with this code.

Inmarsat-B request medical advice by 2-digit code

6.6.3 Inmarsat-C system

Inmarsat-C was introduced in 1991 to complement Inmarsat-A by providing a global low cost two-way data communications network using a small terminal that could be fitted on either a large or small vessel. Its compactness makes it especially suitable for smaller vessels such as yachts, fishing vessels or supply craft. The Inmarsat-C system does not provide voice communications but is a means of sending text, data and e-mail messages to and from shore-based subscribers using a store-and-forward technique. This requires the user to prepare the message prior to sending it; it is then transmitted via the land earth station operator who sends it on to its intended destination. The global communications capability of the Inmarsat-C system, combined with its MSI broadcasts and distress-alerting capabilities, has resulted in the Inmarsat-C system being accepted by the IMO as meeting the requirements of the GMDSS.

The lnmarsat-C system was introduced in 1991 to complement the Inmarsat-A system by providing low-cost global communications on a small terminal, suitable for fitting on all vessels, large and small. The small size makes the lnmarsat-C especially suitable for smaller vessels, such as yachts, fishing vessels or supply craft The Inmarsat-C system does not provide voice communications, but does provide a means of sending text messages or data to and from an SES, using *"store-andforward" m*essaging. This technique requires a user to prepare the message/data on the terminal and then transmit it via the Inmarsat-C satellite system. After a short delay the message/data will be delivered to the recipient's terminal, where it may be printed, viewed or stored.

lnmarsat-C communication services provide the means to send or receive messages between an lnmarsat-C SES and a shore-based telex terminal, personal computer or E-mail service.

An Inmarsat-C SES can also send text messages to a shore-based facsimile terminal EGC services enable authorized shore-based information providers to send information over the lnmarsat-C system to selected groups of SESs. These may be within a defined geographical area, or belong to a defined group such as a shipping company. Two EGC services are available *SafetyNET,* which is used to broadcast MSI to ships and *FleetNET,* which is used typically by companies to send commercial information to ships belonging to their fleet.

The lnmarsat-C system can satisfy the GMDSS satellite communication requirements for sea area A3 through the provision of:

- Distress alerting and distress priority messaging.
- Reception of MSI by means of EGC SafetyNET broadcasts.
- General Communications by means of several types of store-and-forward messaging services besides the lnmarsat-C distress and safety functions.

Depending on individual CES facilities, Inmarsat-C supports the following commercial store-and-forward messaging services:

- *Telex message service:* send and receive messages between the SES and any telex terminal which is connected to the national/international telex networks
- *Facsimile messaging service:* send facsimile messages to a shore-based facsimile terminal, and receive re-typed facsimile messages indirectly, via a facsimile bureau service
- *Messages to and from a computer:* exchange messages, through the intermediary of a specialist service provider, between the SES and any computer terminal which is connected to the *Public Switched Telephone Network* (PSTN), provided that the remote computer and the SES are equipped with suitable hardware and software
- *E-mail services:* exchange messages and files with subscribers to E-mail services, world-wide (e.g. using X.400, Internet, etc.) through the intermediary of an E-mail service provider

The Inmarsat-C system features automatic data reporting and polling, which also results in many advantages for general communications. Data reporting allows for the transmission of information at prearranged intervals or as required, while polling allows the user's shore-based management to interrogate the remote ship terminals at any time for the required information, e.g., position, course, speed, fuel consumption, cargo temperature, etc. It is usual to link the SES terminal with a variety of navigation systems, such as *Global Positioning System* (GPS), in order to provide position reporting, which ensures that the terminal will receive the correct area calls.

A CES may interface with any of the following devices connected to the national/international telecommunications network:

- A telex terminal connected to the international telex network.
- A computer connected to the international *Packet Switched Data Network* (PSDN) or the X.25 or X.400 network, named after the communications standards (protocols) used on the network.
- A computer connected to the PSTN.
- A facsimile terminal connected to the PSTN. The Inmarsat-C-system allows an SES to send messages directly to an SES. A facsimile terminal may, instead, send text messages indirectly, via a facsimile bureau service, where the message is re-typed, and sent as a store-and-forward message to the SES. Several Inmarsat-C CESs and other organizations, offer such a bureau service.
- Dedicated equipment, such as a data-processing system, connected to a private network (such as a leased line).

The CES is connected via leased or public landlines directly to a RCC. Every Inmarsat-C CES can therefore route distress calls from an SES with top priority to a specialized land-based centre, to ensure efficient search and rescue activities.

Depending on its policy, an Inmarsat-C CES may also interface messages received from one SES, for forwarding over the satellite link to another SES, to enable ship-to ship communications.

Use of Inmarsat-C system

The Inmarsat-C system provides a continuous worldwide service for sending and receiving text or data messages.

Various Inmarsat-C SES models available do not have a common control layout or operating features, but all share the common characteristics of providing global communications on a small terminal, which is simple to install and has modest power requirements.

The Inmarsat-C SES may also be used to exchange messages with another Inmarsat-SES (or a Land Mobile Earth Station, LMES), i.e., ship-to-ship or mobile-to mobile messaging.

The Inmarsat-C system is based on digital technology, which means that anything that can be encoded into digital data, whether text keyed in, numeric data read from instruments, or other information in digital form, can be sent and received over the system.

The basic technique used for sending and receiving messages over the lnmarsat-C system is known as "store-and-forward" messaging. Ship-to-shore messages are prepared on the terminal and then transmitted via an Inmarsat satellite, in a series of data packets, to an lnmarsat-C CES. This CES acts as an interface (or gateway) between the satellite link (the space segment) and the national/international telecommunications network. If the CES receives any data packets in error, it signals back to the SES to re-transmit those packets, and the procedure is repeated until the CES has received the complete message with no errors. The CES stores the message briefly before forwarding it over the telecommunication network to its intended destination; hence the term "store-and-forward".

A similar procedure takes place when a shore-based correspondent sends a message through a CES addressed to a terminal. The lnmarsat-C system is very flexible, allowing a wide variety of equipment to be connected at either end. The equipment used at either end and the associated communications services depend on individual circumstances. In the event that communications cannot be established, consult the list of *Non-Delivery Codes Notification* (NDN).

Selecting an Ocean Region

In many parts of the world, the Ocean Regions covered by different satellites overlap. For example, the coverage map of Inmarsat-C CESs shows that the North Sea is covered by the AOR-W, AOR-E, and IOR satellites. Within such an overlap zone, an antenna is in line-of-sight of more than one satellite (provided the antenna is not obstructed), and the SES may be logged-in to any one of the associated Ocean Regions.

N.B. MSI by EGC SafetyNET for Navarea I is only available via the AOR-E satellite (see section 12 for a detailed description of EGC services)

Logging-in to an Ocean Region/ NCS Common Signalling Channel

The SES must be logged-in to an Ocean Region before messages can be sent or received over the lnmarsat-C system. Logging-in informs the system that the SES is now available for communications, and causes the SES to tune to the NCS Common Signalling Channel (or NCS Common Channel) for that Ocean Region. When the SES is tuned to the NCS Common Channel, it is said to be synchronised, or listening, to the channel, or in idle mood.

Some SESs perform a log-in automatically when switched on, selecting the strongest NCS Common Channel signal. Other SESs do not perform an automatic log-in, but must be logged-in manually to a selected Ocean Region /NCS. Refer to the manufacturer's instructions for how to perform a manual log-in.
After a few minutes, the SES should indicate that it has successfully logged-in to the selected Ocean Region, and show the received signal strength of the NCS Common Channel. The signal strength should be at least the minimum suggested by the manufacturer. If not, refer to the manufacturer's instructions concerning further action.

During distress working or when requiring MSI for your ocean area, you should set the automatic scan on your terminal to scan only your ocean region. When changing ocean regions it is only necessary to log-in to the new NCS.

Use of 2-digit code service via Inmarsat-C

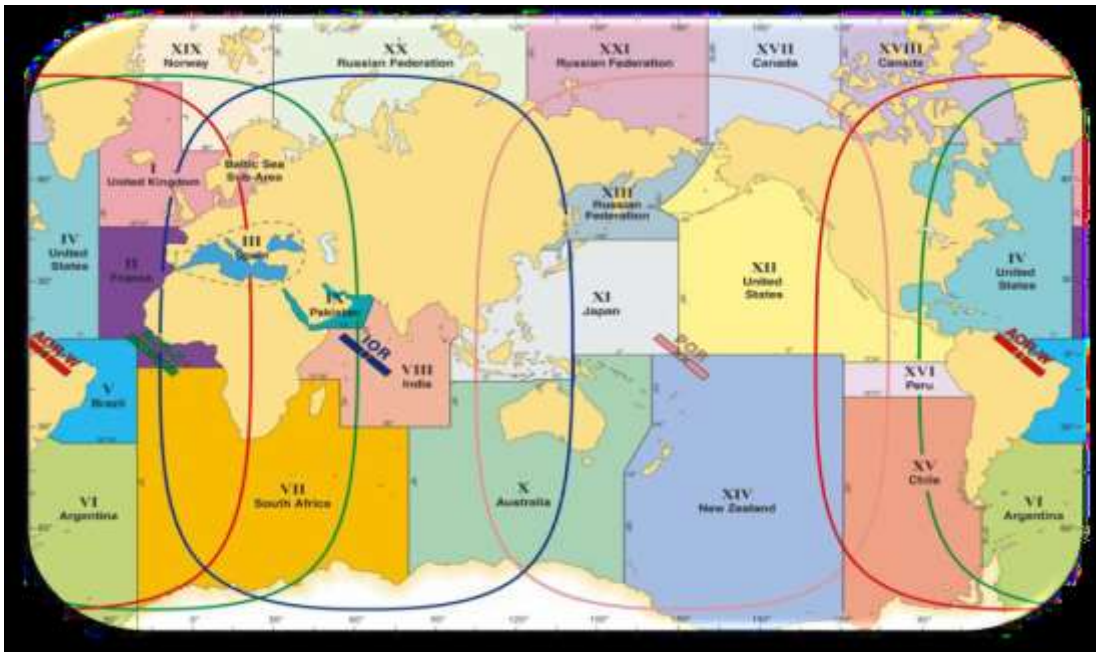
With the two digit code Inmarsat-C SESs have access to special services via telex which are offered by certain institutions ashore.

Routing via a CES

The required CES and routeing is selected using a 3-digit code, e.g., to contact Goonhilly, key in code 102 for the AOR-E routeing or code 002 for the AOR-W routeing. This is usually done as a simple selection from the Transmit menu, where all the CESs are available as a preprogramed list stored in memory. Whilst in the transmit menu, access the address book to programme in the name and number of any terminals that you wish to contact. When the routeing and subscriber have been selected, press <Enter> to transmit.

Navigational areas (Navarea) / Metrological areas (Metarea)

An EGC receiver is able to receive MSI's in the dedicated Navarea / Metarea automatically.



Inmarsat satellites and Navareas / Metareas

Log out before switching off

If possible, keep the SES under power and logged-in to an Ocean Region at all times, so that the SES is ready to send or receive messages immediately. However, if the SES is to be switched off for a prolonged period (for example, to conserve electrical power), and it is logged-in to an Ocean Region, then the SES must be logged-out of that Ocean Region before the SES is switched off.

Logging-out of the SES informs the Ocean Region NCS that the SES is no longer able to receive messages. The system will then reject any messages intended for the SES and inform callers that this SES is not available.

WARNING: Failure to log-out before switching off the SES will result in repeated attempts to send the message via the selected CES to the SES whenever a caller tries to communicate. Eventually, after a number of re-tries (depending on the CES), the CES will cease attempting to deliver the message and, if requested, return a nondelivery notice to the sender. Therefore, switching off an SES without logging-out first may well then result in messages being completely lost rather than being delayed.

Routine operational tasks

The following tasks should be carried out at regular intervals of no more than every eight hours and ideally even more frequently:

- On the SES monitor, check which Ocean Region is currently logged in. If this has changed from the previously intended Ocean Region, make sure that the new Ocean Region is suitable, particularly for potential

correspondents. Remember that the CES selected in the new Ocean Region must support the required communications services.

- Inform potential correspondents of the new Ocean Region, so that they can make contact as desired.

Check that the signal strength indicated on the SES is above the minimum level recommended by the manufacturer.

Quick reference Inmarsat-C guide

The steps below summarize how to use an Inmarsat-C SES for distress and safety purposes, and how to send and receive general communications.

Prepare your SES

1. Make sure your SES antenna has an unobstructed view of the sky in all directions.
2. Switch on your Inmarsat-C SES and all associated equipment.
3. Log in to the ocean region you have selected.
4. Decide on the CES through which you are going to communicate.
5. Confirm that your SES is logged in and receiving a strong NCS Common Channel signal.

Routine checks

1. Throughout your journey, make sure that your SES is receiving a strong signal and all associated equipment is working properly.
2. If you are going to sail outside the ocean region to which you are currently logged in, make sure your SES is logged in either manually or automatically to the new ocean region and receiving a strong signal.

Sending a distress call

You may use your SES to send a brief distress alert or a more detailed distress priority message to an RCC.

Receiving MSI broadcasts

Your SES can receive broadcasts of MSI within an ocean region

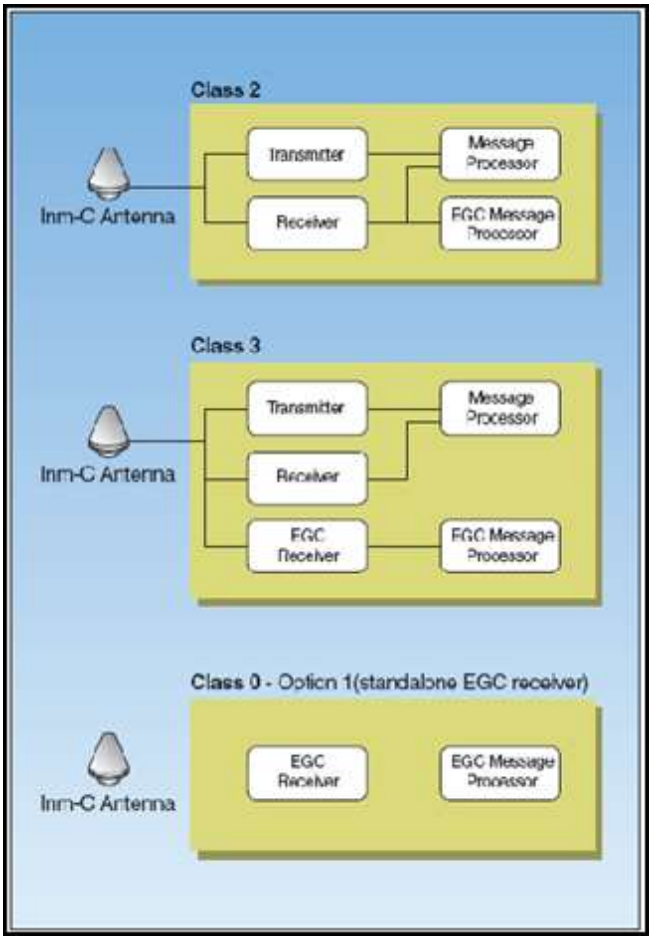
Sending a message (ship-to-shore)

1. Create your message on the SES text editor or edit an existing message.
2. Select transmit (send) mode.
3. Select the CES through which you want your message routed.
4. Select the time of your message and whether you want confirmation of delivery and hardcopy.
5. Before sending your message check that all the details you have entered are correct.
6. Enter the command to transmit (send) your message.

Receiving messages (shore-to-ship)

1. Make sure that everyone who may need to contact you knows how to do so.
2. Provided your SES is logged in and receiving a strong NCS Common Channel signal, it should automatically receive all messages intended for it.
3. Make sure that your SES is set to store and/or print all received messages.
4. Note that some EGC messages may be sent frequently and could fill up your SES's memory or disk storage.

Components of an Inmarsat-C/Mini-C SES



Components of different Inmarsat-C types

Interconnection

Inmarsat permits only type-approved SES models, and their peripherals, to be commissioned into the lnmarsat-C system. An SES comprises two parts — the *Data Terminal Equipment* (DTE) and the *Data Circuit terminating Equipment* (DCE). In some models the DTE and DCE may be built into the same case, whilst in other models they are separate.

DTE Interface

The DTE interfaces external input/output devices to the SES, such as:

- A keyboard, screen and printer
- An external computer

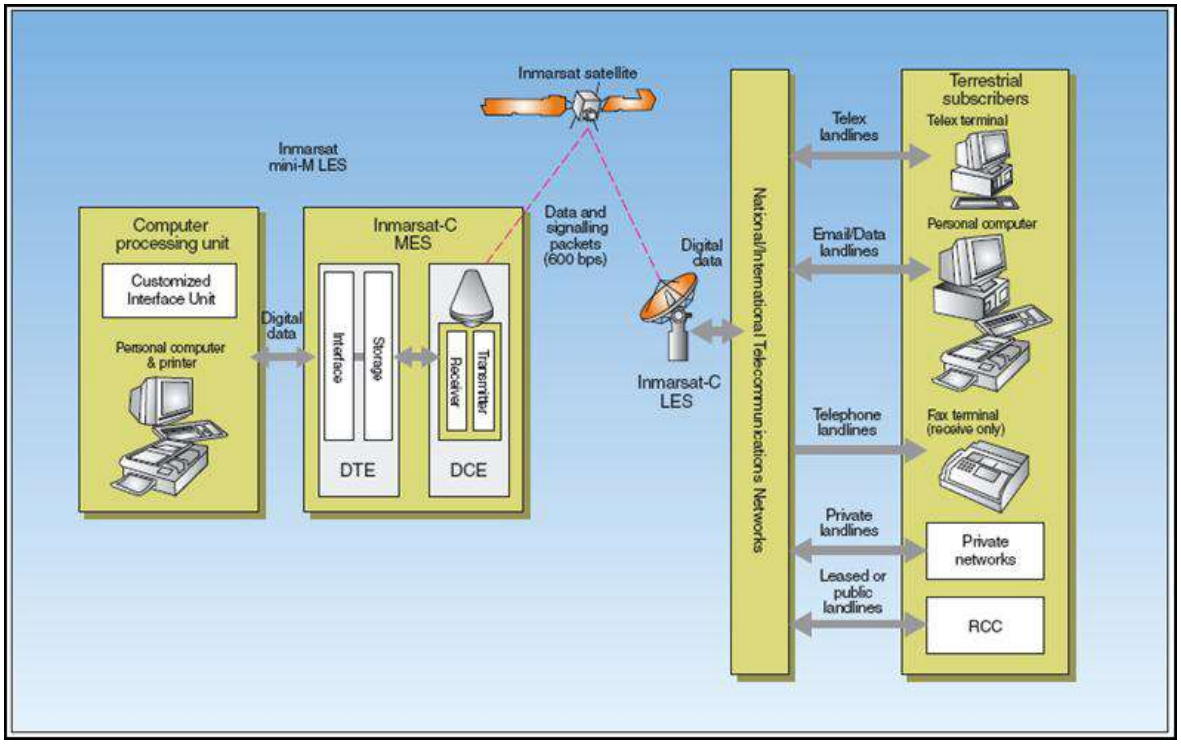
WARNING: If a multi-tasking computer is used to operate an Inmarsat-C SES, no unnecessary software should be installed which could prevent the computer performing an Inmarsat-C function, or cause it to be infected by "viruses", which might adversely affect communications.

A position-reporting system using, for example GPS, the *Global Navigation Satellite System* (GLONASS), to provide the ship's position, for use in periodic position reports.

The DTE also provides storage for messages created on the keyboard, before they are transmitted over the satellite link.

DCE Interface

The DCE interfaces the SES to the satellite system, using its transmitter and receiver and an antenna. The DCE functions in a sense as a "satellite modem" by analogy to a modem, which provides an interface between a computer and the telephone network. The DCE transmitter and receiver can be tuned independently to different channels, depending on the circumstances.



Interface possibilities

Antenna

The antenna must be able to maintain a line-of-sight path with the selected satellite. On a ship-based DCE, the antenna is omni-directional, so that it can transmit to and receive from the intended satellite even when the ship is pitching and rolling in heavy seas.

Note that this type of antenna has no moving parts, unlike the much larger Inmarsat-B directional antenna, which constantly moves to counter the motion of the ship, and so requires considerably elaborate electronics and power sources.

6.6.4 Inmarsat-M systems

Inmarsat-M was introduced in 1993 to complement the existing Inmarsat-A system by providing global telephone/fax and data communications on an SES which is inexpensive and compact in size. The Inmarsat-M SES is smaller and lighter than an Inmarsat-B SES, making this network suitable for smaller vessels such as fishing vessels and yachts.

lnmarsat-M services include two-way global telephone, facsimile and computer data communications. Inmarsat-M SESs are available as either single-channel or multichannel models. However, a multi-channel SES generally requires greater transmission power than a single-channel SES, so the power supply and antenna for a multi-channel Inmarsat-M SES model are larger and of higher gain than for a single-channel model

The Inmarsat mini-M system was launched in January 1997 and offers the same services as Inmarsat-M, but in a smaller, more lightweight and compact unit. This SES can be made smaller because it operates only in the spot-beam coverage of the latest Inmarsat-3 satellites.

Using internal batteries, the typical talking time is about 1.5 - 2.5 hours and up to 50 hours on standby. However, most maritime installations have external power supplies which allow for continuous operation. It is possible to operate an Inmarsat mini-M with a Subscriber Identity Module (SIM) card. It can be easily installed and removed, making it possible for a number of individuals to make calls on a shared Inmarsat mini-M, whilst still allowing for individual billing lnmarsat-M does not form any part of the GMDSS as it is unable to comply with regulations concerning reception of distress alerts due to the fact that the system is voice only and there is no facility for direct printing of messages.

Limitations regarding Inmarsat-M and the GMDSS

Inmarsat-M does not form any part of the GMDSS as it is unable to comply with regulations concerning reception of distress alerts due to the fact that the system is voice only and there is no facility for direct printing of messages.

6.6.5 Inmarsat Fleet 77

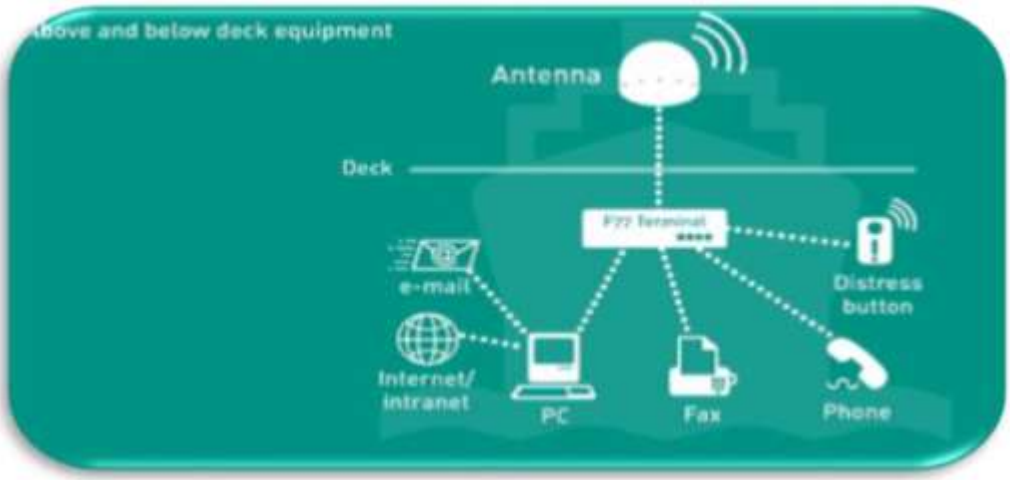
The Inmarsat Fleet 77 system was launched in November 2001. It offers a unique high performance service for high-speed shore-to-ship and ship-to-shore communications. Fleet 77 introduces a new Mobile ISDN and *Mobile Packet Data Service* (MPDS) delivering voice, fax and data at speeds of up to 64 kbit/s. Inmarsat Fleet 77 is equipped to satisfy and safety telephony requirements of the GMDSS only. It offers more efficient data-driven communications for applications such as technical management and crew roistering, accessing a head office intranet, and obtaining updates of weather and chart information. Store-and-forward video is also available for on board diagnostics and telemedicine.

Fleet 77 Service (-4dB/k antenna)	**Fleet 55 Service** (-7dB/k antenna)	**Mobile Physical Port**
Global 4.8kbps AMBE voice / DTMF (mandatory)	Global 4.8kbps AMBE voice / DTMF (mandatory)	Via ISDN handset(s) & RJ-11 analogue, 2-wire
Distress calling, AMBE voice (mandatory)	No Distress service	Via ISDN handset(s) and dedicated alarm button(s)
Global 64kbps UDI (mandatory) for G4 fax etc.	Spot beam 64kbps UDI (mandatory) for G4 fax etc.	RJ-45 ISDN S/T bus (and USB port)
Global 56kbps Data (via V110 rate adaptation)	Spot beam 56kbps Data (via V110 rate adaptation)	RJ-45 ISDN S/T bus
Global 64kbps/3.1kHz Audio – G3 fax & analogue services etc.	Spot beam 64kbps/3.1kHz Audio – G3 fax & analogue services etc.	Via ISDN TA (and via 2-wire analogue)
Global 64kbps Speech	Spot beam 64kbps Speech	Via ISDN handset(s)
Global MPDS (mandatory)	Spot beam MPDS (mandatory)	RS-232 (also RS-422 and USB port)
Global 2.4kbps G-3 facsimile (optional)	No	RJ-11, via FIU two wire analogue
Global 9.6kbps G-3 facsimile (optional)	Spot beam 9.6kbps G-3 facsimile (optional)	RJ-11, via FIU two wire analogue
Global 9.6kbps async data (optional)	Spot beam 9.6kbps async data (optional)	RS-232 serial port

Different Inmarsat Fleet systems in comparison

Components of an Inmarsat Fleet ship earth station

In general, Inmarsat Fleet 77 equipment consists of a parabolic antenna, a power supply unit, a transceiver, a PC, a keyboard, a printer and a control unit. The control unit contains a display, control buttons, a distress button and a handset.

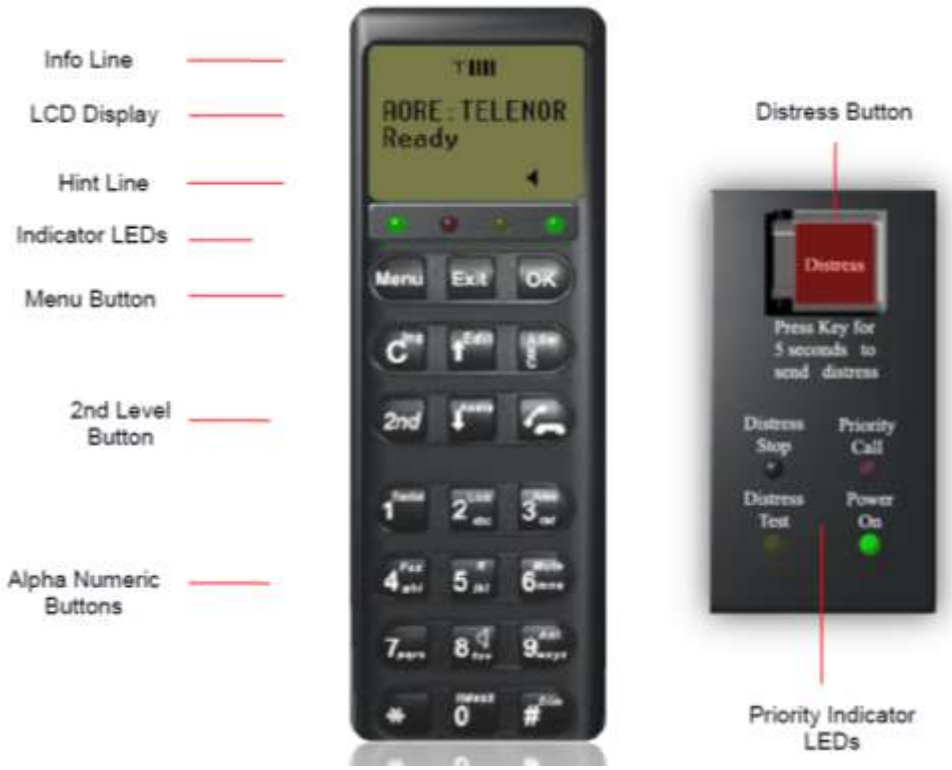


Inmarsat Fleet 77 components

Method of acquiring satellite both manually and automatically

The Inmarsat Fleet 77 system works mainly automatically. The equipment has to be connected to a GNSS receiver (e.g. GPS). This ensures that the equipment will direct the antenna automatically to the correct azimuth and elevation angel of the most suitable satellite and will log in.

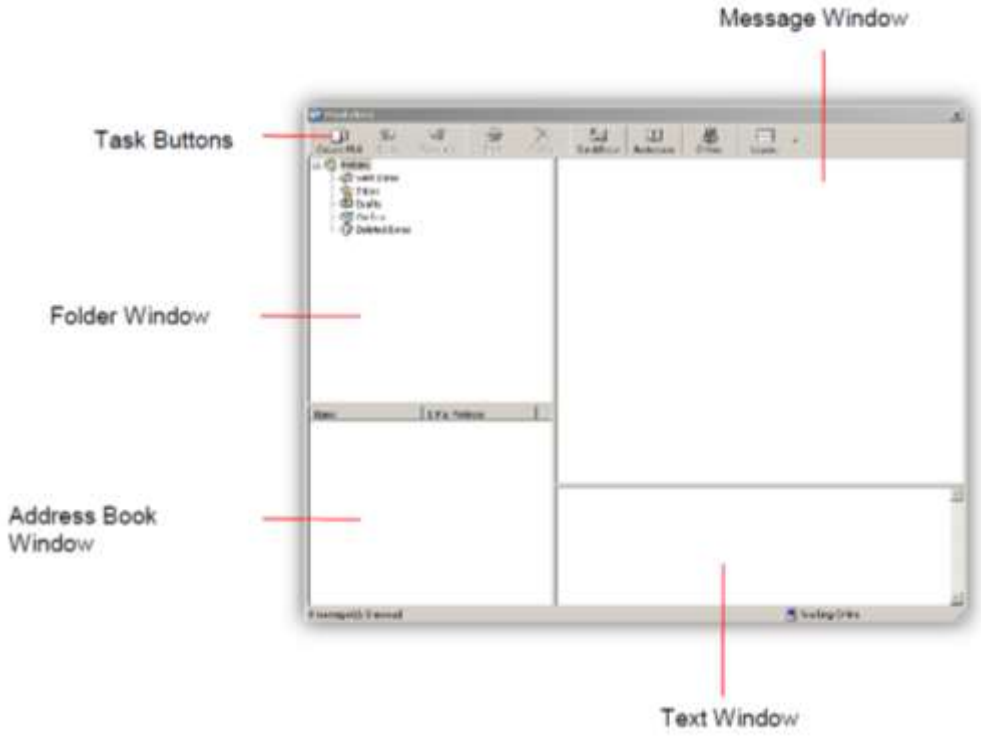
Handling of an Inmarsat Fleet 77 SES



Inmarsat Fleet 77 cradle

The handset is the primary interface for the Fleet 77 system. It enables the user to dial numbers, it displays error and status messages, and it is used to configure the transceiver.

- Distress Button – push to transmit a distress alarm
- Priority Indicator LEDs – this section gives info about transmitting priorities
- Info Line – shows the mailbox and signal strength
- LCD Display – shows details of the current menu. This section gives the user visual indications about the operation and status of the system.
- Hint Line – gives hints to the current used menu
- Indicator LEDs – shows info about power, alarm, synchronisation and connection
- Menu Button – gives access to different menus. This section enables the user to interact with the software menu system of the transceiver.
- 2nd Level Button – gives access to the 2nd key level
- Alpha Numeric Buttons – this section enables the user to dial and perform data entry functions into the transceiver



Inmarsat Fleet 77 Email screen

- Folders window – is located in the upper left part of the screen. This window includes the following folders:
  - Sent Items - sent messages
  - Inbox - Incoming messages
  - Drafts - draft messages for transmission
  - Outbox - messages ready for transmission
  - Deleted Items - deleted messages

- Address Book window – is located in the bottom left part of the screen. This window contains a list of email subscribers.

- Message window – is located in the right part of the screen. The details of the marked message can be seen in the bottom part of the window.

- Text Window – is located in the lower right part of the screen. The details of the marked message can be seen.

Use of 2-digit code service via Inmarsat Fleet

With the two digit code Fleet SESs have access to special services via telephony which are offered by certain institutions ashore. It should be noted, that some services required by two digit code are liable to pay costs.

6.6.6 Inmarsat-D and D+

Inmarsat-D is a one way data transfer system for mobile stations (Simplex Broadcast). Inmarsat-D+ is more enhanced with a back channel where an acknowledgement can be received. Inmarsat-D and D+ are often used as a *Ship Security Alarm System* (SSAS).

6.6.7 Inmarsat Numbers IMN

Each system uses a distinctive *Inmarsat Number* (IMN) series which allows the SES functionality to be recognized from the number allocated to that terminal:

- Inmarsat-B Nine digits, beginning with 3
- Inmarsat-C Nine digits, beginning with 4

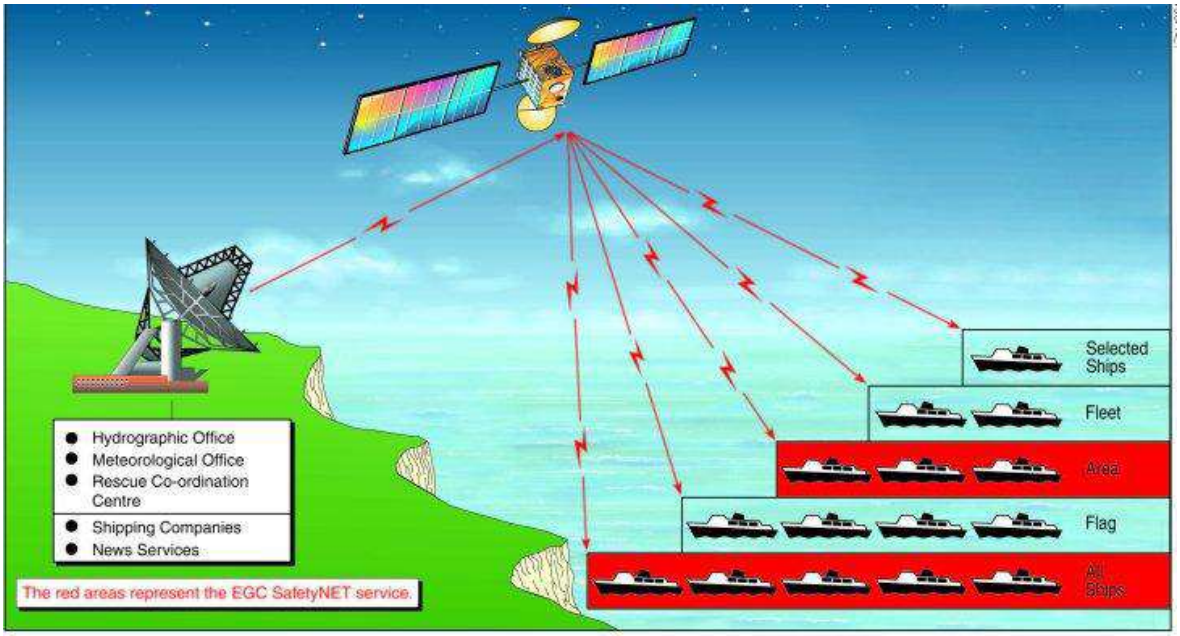
- lnmarsat-M Nine digits, beginning with 6
- Inmarsat Fleet 77Nine digits, beginning with 76
- Inmarsat Fleet 77Nine digits, beginning with 60 (HSD) Beispiel

6.6.8 Overview of SafetyNET and FleetNET services

SafetyNET and FleetNET are part of EGC.

FleetNET offers the possibilities for receiving information transmitted for groups of ships, for fleets or ships of a certain flag state (See Overview of SafetyNET and FleetNET).

Information regarding it should be noted, that the participation of FleetNET is liable to pay costs.



Overview of SafetyNET and FleetNET

6.6.9 Operational voice procedure via Inmarsat

Inmarsat-B, -M and Fleet systems are constructed among others for voice communications.

Distress-, urgent- safety and routine communication

The distress-, urgency- and safety communications in the GMDSS must comply with the appropriate rules of the RRs as defined in chapter VII. Some Inmarsat equipment offers the possibility to transmit so called “priority messages”. Priority messages suppress other messages with a lower importance (See Overview of priorities).

Distress	**Priority P3** A distress (P3) will pre-empt all other communications			
Urgent		**Priority P2** An urgency (P2) call will pre-empt both safety (P1) and routine (P0) calls		
Safety			**Priority P1** A safety (P1) call will pre-empt a routine (P0) call	
Routine				**Priority P0** Lowest priority

Overview of priorities

Procedure for sending a distress alert-, call- and message via Inmarsat-B and Inmarsat Fleet 77

To perform a distress alert the user has to press the distress button on the cradle. This ship to shore distress alert produces the satellite number, the ships Inmarsat ID and the priority "distress" on a screen in the appropriate *Maritime Rescue Coordination Centre* (MRCC) / RCC. The alert will be interrupted if the button is released within five seconds.

After the MRCC has responded to the ship the vessel starts its transmission of a distress call and distress message as described under 0 with the exemption that a transmission of a MMSI is not necessary.

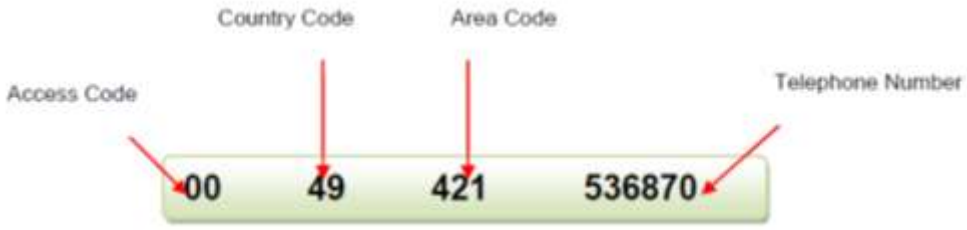
Distress messages transmitted through Inmarsat systems are sent through the general communication channels with absolute priority to ensure rapid receipt. To perform a distress alert relay in the direction ship to shore, the user has to transmit a distress priority message to a MRCC without pressing the distress button.

When receiving a distress priority call in the direction shore to ship, the personal on board will be alerted by an audible alarm and by an indicator light.

Procedure for sending an urgency call- and message via Inmarsat-B and Inmarsat Fleet 77

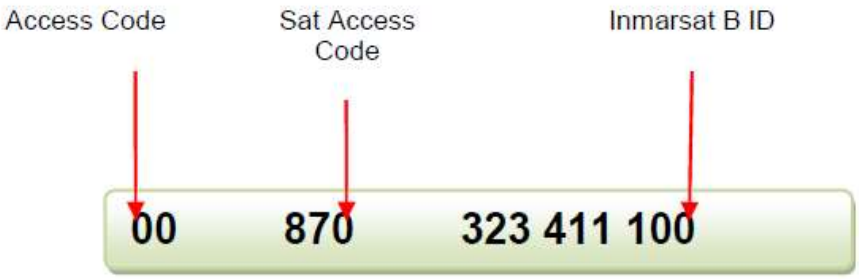
Every urgency call and message has to be addressed either to a subscriber ashore or to another ship earth station. When editing an urgency call it has to be noted that the priority P2 must be selected. Subscribers ashore can be e. g. Hospitals and MRCCs.

The land subscribers telephone number is mostly compose of as follows:



Example Inmarsat land subscriber international phone number

Calling a ship earth station needs after the common access code the satellite access number for telephony and then the ships Inmarsat ID e.g. Inmarsat-B ID:



Example Inmarsat B ship earth station phone number

The priority P2 indicates that the following communications are of a very high importance. Because of this the use of the urgency signal Pan Pan is therefore not necessary, it would confuse the subscriber e.g. a hospital ashore. The urgency signal can be used in connection with MRCCs, RCCs and ship earth stations. The voice procedures to conduct P2 communications.

Procedure for sending a safety announcement, call and message via Inmarsat-B and Inmarsat Fleet 77

Every safety call and message has to be addressed either to a subscriber ashore or to another ship earth station. When editing a safety call it has to be noted that the priority P1 must be selected. Subscribers ashore can be e. g. NAVTEX coordinator, weather administrations, MRCCs....

The priority P1 indicates that the following communications are regarding the safety of navigation or important weather information. Because of this the use of the safety signal Securite is therefore not necessary, it would confuse the subscriber e.g. national hydrographic offices. The safety signal can be used in connection with MRCCs, RCCs and ship earth stations. The voice procedures to conduct P1 communications.

Routine communication via Inmarsat-B and Fleet 77

Every routine call and message has also been addressed either to a subscriber ashore or to another ship earth station.

6.6.10 Operational Inmarsat telex procedure

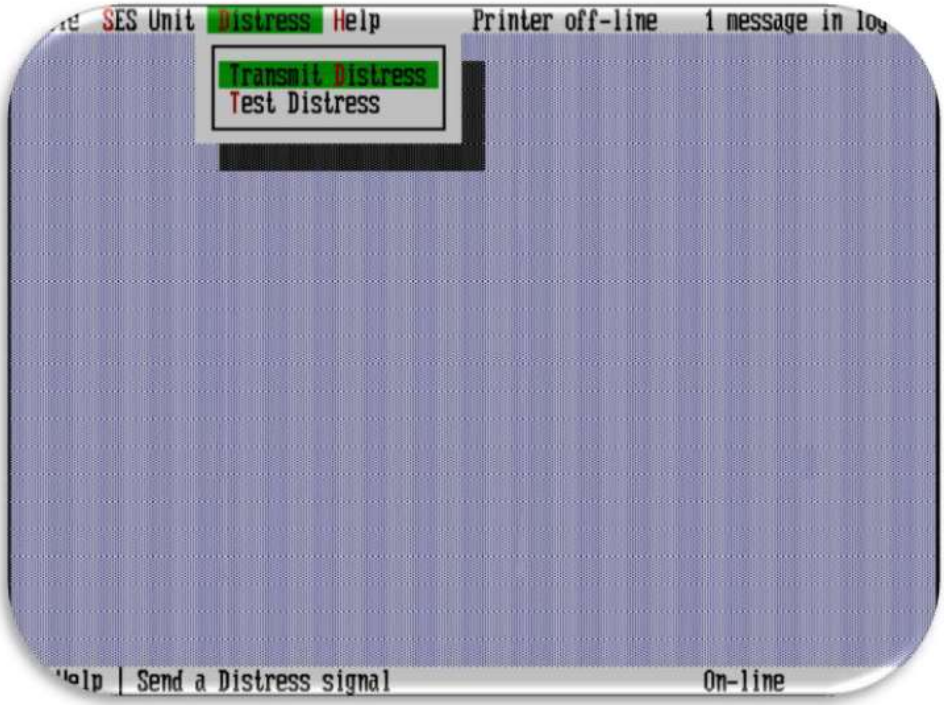
Inmarsat-B and Inmarsat-C are constructed, among others, for telex communications. The distress-, urgency- and safety communications in the GMDSS must comply with the appropriate rules of the RRs as defined in chapter VII.

For the transmission of priority messages, the appropriate instructions of the manufactures are to be observed.

Distress via Inmarsat-B telex

Inmarsat-B provides the possibility to transmit a true distress alert or a distress test.

To perform a telex distress alert the user has to select the distress menu and to click within the menu on “Transmit Distress”.



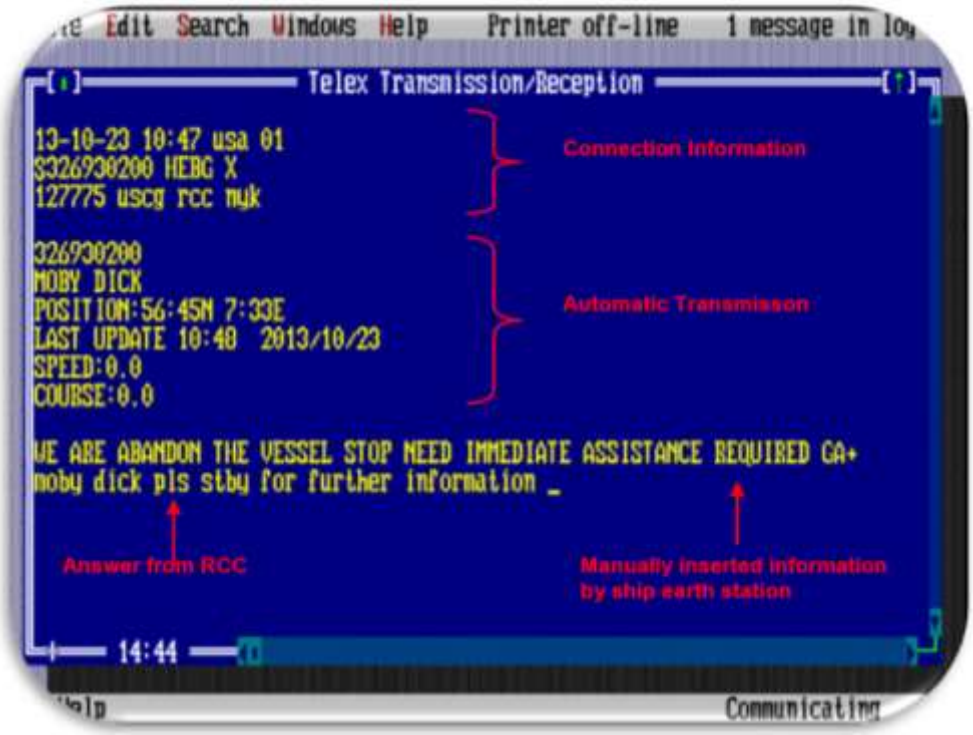
Inmarsat-B telex selecting distress transmission

The distress information will be conveyed from the SES via the satellite and the CES to the responsible MRCC.

After the connection is established the automatic transmission of distress information will start. When the automatic transmission is finished additional details can be manually added by the operator on the ship in distress.

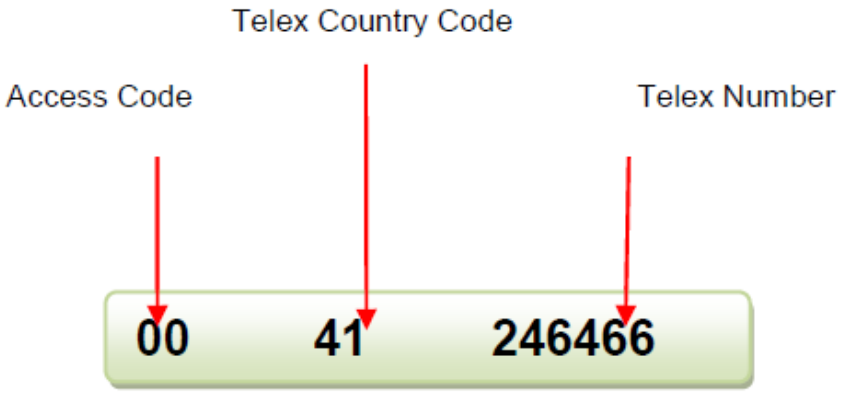
The existing connection is a duplex connection so both parties are able to respond after inviting each other with “GA+” (go ahead).

Distress messages transmitted through Inmarsat systems are sent on the general communication channels with absolute priority to ensure rapid receipt.



Inmarsat-B telex distress transmission

To perform a distress alert relay in the direction ship to shore, the operator has to transmit a distress priority message to a MRCC / RCC by entering the appropriate telex number.



Example International Inmarsat land subscriber telex number

The further On Scene Communications must be carried out on VHF or MF and, where necessary on HF distress frequencies.

Distress via Inmarsat-C telex

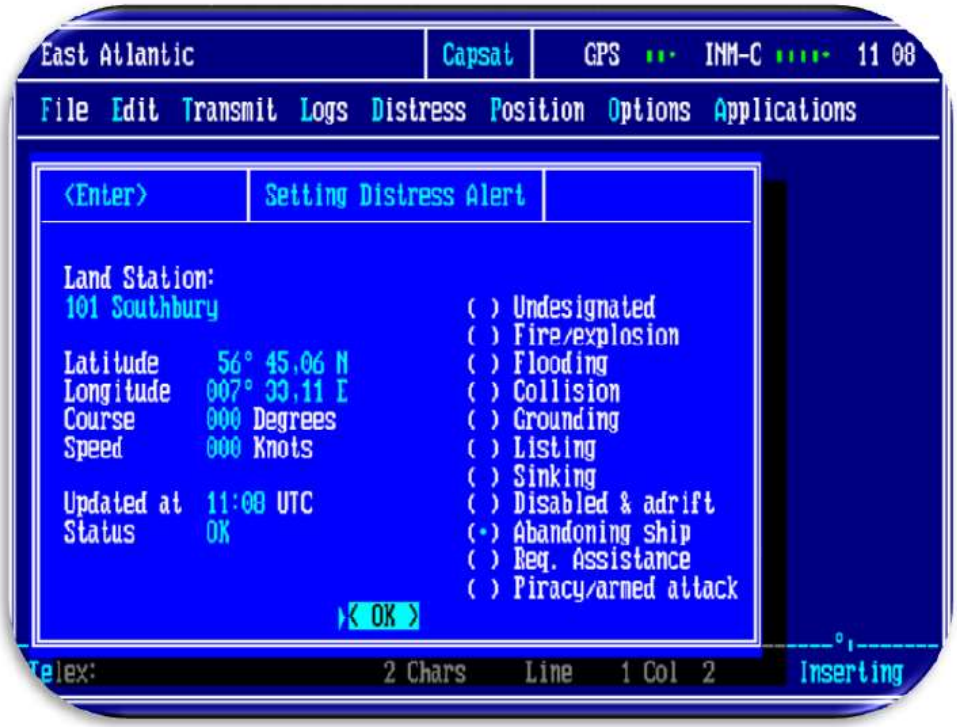
Inmarsat-C provides two possibilities to transmit a distress alert:

- Distress alert including the ships Inmarsat ID and the last known position and time.
- Distress alert including the ships Inmarsat ID, the last known position and time and additionally the nature of distress.

In the first method open the cover lid and press the distress button for at least 5 seconds, until the transmission starts.

Inmarsat Mini-C telex distress panel

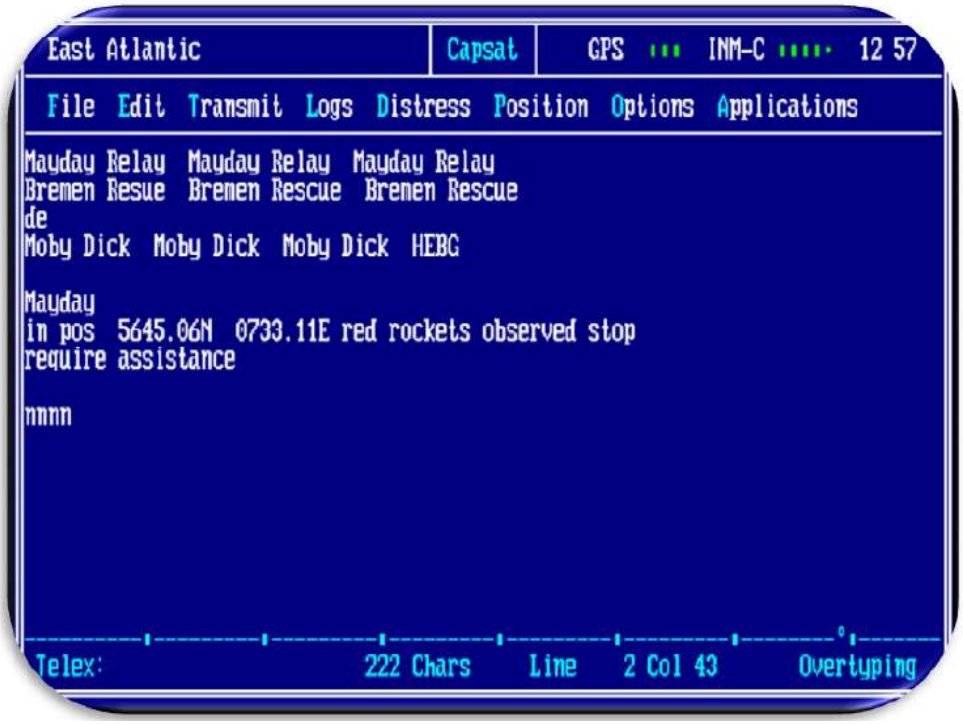
In the second method enter the distress menu and select the nature of distress. Then lift the cover lid and push the distress button for at least 5 seconds.



Inmarsat-C distress telex settings

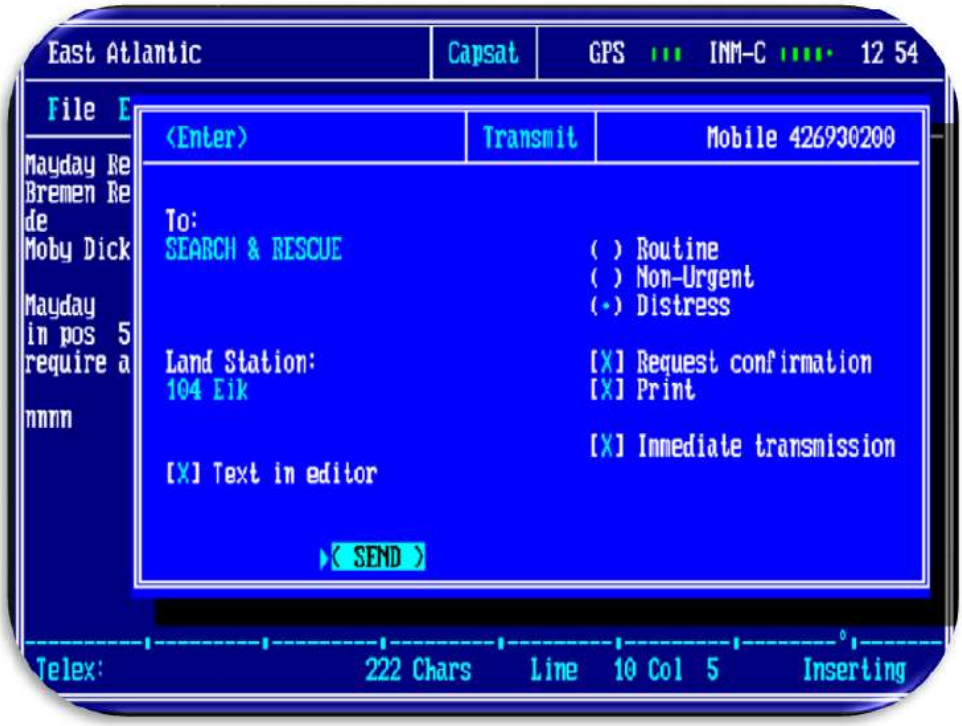
The distress information will be conveyed from the SES via the satellite and the CES to the responsible MRCC.

To perform a distress alert relay in the direction ship to shore, the operator has to prepare a distress relay message.



Inmarsat-C mayday relay telex transmission

Thereafter, the operator has to select the transmit menu and click on the distress priority. Then the addressee will change to “SEARCH & RESCUE” automatically. After pressing the send button the distress information will be conveyed from the SES via the satellite and the CES to the responsible MRCC.



Inmarsat-C priority settings

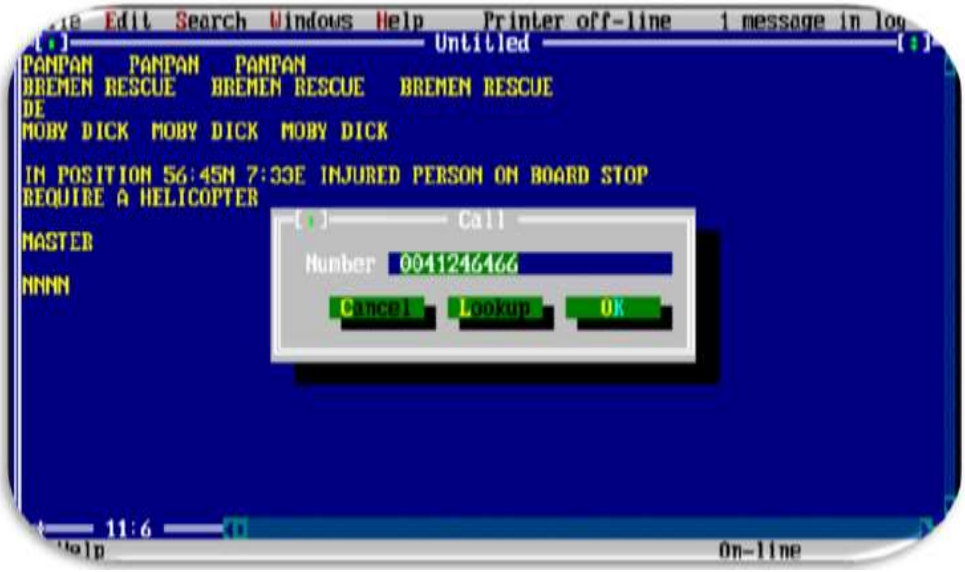
The further On Scene Communications has to be carried out on VHF or MF and, where necessary on HF distress frequencies.

Urgency / Safety Inmarsat-B telex

Inmarsat-B offers two possibilities to transmit messages to any subscriber:

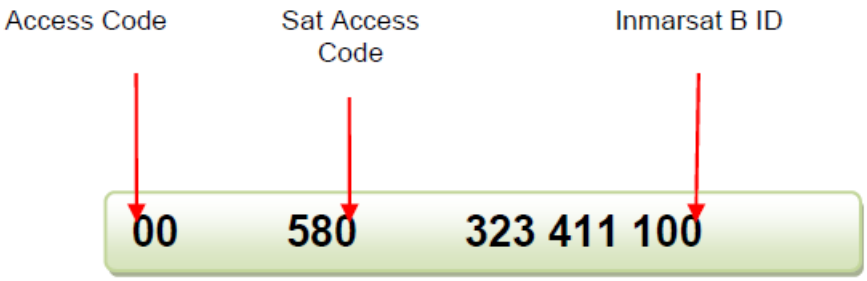
- Transmit the message directly to the subscriber and interrupt the connection after sending automatically.
- Set up a "conversation call" then transmit the message. The existing connection is a duplex connection so both parties are able to respond after inviting each other with "GA+" (go ahead).

After preparing an urgency or safety message the access code (00), the telex country code (41) and the telex number of the destination (246466) have to be filled into the appropriate address field. By pushing the return key on the keyboard the transmitting starts.



Inmarsat-B urgency transmission

To perform an urgency or safety call and message to another SES the access code, the Sat access code and the Inmarsat-B ID of the other SES have to be filled into the address field as shown below.



Example Inmarsat-B ship earth station telex number

Urgency / Safety via Inmarsat-C telex

The Inmarsat-C system does not offer the possibility for a "call for conversation". Subscribers either ashore or on a ship cannot be reached by a direct call in the Inmarsat-C system. The store and forward mode is possible only. That means that prepared messages are send from the SES via a satellite into a memory of a CES. Then the connection will be interrupted automatically. The CES will forward the message to the addressee automatically as soon as possible. After delivery the CES will send an appropriate acknowledgement to the SES.

Routine communication

Sending and receiving a telex / fax via Inmarsat-B

The format for a telex has to be composed in accordance with the relevant ITU-T Recommendation. For dialling a telex subscriber it has to be started with the access code 00 (automatic dialling) followed by the telex country code (28) and the telex subscriber number (511244). In the direct connection after the telex delivery the connection will be shut down automatically.

On the other hand there is a possibility for direct conversation between the SES and the subscriber ashore. After dialling the subscriber's number, within approximately 15 seconds you should receive the answerback of the called. This means that the telex connection to the called subscriber has been established. You may now proceed with your telex message.

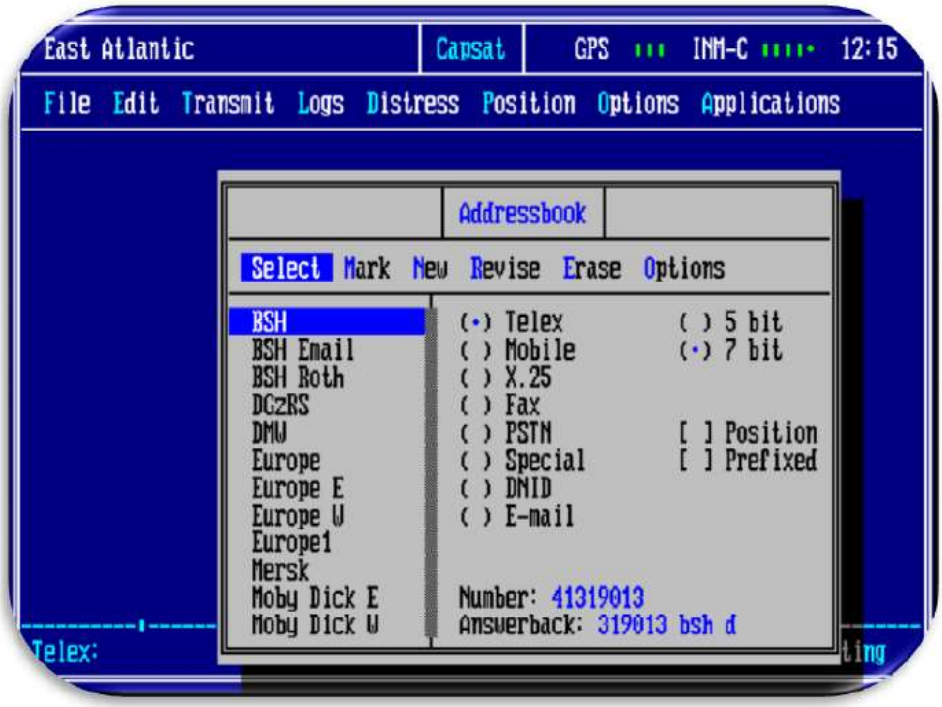
To send a fax it is necessary to dial the number like the normal phone connection.

Sending and receiving a telex / fax via Inmarsat-C

Before transmitting a prepared telex or fax, the address book which contains different types of addresses, has to be opened to select the correct telex or fax address. After composing a telex or a fax it is possible to transmit a telex via two different types of telex addresses:

- Subscriber ashore: Click on "Telex", enter telex country code and subscribers number as well as subscribers answerback.
- Ship subscriber: Click on "Mobile", enter satellite access code (580) and the Inmarsat-C ID of the ship to be called.

For a fax transmission the address book has to contain a fax address in which "Fax" is selected and the country code, area code, and the subscribers fax number is entered.



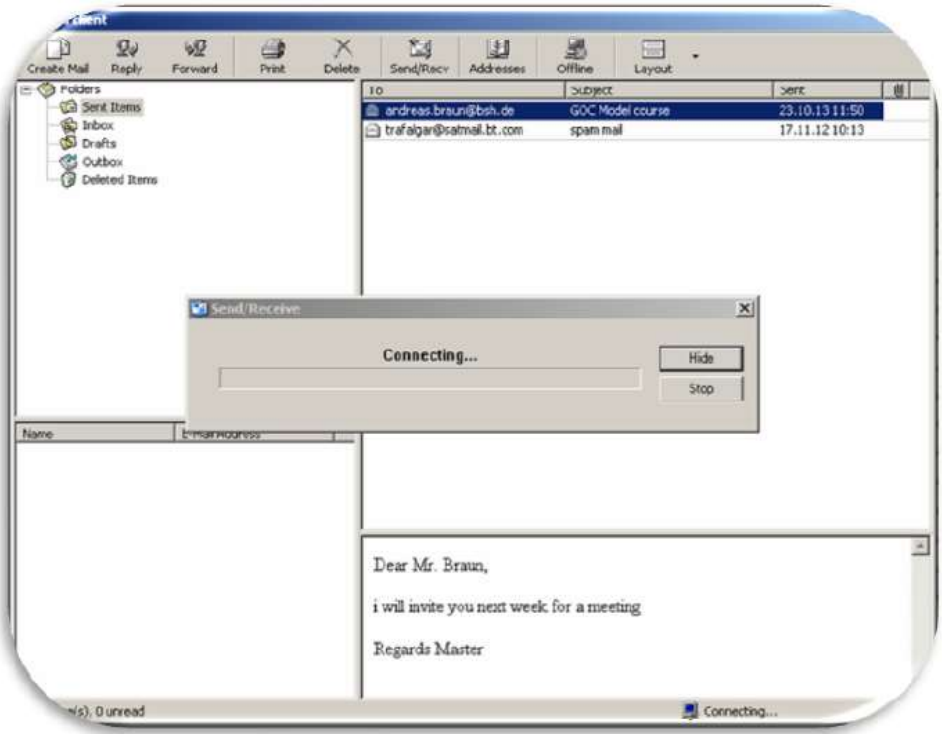
Inmarsat-C address book

6.6.11 Inmarsat Email procedure

Inmarsat Fleet 77 and Inmarsat-C offer the possibility to transmit emails in the direction ship to shore and ship to ship.

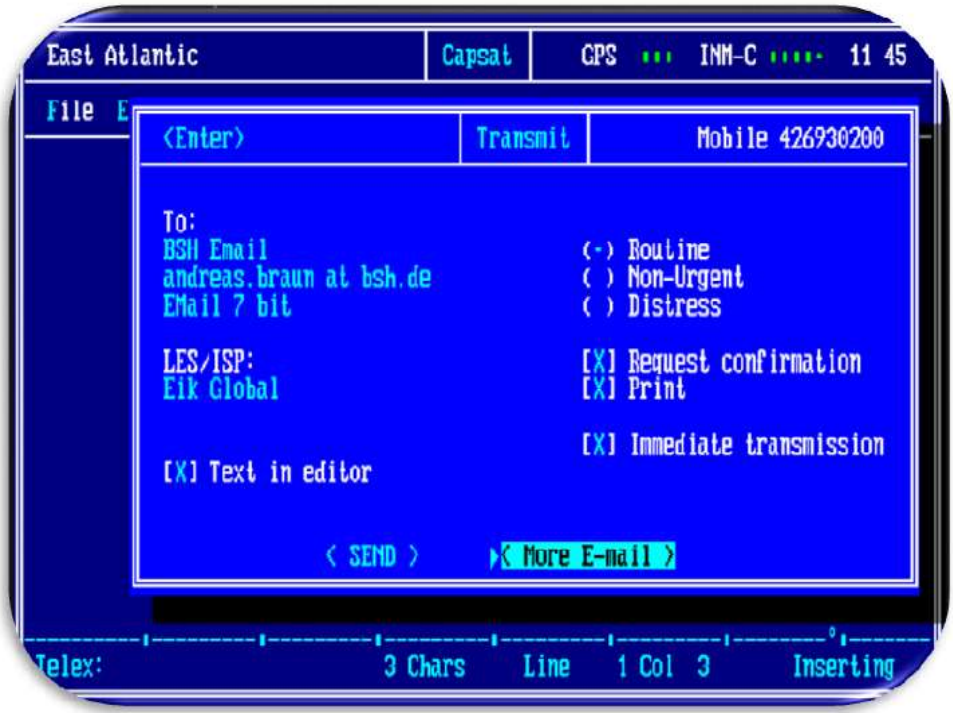
Procedure for sending an email to shore

An easy way to send an email is to use Inmarsat Fleet 77. After composing an email it should be made sure, that the system is online. Then select or enter the correct email address and press the send button. The email will be immediate send to the addressee.



Inmarsat Fleet 77 Email transmission

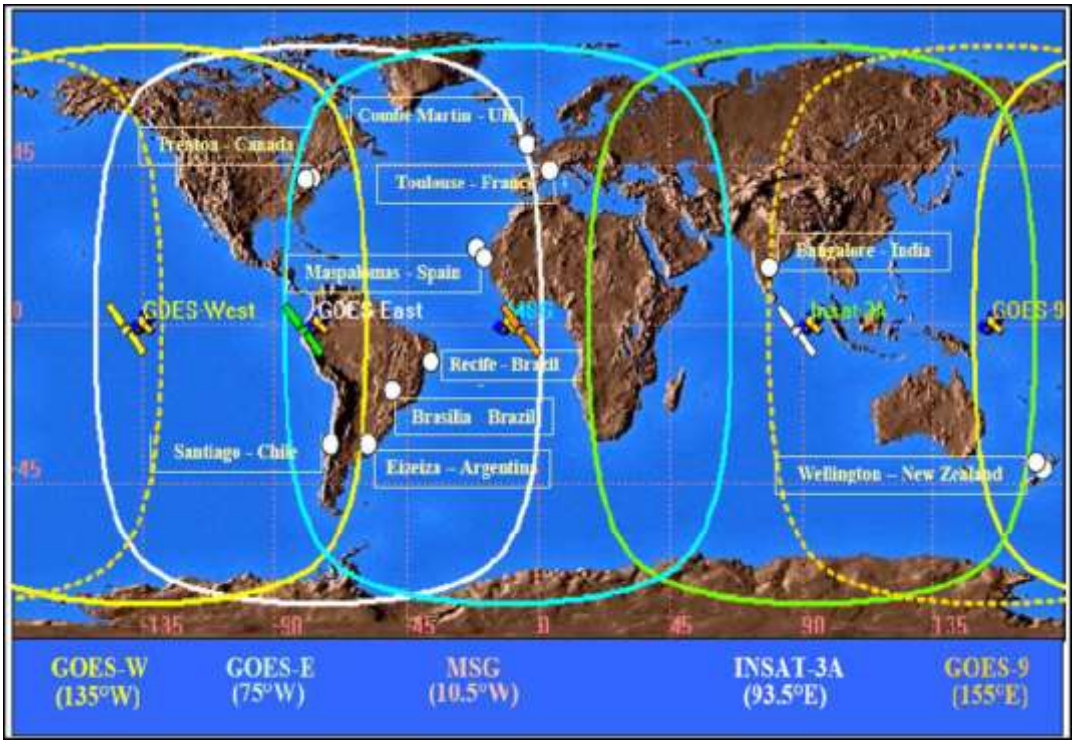
Before sending a composed or stored email, the address book has to be prepared with an email address. Then click the email address, click “More E-mail” and enter subject details then press “SEND” (See Figure 97). The email will now deliver to the subscriber.



Inmarsat Fleet 77 Email settings

6.7 Cospas/ Sarsat

- Structure



Cospas/Sarsat space segment

Geostationary Search and Rescue (GEOSAR) satellite constellation – The GEOSAR constellation is comprised of satellites provided by the USA (geostationary operational environmental satellite series), India (Indian national satellite system series) and the European Organisation for the exploitation of meteorological satellites.

Cospas-Sarsat GEOSAR system – The GEOSAR system consists of 406 MHz repeaters carried on board various geostationary satellites, and the associated *Local User Terminals* (LUT)s called GEOLUTs which process the satellite signal.

As a GEOSAR satellite remains fixed relative to the Earth, there is no Doppler effect on the received frequency and Doppler radio location positioning techniques cannot be used to locate distress beacons. To provide rescuers with beacon position information, such information must be either:

- acquired by the beacon through an internal or an external navigation receiver and encoded in the beacon message, or
- derived, with possible delays, from the *Low Earth Orbit Search and Rescue* (LEOSAR) System.

406 MHz GEOSAR system – Cospas-Sarsat has demonstrated that the current generation of Cospas-Sarsat 406 MHz beacons could be detected using search and rescue instruments on board geostationary satellites. The GEOSAR system consists of 406 MHz repeaters carried on board various geostationary satellites and the associated ground facilities called GEOLUTs which process the satellite signal.

Geostationary satellites orbit the Earth at an altitude of 36,000 km, with an orbit period of 24 hours, thus appearing fixed relative to the Earth at approximately 0 degrees latitude (i.e. over the equator). A single geostationary satellite provides GEOSAR uplink coverage of about one third of the globe, except for Polar Regions.

Therefore, three geostationary satellites equally spaced in longitude can provide continuous coverage of all areas of the globe between approximately 70 degrees North and 70 degrees South latitude.

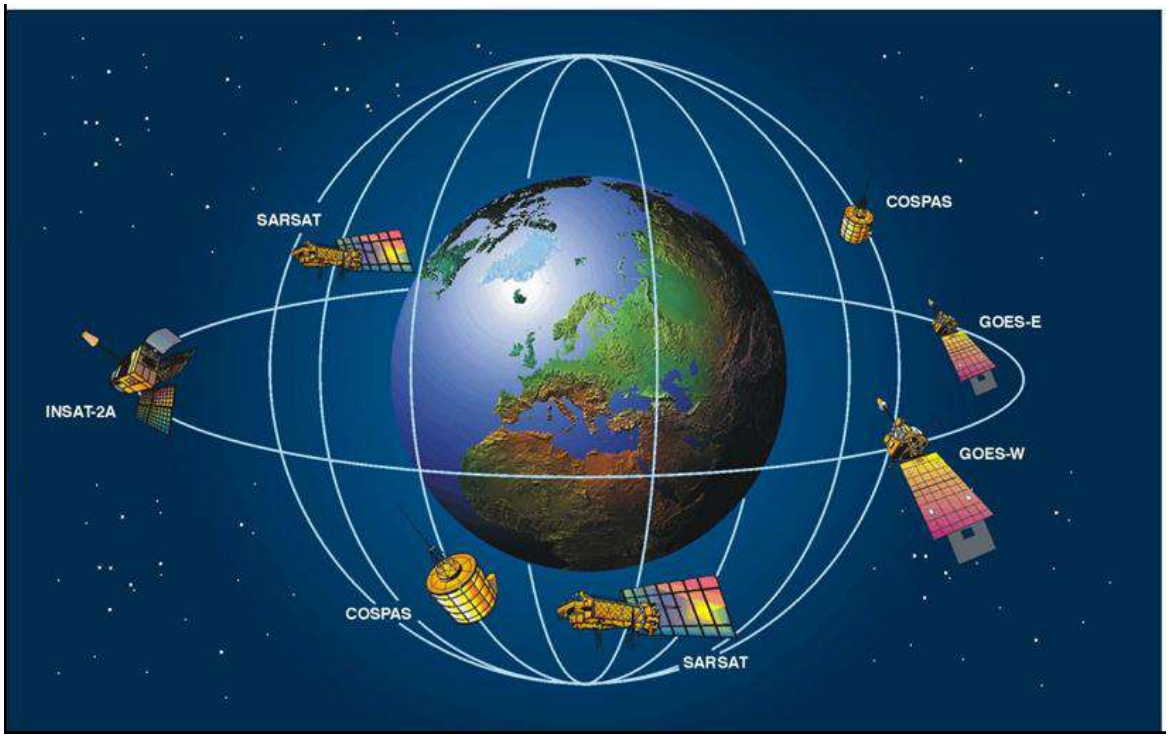
Since GEOSAR satellites remain fixed relative to the Earth, there is no Doppler effect on the received frequency and, therefore, the Doppler positioning technique cannot be used to locate distress beacons. To provide rescuers with position information, the beacon location must be either:

- acquired by the beacon though an internal or an external navigation receiver and encoded in the beacon message, or
- derived from the LEOSAR system Doppler processing.

Cospas-Sarsat has demonstrated that the GEOSAR and LEOSAR system search and rescue capabilities are complementary. For example the GEOSAR system can provide almost immediate alerting in the footprint of the GEOSAR satellite, whereas the LEOSAR system:

- provides excellent coverage of the polar regions (which are beyond the coverage of geostationary satellites);
- can calculate the location of distress events using Doppler processing techniques; and
- is less susceptible to obstructions which may block a beacon signal in a given direction because the satellite is continuously moving with respect to the beacon.

LEOSAR satellite constellation – The Cospas-Sarsat 406 MHz LEOSAR system uses the same polar-orbiting satellites as the 121.5 MHz system and, therefore, operates with the same basic constraints which result from non-continuous coverage provided by LEOSAR satellites, although with significantly improved performance resulting from the improved beacon technical characteristics. The use of low-altitude orbiting satellites provides for a strong Doppler effect in the up-link signal thereby enabling the use of Doppler positioning techniques. The Cospas-Sarsat 406 MHz LEOSAR system operates in two coverage modes, namely local and global coverage.



LEOSAR and GEOSAR satellite constellation

406 MHz LEOSAR global mode – The 406 MHz SARP system provides global coverage by storing data derived from on board processing of beacons signals, in the spacecraft memory unit. The content of the memory is continuously broadcast on the satellite downlink. Therefore, each beacon can be located by all LEOLUTs which track the satellite (even for LEOLUTs which were not in the footprint of the satellite at the time the beacon was detected by the satellite).

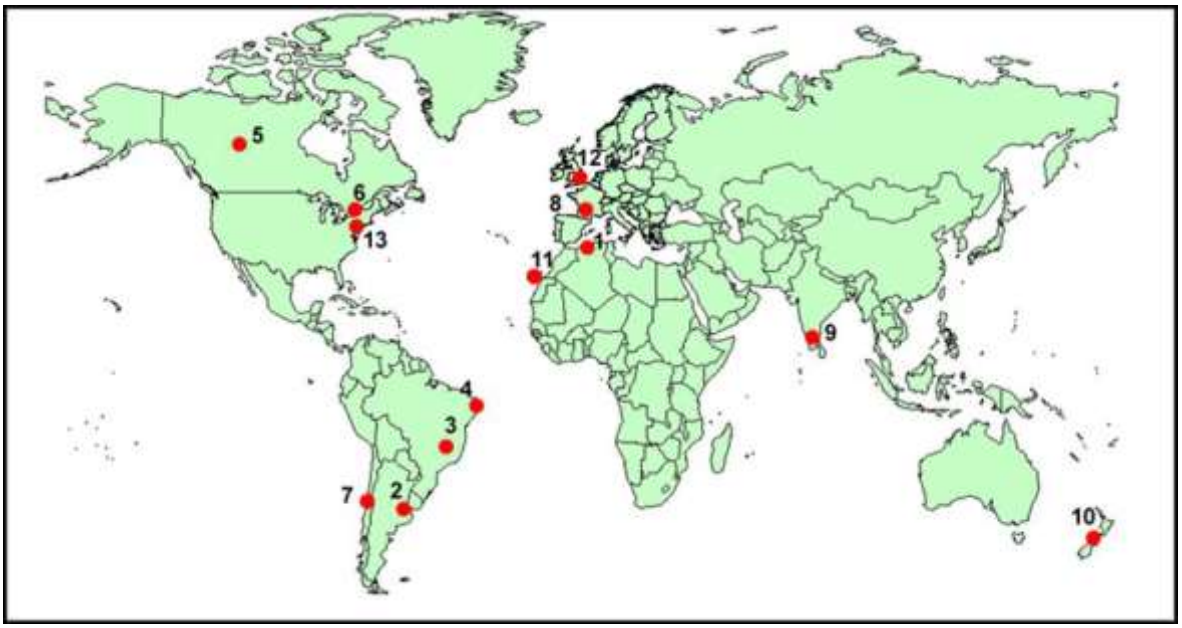
This provides the 406 MHz global coverage and introduces ground segment processing redundancy. The diagram to the right depicts a LEOSAR satellite orbiting the Earth in the direction of the North Pole. The blue circle represents the satellite field of view at a point in the recent past when the satellite was over the southern Atlantic Ocean. At that point in time the satellite detected the 406 MHz beacon in Antarctica, however, since there were no LEOLUTs in its field of view, a distress alert could not be generated at that time. Nevertheless, the satellite continued to transmit the processed data associated with this distress beacon. When the LEOLUT located on the North West coast of Africa came into the view of the satellite, this LEOLUT received the beacon information and generated a distress alert.

The 406 MHz global mode may also offer an additional advantage over the local mode in respect of alerting time. As the beacon message is recorded in the satellite memory by the first satellite pass which detected the beacon, the waiting time is not dependent upon the satellite achieving simultaneous visibility with the LEOLUT and the beacon. Consequently, the time required to produce alerts could be considerably reduced.

The animated graphic depicts two beacons: the yellow beacon is detected in global mode only whereas the red beacon is detected in both local and global modes.

Cospas/Sarsat ground segment

GEOLUTs – A GEOLUT is a ground receiving station in the Cospas-Sarsat System that receives and processes 406 MHz distress beacon signals which have been relayed by a Cospas-Sarsat geostationary satellite. Due to the extremely large continuous coverage footprint provided by each geostationary satellite, GEOLUTs are able to produce near instantaneous alerting over extremely large areas. However, due to the fact that the satellite remains stationary with respect to distress beacons, GEOLUTs are not able to determine beacon locations using Doppler processing techniques. In view of this, 406MHz beacons with location protocols allow for the encoding of position data in the transmitted 406 MHz message, thus providing for quasi-real time alerting with position information via the GEOSAR system.



GEOLUT stations

LEOSAR coverage – The Cospas-Sarsat LEOSAR system provides global coverage for 406 MHz beacons and coverage over most land areas for 121.5 MHz beacons. The shaded areas indicate regions without coverage for 121.5 MHz beacons.

1	ALGIERS, ALGERIA	15	BEIJING, CHINA	29	LAHORE, PAKISTAN
2	OUARGLA, ALGERIA	16	HONG KONG, CHINA	30	CALLAO, PERU
3	PARANA, ARGENTINA	17	TOULOUSE, FRANCE	31	ARKHANGELSK, RUSSIA
4	RIO GRANDE, ARGENTINA	18	BANGALORE, INDIA	32	NAKHODKA, RUSSIA
5	ALBANY, AUSTRALIA	19	LUCKNOW, INDIA	33	JEDDAH, SAUDI ARABIA
6	BUNDABERG, AUSTRALIA	20	JAKARTA, INDONESIA	34	SINGAPORE
7	BRASILIA, BRAZIL	21	BARI, ITALY	35	CAPE TOWN, SOUTH AFRICA
8	RECIFE, BRAZIL	22	KEELUNG, ITDC	36	MASPALOMAS, SPAIN
9	CHURCHILL, CANADA	23	YOKOHAMA, JAPAN	37	BANGKOK, THAILAND
10	EDMONTON, CANADA	24	DAEJEON, KOREA	38	COMBE MARTIN, UK
11	GOOSE BAY, CANADA	25	WELLINGTON, NEW ZEALAND	39	ALASKA, USA
12	EASTER ISLAND, CHILE	26	ABUJA, NIGERIA	40	CALIFORNIA, USA
13	PUNTA ARENAS, CHILE	27	TROMSOE, NORWAY	41	FLORIDA, USA
14	SANTIAGO, CHILE	28	SPITSBERGEN, NORWAY	42	GUAM
				43	HAWAII, USA
				44	HAIPHONG, VIETNAM

Cospas / Sarsat LUTs

LEOLUTs – The configuration and capabilities of each LEOLUT may vary to meet the specific requirements of the participating countries, but the Cospas and Sarsat LEOSAR spacecraft downlink signal formats ensure inter-operability between the various spacecraft and all LEOLUTs meeting Cospas-Sarsat specifications.

The capability of a LEOLUT is determined, for the most part, by the LEOSAR satellite channels it was designed to process. There are a possible 4 channels that may, depending upon the specific satellite being tracked, be available for processing.

Some satellites support all the channels listed below, and some only support a limited set of them.

- The 406 MHz Search and Rescue Processor (SARP) satellite channel transmits received 406 MHz beacon data which has already been partially processed by the satellite to determine the identification, transmit time, and received frequency for each distress beacon transmission burst. Because of the on board memory capability of the SARP channel, this channel provides global (yet not continuous) coverage for distress beacons which operate at 406 MHz

- The 406 MHz Search and Rescue Repeater (SARR) channel receives 406 MHz beacon transmission bursts and immediately retransmits them on the satellite downlink. Since there is no memory associated with the repeater channel, this type of processing supports only local mode coverage (i.e. the distress beacon and the LEOLUT must be in simultaneous view of the satellite for a period of time). Furthermore, since the satellite does not process the data, all the processing is performed by the LEOLUT.

- 121.5 MHz and 243 MHz Search and Rescue Repeater (SARR) channels operate in a fashion similar to the 406 MHz SARR channel; however, 121.5/243 MHz beacons do not include identification information.

For the 121.5 MHz, 243 MHz and 406 MHz signals received via their respective SARR channel, each transmission is detected and the Doppler information calculated. A beacon position is then determined using this data. In the case of 406 MHz distress beacons, the LUT is also able to provide identification information associated with the beacon.

Processing the SARP channel 2400 *bits per second* (bps) data (i.e. those generated from 406 MHz transmissions) is relatively straightforward since the Doppler frequency is measured and time-tagged on board the spacecraft. All 406 MHz data received from the satellite memory on each pass can be processed within a few minutes of pass completion.

To maintain accurate location processing, an update of the satellite ephemeris is produced each time the LUT receives a satellite signal. The downlink carrier is monitored to provide a Doppler signal using the LUT location as a reference, or highly stable 406 MHz calibration beacons at accurately known locations are used to update the ephemeris data.

6.8 Emergency Positioning-Indication Radio Beacon (EPIRB)

The transmission of an EPIRB signal can be considered to be a distress alert. The essential purpose of an EPIRB signal is to help determine the position of survivors during SAR operations.

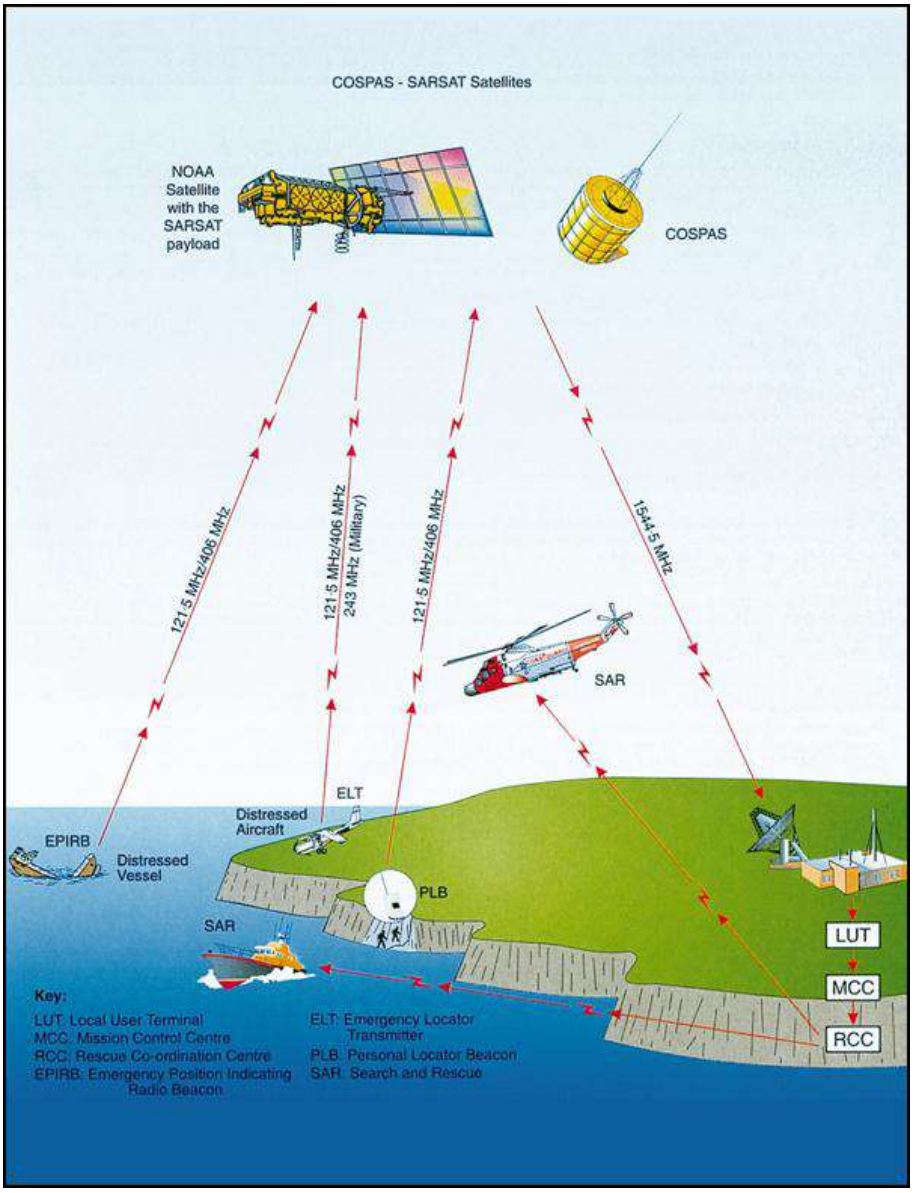
The EPIRB signal indicates that one or more persons are in distress, that they possibly may no longer be on board a ship or aircraft and that receiving facilities may no longer be available.

Different EPIRB types

- Basic operation of the COSPAS-SARSAT satellite system and signal routing/path

A LUT receiving an EPIRB transmission would consider that the vessel in distress is unable to transmit a distress message and so a distress alert relay and a distress message would normally be transmitted by a coast station to ships in the area by any suitable means, e.g., Inmarsat (EGC), DSC, NAVTEX.

This EPIRB-system uses low-altitude polar-orbiting satellites operating in the 406 MHz band. The transmissions are received by the satellites, which pass on the relevant information to a LUT, which then passes information to rescue authorities via a *Mission Control Centre* (MCC).



Communication path in Cospas / Sarsat system

- Essential parts of Cospas / Sarsat EPIRBs

An EPIRB consists of a buoy, which carries antennas and the necessary electronic equipment, power supplies, navigational aids, a hydrostatic release, and possibly a control panel with an interface to the ship's power supply and remote activator.

Some EPIRB types incorporate an integral navigation receive capability provided e.g. by a GPS receiver, enabling the position to be updated automatically. In this case, data may be fed directly into the Distress Message Generator.

All types of EPIRBs should additionally be equipped with a flashing light with a low duty-cycle ratio, which is automatically activated by the onset of darkness to locate the EPIRBs position visually.

- Basic characteristics of operation on 406 and 121.5 MHz EPIRB

The emission of a 406 MHz band EPIRB will be relayed by an appropriate satellite to a LUT which forwards the distress information via a MCC to the MRCC automatically.

A 121.5 MHz terrestrial signalling facility is included on all current production Cospas / Sarsat EPIRBs, which serves primarily to provide a homing signal for SAR units and other aircrafts.

- Registration and coding of a 406 MHz EPIRB

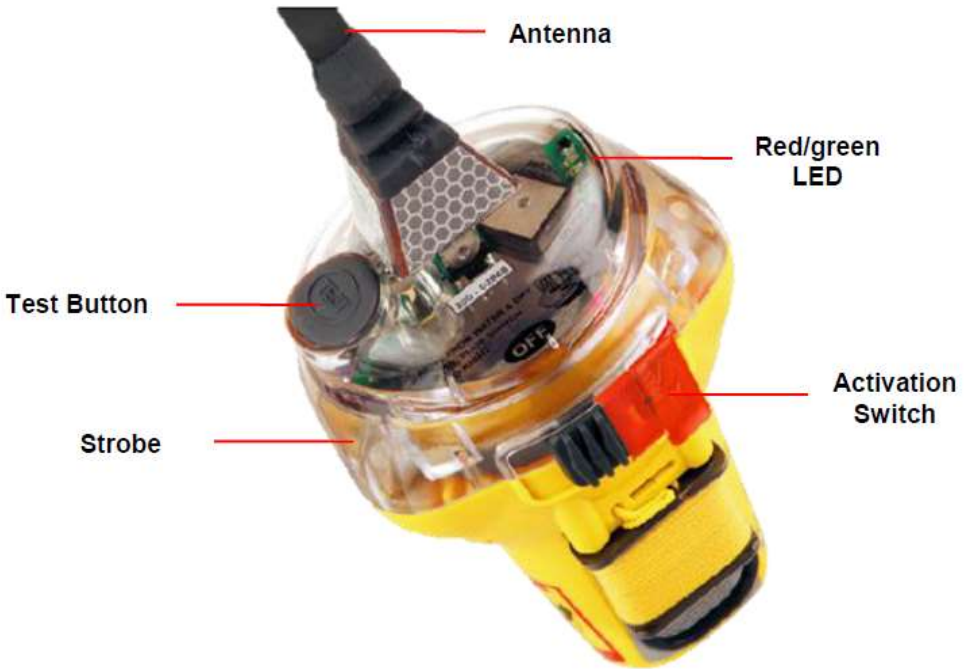
The ship owner must ensure that any EPIRB have been registered with the relevant authority in the flag state, enabling details to be available to SAR authorities when requested.

- Information contents of a distress alert

The position of the EPIRB can be found by the satellite, using Doppler frequency-shift measurement techniques. The 406 MHz EPIRB transmits digitally coded information, regarding: distress information, country of origin and ships identification and serial number. Optionally EPIRBs can additionally transmit the distress position, the date and time, if supplied with navigational aids. Some EPIRBs offer the feature for remote control with the possibility to select the nature of distress which then will also be transmitted.

- Operation

All EPIRBs should have arrangements for local manual activation or float-free release and self-activation. Remote activation from the navigating bridge, while the EPIRB is installed in the float-free mounting, may also be provided. The equipment, mounting and releasing arrangements should be reliable, and should operate satisfactorily under the most extreme conditions likely to be met at sea. Manual distress alert initiation should require at least two independent actions, remove a protection facility then activate the distress switch.



EPIRB

- Float-free function

The buoy is mounted in place until it is released manually or by the float-free mechanism. A float free mechanism consists of a hydrostatic release facility which releases the EPIRB out of its bracket in case of sinking when the EPIRB has reached a certain water depth (approx. 1.5m). A possible interface to ship's radio and navigational systems may be done by means of conventional plugs and sockets or by cordless connection which must not hinder the EPIRB on free floating.

- Correct use of the lanyard

EPIRBs should be installed so that they cannot be tampered with or accidentally activated. EPIRBs are equipped with a buoyant lanyard suitable for use as a tether in order to secure the beacon to a life raft, boat or person in the water.

To prevent the EPIRB from being dragged under water, the lanyard should never be attached to the ship, or arranged in such a way that it can be trapped in the ship's structure when floating free.

- Routine maintenance, testing requirements and test operation

EPIRBs incorporate the means to carry out regular tests (without access to the space segment) and indicate the emission of a distress alert or any fault in the equipment.

EPIRBs should be tested in accordance with producer's manual on a regular basis as follows:

- Press and release test button.
- Red lamp should flash once.
- The indicator lamp should flash in accordance with the appropriate producer's information. After 60 seconds the EPIRB must switch off automatically.

- Additional EPIRB features

The VHF EPIRB is intended for use in al sea areas and operates by transmitting a DSC Distress alert on the channel 70 (156.525 MHz).

The "nature of distress" indication should be "EPIRB emission". The "distress coordinates" and "time" need not be included in the DSC message. In this case, however, the digit "9" repeated ten times and the digit "8" repeated four times should replace the missing position and time information. The "type of subsequent communication" should be "no information", Some VHF DSC EPIRBs also incorporate a 9 GHz search and rescue transponder for the purpose of providing a locating signal.

- Withdrawal of an unintended false distress transmission

If an EPIRB is accidentally activated, the nearest coast station or an appropriate coast earth station or MRCC/RCC MUST be informed immediately that a false distress alert has been transmitted and should be cancelled. Details of those stations which are involved are to be found in the ITU List of Coast Stations and various publications produced by national Administrations and service providers.

6.9 Search and Rescue Radar Transponder (SART)

The SART is an equipment used to home SAR units to the position of a vessel or persons in distress. This piece of equipment should only be activated in cases of distress. To ensure that the SART transmission will be receivable over a

useful distance it is essential that the SART be mounted as high as possible. In order to maximize the range, the regulations require a mounting height of at least 1 meter above sea level.

SART

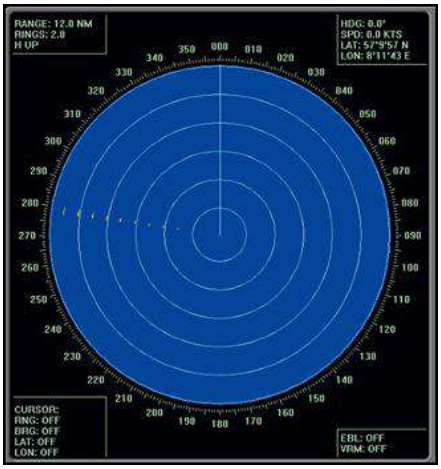
- Different types of SARTs and their operation

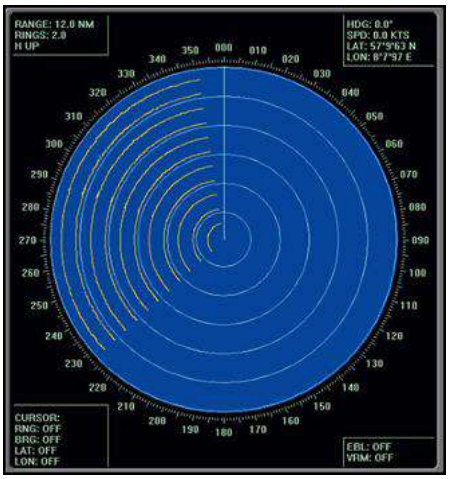
Search and rescue radar transponder

They operate in the 9 GHz band and transmit only, assuming they are switched on, when triggered by another radar pulse of a vessel or a radar station ashore. The range of a radar transponder depends of the height of its antenna which should be at least 1meter above sea level. Then the SART signals can be received by vessels in a distance of approximately 5 nautical miles, detection at longer ranges will be achieved from aircraft; at 3000 ft. for example, the aircraft radar should elicit a useful response up to 30 nautical miles away from the SART.

The transmission produces a distinctive line on the radar display of about 12 blips extending out from the location of the SART along the line of bearing. These change to concentric circles when the SAR unit reaches to within about 1 mile of the SART.

The radar display produced by the SART is shown below.





SART images on radar screen

The SART image on the radar display may be more easily identified, especially if clutter or many other targets are present, by detuning the SAR unit's radar. Detuning reduces the intensity of return echoes on the display but allows the SART signal to be seen more easily since the SART emits a broad-band signal which detuning does not affect to the same degree. Detuning the radar can be dangerous, and may infringe collision- avoidance regulations in some locations, because echoes from real targets will be removed.

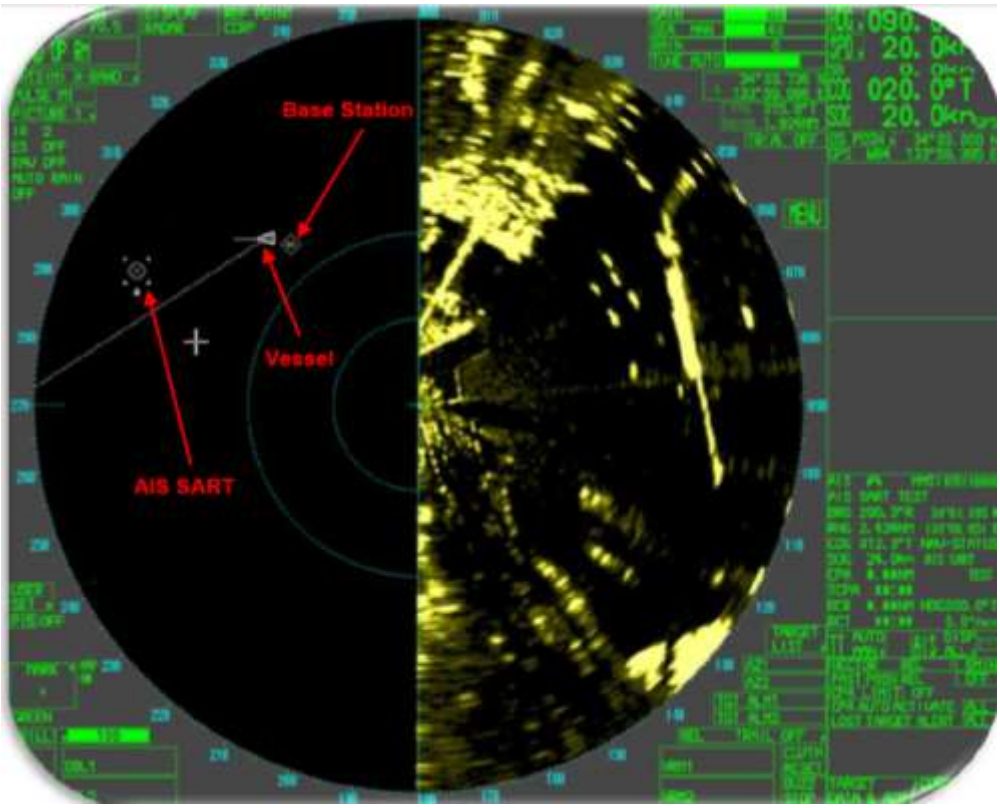
AIS radar transmitter

The AIS radar transmitter operates on channel AIS1 and AIS2 in the maritime mobile VHF band. The AIS SART is a self-contained radio device used to locate a survival craft or a distress vessel by sending updated position reports using a standard automatic identification system (AIS) class A position report.

A position and time synchronization of AIS SART are derived from a build in GNSS receiver (e.g. GPS). Once per minute the position is send as a serious of eight identical position report message (four on AIS1 and four on AIS2). This scheme creates a high probability that at least one of the messages is send on the highest point of a wave.

The range of AIS transmitters depends of the height of its antenna and is comparable to the range of the radiation of maritime VHF equipment.

The transmission of an AIS SART generates a special symbol on electronic sea charts (circle with cross). The picture below shows a half gated radar screen in order to point out the AIS signals (SART, Vessel, Base station).



AIS SART image on radar screen

- **Routine maintenance, testing requirements and test operation**

SARTs incorporate the means to carry out regular tests and indicate any fault in the equipment.

Radar transponders should be tested in accordance with producer's manual on a regular' basis as follows:

- Switch SART to test mode.
- Hold SART in view of radar antenna. Check that visual indicator light operates Check that audible beeper operates.
- Observe radar display. Concentric circles should be displayed AIS radar transmitters cannot be tested except by authorised persons with special test equipment on board the vessel. The producer instructions are to be observed.

The batteries' life should be checked in accordance with the appropriate label on the SART (AIS+Radar).

6.10 Maritime Safety Information (MSI)

Maritime safety information comprises navigational and meteorological warnings, meteorological forecasts, shore-to-ship distress alerts, SAR information and other urgent safety-related messages of vital importance broadcast to ships. It may also include electronic chart correction data.

The MSI service is an internationally coordinated network of broadcasts of MSI from official information providers, such as:

- National hydrographic offices, for navigational warnings and electronic chart correction data
- National meteorological offices, for weather warning and forecasts
- Maritime rescue co-ordination centres for shore-to-ship distress alerts, and other urgent information
- The International Ice Patrol, for North Atlantic ice hazards

Reception of MSI broadcasts is free of charge to all ships.

- **Basics**

There are different systems for broadcasting MSI:

– The **International NAVTEX Service**, whereby the Information Provider forwards the MSI for a given area via a NAVTEX transmitter. The reception of NAVTEX MSI is limited by the range of the MF propagation to the coastal area around the transmitter.

– The **International SafetyNET Service**, whereby the Information Provider forwards the MSI for a given area to an Inmarsat-C Land Earth Station (LES), for broadcasting via the satellite network over an entire Inmarsat Ocean Region; consequently, ships can receive SafetyNET MSI anywhere in that Ocean Region, irrespective of their distance from the LES or MSI Provider.

– MSI information can also be broadcast by coast radio stations on **VHF and HF frequencies** using Radiotelephony as well as Radiotelex on HF. The VHF propagation is limited to a range of approximate 30 miles, the HF propagation can be unlimited (including Polar Regions) depending on the appropriate frequency range.

- **NAVTEX**

NAVTEX is an international automated direct-printing service for promulgation of navigational and meteorological warnings, meteorological forecasts and other urgent information to ships. It was developed to simple and automated means of receiving MSI on board ships at sea in coastal waters. The information transmitted may be relevant to all sizes and types of vessel and the selective message-rejection feature ensures that every mariner can receive a safety information broadcast which is tailored to his particular needs.

In the GMDSS, a NAVTEX receiving capability is part of the mandatory equipment which is required to be carried in certain vessels under the provisions of the International Convention for the Safety of Life at Sea (SOLAS).

Details of operational and planned NAVTEX services are published periodically in the various national lists of radio signals, in an annex to the International Telecommunication Union's ITU List of coast stations and special service stations in the GMDSS Master Plan published by IMO in its series of GMDSS Circulars.

NAVTEX frequencies

The following frequencies may be used for NAVTEX broadcasts:

518 kHz

Type of service:	International
Content:	MSI
Language:	English
Co-ordination:	By IMO NAVTEX Co-ordinating Panel

490 kHz and 4209.5 kHz

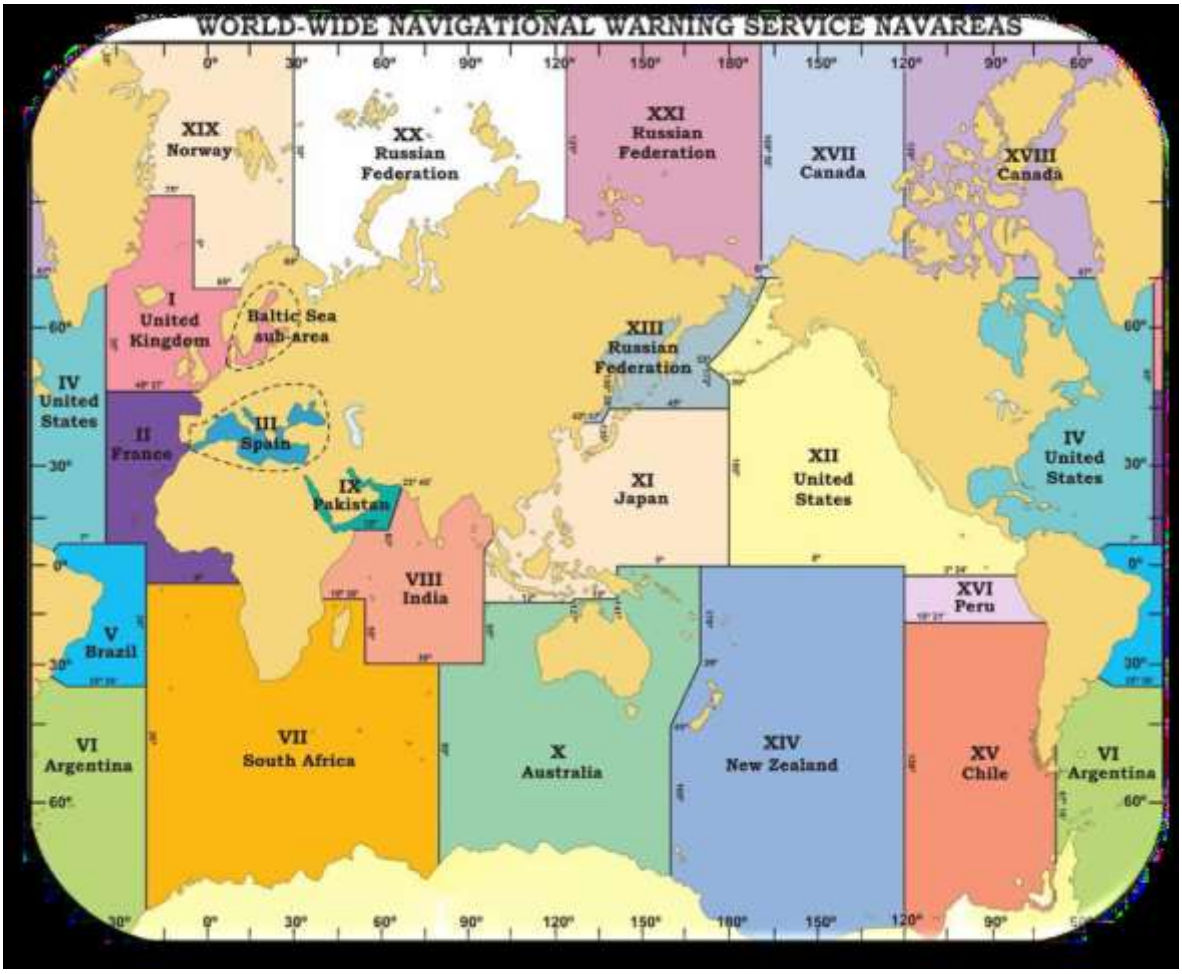
Type of service:	National
Content:	MSI
Language:	As selected by the national administration
Co-ordination:	Transmitter identification character allocated by IMO NAVTEX Co-ordinating Panel

Other national frequencies allocated by the ITU

Type of service:	National
Content:	As selected by the national administration
Language:	As selected by the national administration
Co-ordination:	By appropriate national administration

NAVTEX system

As shown below, the worldwide NAVTEX system comprises 21 Navareas / Metareas. In each Navarea / Metarea there are several NAVTEX transmitting stations available, each identified by a different single letter of the alphabet.



Navarea / Metarea overview

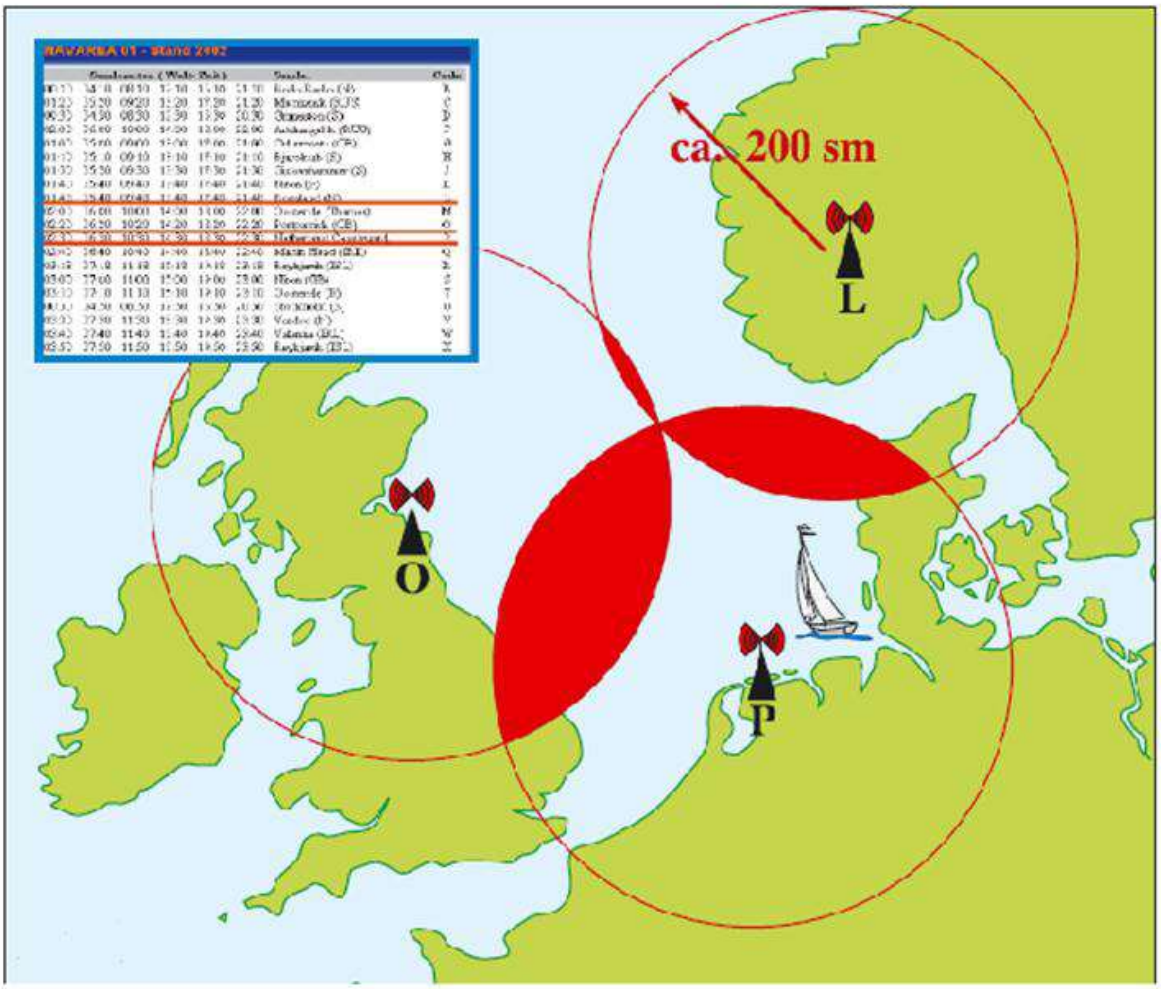
The principal features of NAVTEX are the use of a single frequency, with transmissions from stations within and between Navareas and Metareas coordinated on a time-sharing basis to reduce the risk of mutual interference.

The list below shows the transmitter identification characters and their associated transmission start times. Each transmitter identification character is allocated a maximum transmission time of 10 minutes every 4 hours.

Transmitter identification character (B_1)	Transmission start times (UTC)					
A	0000	0400	0800	1200	1600	2000
B	0010	0410	0810	1210	1610	2010
C	0020	0420	0820	1220	1620	2020
D	0030	0430	0830	1230	1630	2030
E	0040	0440	0840	1240	1640	2040
F	0050	0450	0850	1250	1650	2050
G	0100	0500	0900	1300	1700	2100
H	0110	0510	0910	1310	1710	2110
I	0120	0520	0920	1320	1720	2120
J	0130	0530	0930	1330	1730	2130
K	0140	0540	0940	1340	1740	2140
L	0150	0550	0950	1350	1750	2150
M	0200	0600	1000	1400	1800	2200
N	0210	0610	1010	1410	1810	2210
O	0220	0620	1020	1420	1820	2220
P	0230	0630	1030	1430	1830	2230
Q	0240	0640	1040	1440	1840	2240
R	0250	0650	1050	1450	1850	2250
S	0300	0700	1100	1500	1900	2300
T	0310	0710	1110	1510	1910	2310
U	0320	0720	1120	1520	1920	2320
V	0330	0730	1130	1530	1930	2330
W	0340	0740	1140	1540	1940	2340
X	0350	0750	1150	1550	1950	2350

NAVTEX transmission

NAVTEX transmissions have a designed maximum range of about 400 nautical miles. The minimum distance between two transmitters with the same transmitter identification identifier is, therefore, be sufficient to ensure that a receiver cannot be within range of both at the same time. In order to avoid erroneous reception and interference of transmissions from two stations having the same transmitter identification character, it is necessary to ensure that such stations have a large geographical separation.



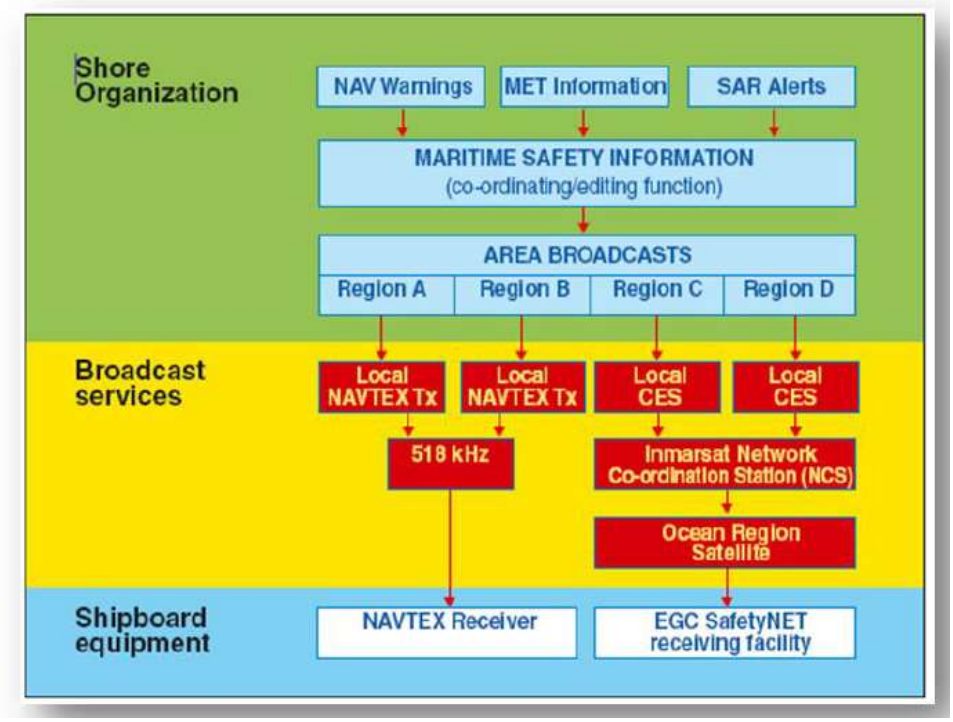
Example NAVTEX coverage areas of transmission

Responsibilities of a NAVTEX Co-ordinator

The NAVTEX Co-ordinator is responsible for the messages transmitted by each station under his control. This responsibility includes checking that the content of each message is in accordance with the international regulations and that it is relevant to the NAVTEX service area of the transmitting station.

Messages

The national providers forward an MSI to a responsible NAVTEX co-ordinator in order to transmit the message via one or more NAVTEX stations within his Navarea.



MSI information line

The NAVTEX co-ordinator decides whether a message belongs to the priority vital, important or routine

- VITAL priority messages – Messages assessed as VITAL, are to be broadcast immediately, subject to avoiding interference to on-going transmissions. On receipt of a message with a VITAL priority, the NAVTEX Co-ordinator will commence monitoring the NAVTEX frequency. If the frequency is clear, the VITAL message is to be transmitted immediately. If the frequency is in use, the Co-ordinator shall contact the station which, according to the schedule, will be transmitting during the following time slot and ask it to postpone their transmission start by one minute, to allow a space for the VITAL message. Once the VITAL message has been transmitted, the scheduled station is free to start its routine transmissions;

  Example: SAR information, Tsunami warnings etc. = VITAL priority

- IMPORTANT priority messages – Messages assessed as IMPORTANT, are to be broadcast during the next available period when the NAVTEX frequency is unused. This is to be identified by monitoring the frequency. It is expected that this level of priority will be sufficient for the majority of urgent information.

  Example: Meteorological warnings = IMPORTANT priority and

- ROUTINE priority messages – Messages assessed as ROUTINE, are to be broadcast at the next scheduled transmission time. This level of priority will be appropriate for almost all messages broadcast on NAVTEX and are always to be used unless special circumstances dictate the use of the procedures for an IMPORTANT or VITAL priority message.

  Example: Meteorological forecasts = ROUTINE priority

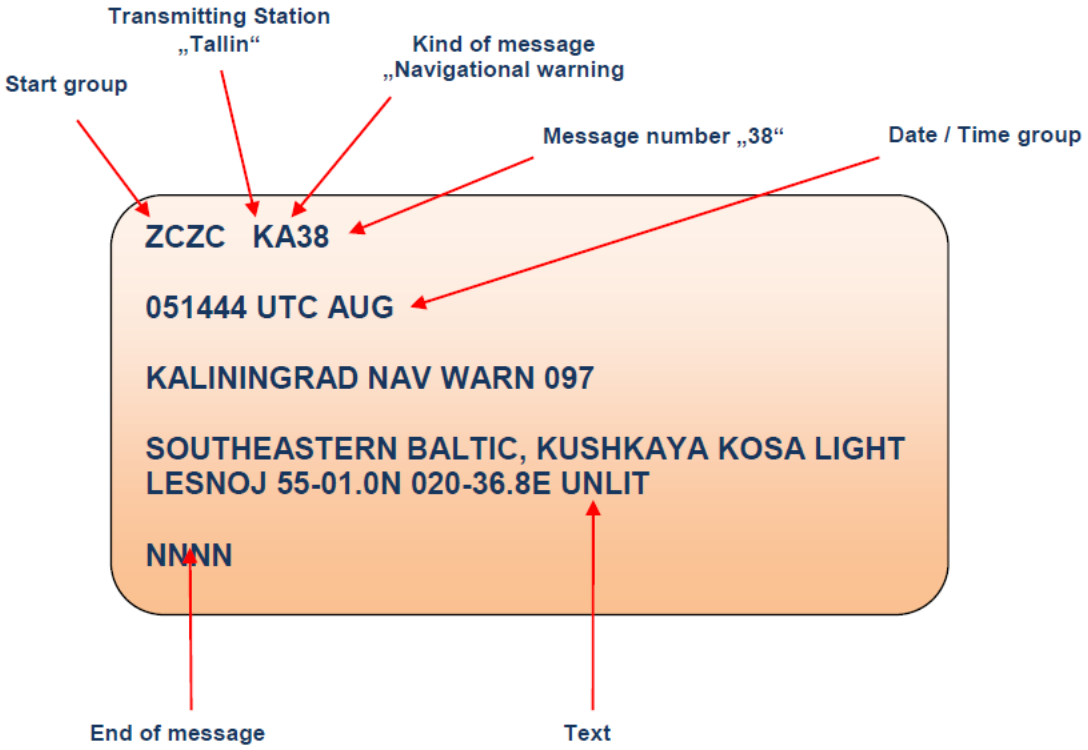
NAVTEX messages include instructions to the NAVTEX receiver for processing MSI. These instructions consist of four technical "B" characters which make up an alphanumeric code as follows:

- B1 Transmitter Identification Character: The transmitter identification character is a single letter which is allocated to each transmitter. It is used to identify the broadcasts which are to be accepted by the receiver and those to be rejected, and also the time slot for the transmission.
- B2 Subject Indicator Character: Information is grouped by subject in the NAVTEX broadcast and each subject group is allocated a B2 subject indicator character. The subject indicator character is used by the receiver to identify the different classes of messages as listed in Table 24. Messages received which have been transmitted using subject indicator character D will set off an alarm built into the NAVTEX receiver.
- B3B4 Message Numbering Characters: Each message within each subject group is allocated a two digit sequential serial number, beginning at 01 and ending at 99. The B3B4 message numbering characters together, are often referred to as the "NAVTEX number". The NAVTEX number is solely allocated as a component of the NAVTEX message identity and should not be confused with (and bears no correlation to), the series identity and consecutive number of the Navarea or Coastal warning contained in the message.

B_1 Transmitter Identification Character	B_2 Subject Indicator Character	B_3 B_4 Message Numbering Characters
1 letter	1 letter	2 digits
A to X	A = Navigational warnings	01 to 99 (message numbering characters "00" are not to be used for routine messages)
	B = Meteorological warnings	
	C = Ice reports	
	D[12] = Search and rescue information, acts of piracy warnings, tsunamis and other natural phenomena	
	E = Meteorological forecasts	
	F = Pilot and VTS service messages	
	G = AIS service messages (non navigational aid)	
	H = LORAN messages	
	I = currently not used	
	J = GNSS messages	
	K = Other electronic navigational aid system messages	
	L = Other Navigational warnings – additional to B_2 character A[13]	
	M = N = O = P = Q = R = S = T = U = currently not used	
	V = W = X = Y = Special services allocation by the IMO NAVTEX Co-ordinating Panel	
	Z = No messages on hand	

Codes for message types

The NAVTEX message below is an example for a typical NAVTEX reception. The navigational warning (A) was transmitted in the Navarea I by the NAVTEX station Tallinn (K).



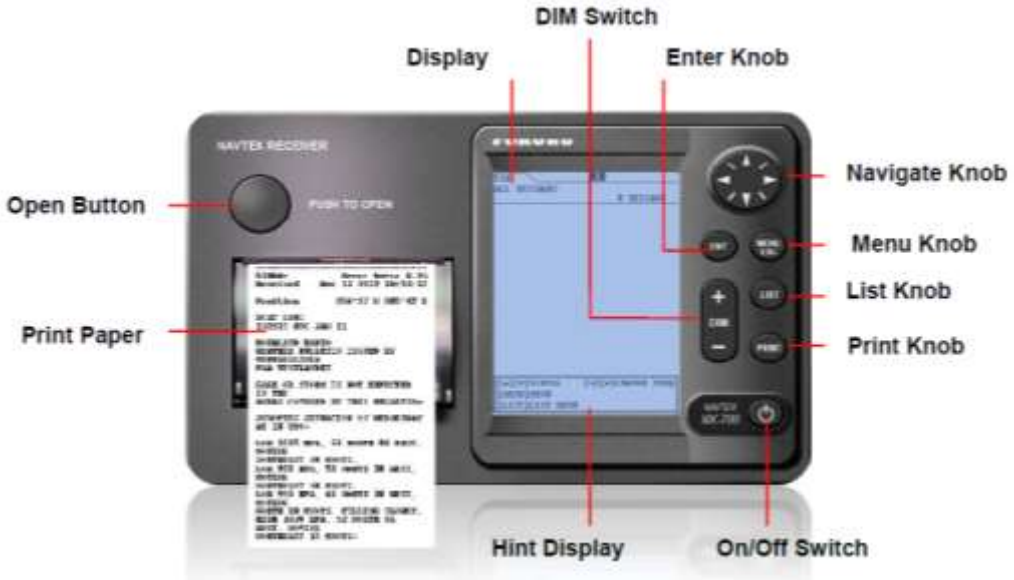
Example of a navigational warning via NAVTEX

Operation of the NAVTEX receiver

A dedicated NAVTEX receiver comprises a radio receiver, a signal processor and a printing device. Optionally the NAVTEX equipment can additionally include:

- an integrated printing device; or
- a dedicated display device with a printer output port and a message memory; or
- a connection to an integrated navigation system and a message memory, which has the ability to select messages to be printed, or viewed and stored in a memory.

The operational and technical characteristics of the NAVTEX system are contained in relevant ITU Recommendation. Performance standards for ship borne equipment are laid down in relevant IMO Resolutions.



NAVTEX receiver

- **On/Off Switch** – push turns the power on or off
- **Menu Button** – Opens menu/Returns to the previous display
- **Nav Button** – Shifts the cursor and display; selects items on menus
- **Enter Button** – Selects a shown item
- **List Button** – Opens the LIST options
- **Print Button** – Opens the PRINT option
- **Display** – Indicates particulars of a received message
- **Hint Display** – Indicates menu functions
- **Dim Switch** – Adjusts the panel and LCD dimmer (+: raises the setting -: decreases the setting)
- **Print Paper** – Received message will be printed out on the print paper
- **Open Button** – Push to replace the paper roll

Selection of transmitters, message type

Reception of messages, transmitted using subject indicator characters A, B, D and L, which have been allocated for navigational warnings, meteorological warnings, search and rescue information, acts of piracy warnings, tsunamis and other natural phenomena, is mandatory and cannot be rejected on the NAVTEX receiver. This has been designed to ensure that ships using NAVTEX always receive the most vital information.

Some subject indicator characters can be used to reject messages concerning certain subjects which may not be required by the ship (e.g. LORAN messages may be rejected by deselecting the B2 subject indicator character H on the NAVTEX receiver on board a ship which is not fitted with a LORAN receiver).

A user may choose to accept messages, as appropriate, either from the single transmitter which serves the sea area around his position or from a number of transmitters. Ideally, the user should select the station within whose coverage area his vessel is currently operating and the station into whose coverage area his vessel will transit next.

- **EGC**

As the NAVTEX system covers coastal waters up to about 400 nautical miles only, shipping must be enabled to receive MSI beyond the NAVTEX coverage. One of these systems is the EGC.

The EGC system supports two services for selective reception:

- The **EGC SafetyNET service**, which allows the EGC receiver operator to program the receiver with the geographical areas for which MSI will be received, and the categories of MSI messages required
- The **EGC FleetNET service**, a commercial service, where individual EGC receivers are programmed to store an *EGC network Identification* (ENID) code, which is used to select only messages intended for ships belonging to a group, such as a fleet or national flag, or subscribers to an information service.

EGC receivers can be programmed individually to use this information to select only the required messages, and to reject all others. In the sea area A4 an EGC reception is impossible because the satellite propagation is hinder by the earth curvature.

Navareas / Metareas within the sea area A4 will be supplied with MSI by HF radiotelephony or radiotelex via a coast station.

Geographic area messages and Inmarsat system messages

The following is a list of the different types of MSI which can received with EGC receivers:

- All ships (general call)
- Navarea / Metarea warnings, MET forecast or Piracy warnings to Navarea or Metarea
- Navigational, Meteorological or Piracy warnings to a circular or rectangular area
- Search and Rescue coordination to ships to a circular or rectangular area
- Shore-to-ship distress alerts to a circular area
- Coastal warnings include the following type of messages
- Navigational warnings
- Meteorological warnings
- Ice reports
- Search and rescue information, acts of piracy warnings, tsunami and other natural phenomena
- Meteorological forecasts
- Pilot and VTS service messages
- AIS service messages (non navigational aid)
- LORAN system messages
- GNSS messages
- Other electronic navigational aid messages
- Other Navigational warnings (additional to Navigational warnings)
- No messages on hand

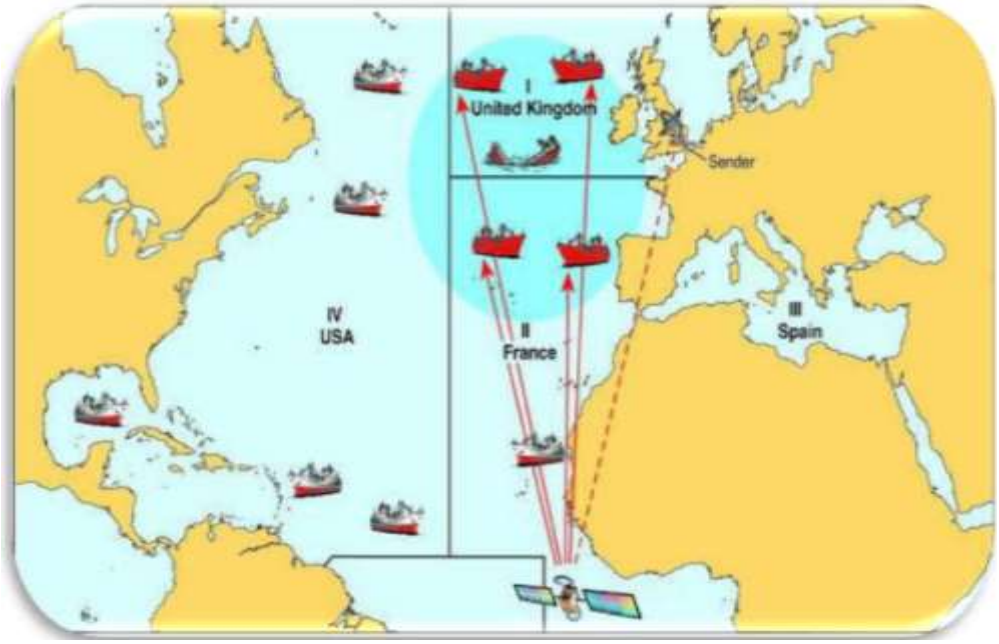
To avoid excessive duplication of broadcasts, the IMO has authorized the following arrangements:

- For a given Navarea 7 Metarea or other area, which is covered by more than one Ocean Region satellite, scheduled broadcasts of MSI, such as navigational warnings and meteorological information, are made only via a single nominated satellite/Ocean Region.
- For a Navarea / Metarea or other area, which is covered by more than one Ocean Region satellite, unscheduled broadcasts of MSI, such as gale warnings, distress alert relays, search and rescue coordination are made via all satellites/Ocean Regions which cover the area concerned.

SafetyNET offers the ability to address MSI to a given geographical area. The area may be fixed, as IMO defined Navareas and Metareas coastal warning area or it may be a user defined circular or rectangular area. MSI is submitted for broadcast using three priorities:

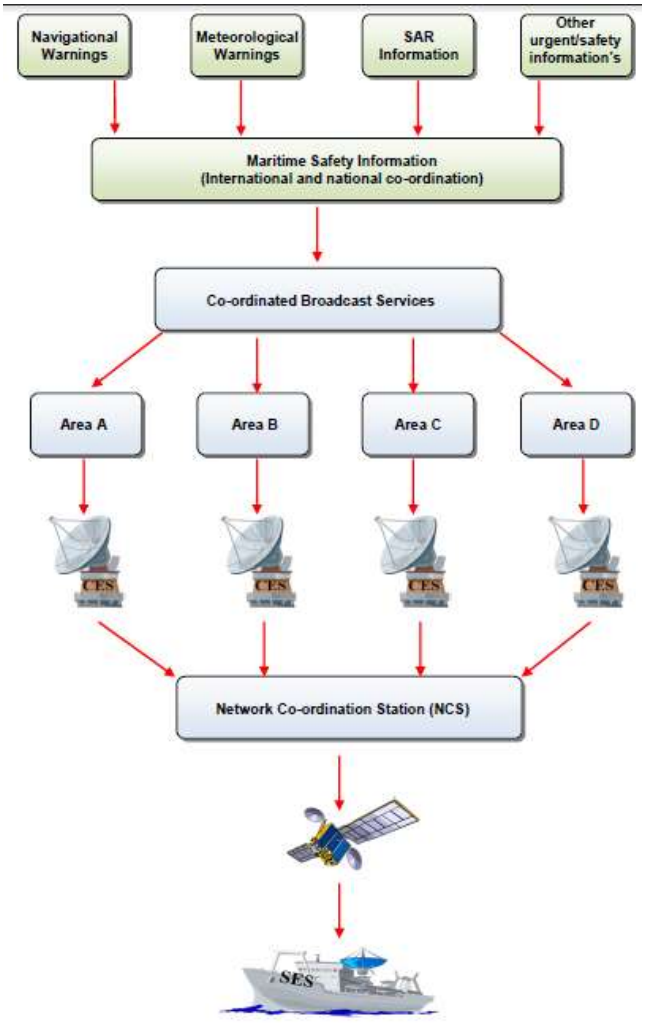
- Safety – Priority 1,
- Urgency – Priority 2
- Distress- Priority 3

Aboard ships MSI messages are received by Inmarsat-C and mini-C type- approved maritime terminals with EGC SafetyNET capability as illustrated below



Geographical EGC transmission

Information providers authorized to broadcast messages (MSI) through a CES and NCS to SESs which are equipped with an EGC receive capability as illustrated below:



The text below shows a typical **safety message** broadcasted via Inmarsat-C EGC:

LES 102 - MSG 7698 - MetWarn/Fore Safety Call to Area: 1 - PosOK

STRATOS CSAT 81.148.5.74 1-MAY-2011 05:44:00 606085
NAVAREA ONE 044
ENGLAND, EAST COAST
Thames Estuary.
Chart BA 1975.
Black Deep light-buoy moved to 51-47.79N 001-36.31E.

EGC navigational warning

The text below shows a typical **urgent message** broadcasted via Inmarsat-C EGC:

LES 112 - MSG 1140 - MetWarn/Fore Urgent Call to Area: 5 - PosOK

NL BURUM LES 28-MAY-2011 15:36:29 831346
WARNING NR 074/2011
ROUGH SEA WARNING
ISSUED AT 1500 GMT - MON - 28/FEB/2011
SOUTH OCEANIC AREA S OF 30S AND E OF 035W STARTING AT 010000 GMT. WAVES FM NE/NW BECOMING SW/SE 3.0/4.0 METERS.
VALID UNTIL 020600 GMT.

EGC weather information

The text below shows a typical **Distress Relay** broadcasted via Inmarsat-C EGC:

LES 105 - MSG 5966 - SAR Distress Call to Area: 35+36 N 11+14 E – PosOK

FM MRCC ROME - ITALIAN COAST GUARD

TO ALL SHIPS TRANSITING IN SICILY CHANNEL

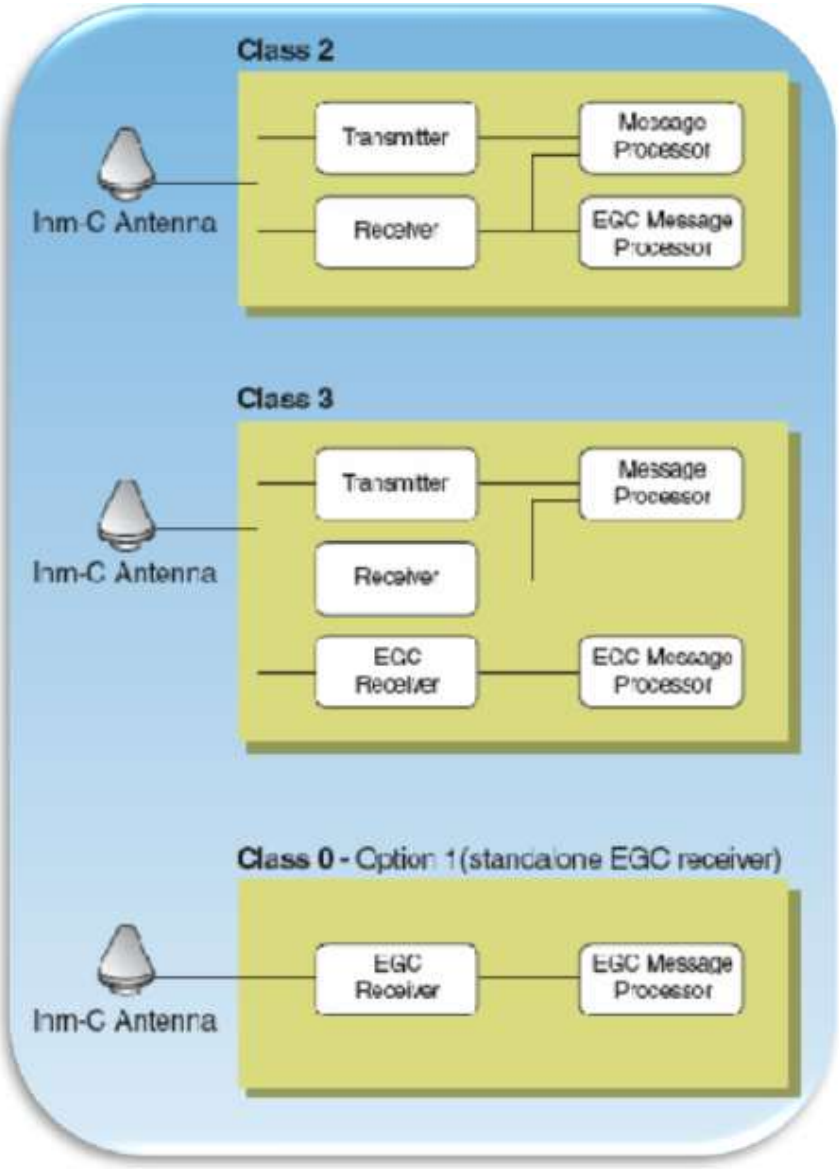
IN ORDER TO PROTECT THE HUMAN LIFE AT SEA, YOU ARE KINDLY REQUESTED TO KEEP A SHARP LOOKOUT AND TO REPORT ANY SIGHTINGS OF BOATS WITH MIGRANTS ON BOARD TO MRCC ROME AT FOLLOWING NUMBERS:

PHONE: 0039 06 59084527 / 59084409
FAX: 0039 06 5922737 / 59084793
INM-C: 424744220
EMAIL: ufficio3.reparto3@mit.gov.it

EGC SAR information

Classes of Inmarsat-C receiver types

EGC SafetyNET (and FleetNET) broadcasts are received using Inmarsat-C or Inmarsat mini-C maritime terminals of different classes. Class 2 and 3 models provide EGC capability in addition to shore-to-ship and ship-to-shore messaging capability; class 0 are stand-alone EGC receivers only.

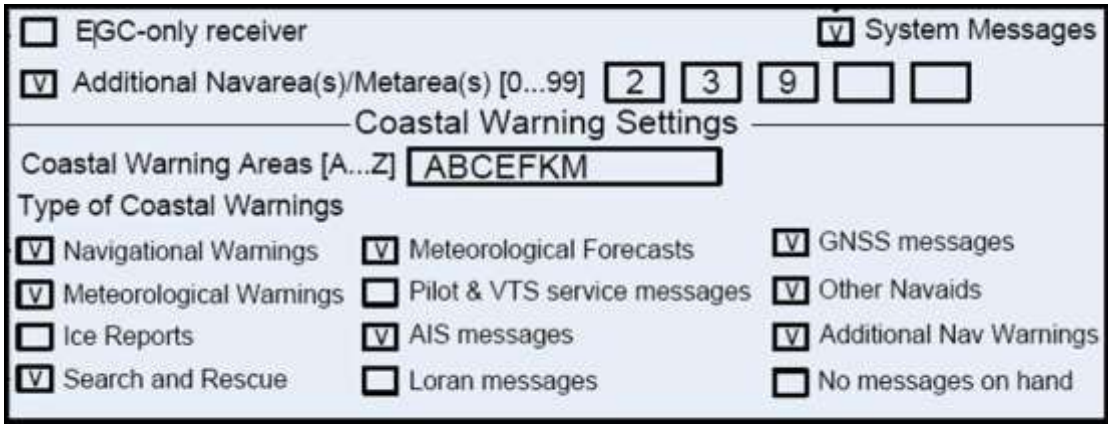


Example of different Inmarsat-C classes

EGC setup

The EGC setup window shown below shows that additional Navareas / Metareas 2, 3 and 9 and Coastal warning areas A, B, C, E, F, K, M are selected to receive MSI. To be sure that this information will be received, it is necessary to check that the terminal is logged in to the nominated satellite.

System Messages options is used to set up the terminal to receive Inmarsat "System" type EGC messages giving information about Inmarsat systems, planned outages, new services, etc.



Inmarsat-C EGC set up window

- MSI via VHF/MF/HF

Maritime safety information is information that is necessary for the safety of navigation. This information includes SAR information, meteorological and navigational warnings as well as weather forecasts and weather analyses and charts.

Coast stations may transmit MSI using radiotelex in the FEC mode on the following frequencies:

4210 kHz	16806.5 kHz
6314 kHz	19680.5 kHz
8416 kHz	22376 kHz
12579 kHz	26100.5 kHz

Transmission times are given in the ITU List of Coast Stations and Special Service Stations.

Navigation and weather messages are also transmitted on R/T frequencies at the times indicated in the ITU List of Coast Stations and Special Service Stations and in various national publications.

6.11 The use and functions of portable VHF radio

Maritime VHF handheld

- **On/Off Switch:** To push the On/Off button switch the device on or off
- **Power Knob:** Push this button to switch between Low and high power (1W or 6W)
- **Display:** The display shows the current settings of Channel, Volume, Squelch, Transmitting power, Loudspeaker condition etc.
- **Volume:** Press Volume key and adjust the volume by pressing the navigate buttons up or down
- **Scan Knob:** Press and hold Scan key to scan all channels or set a channel and press and hold scan key
- **Ch16 Switch:** push to select ch 16 as fast as possible
- **Squelch:** Push squelch button to select squelch mode than adjust with navigation buttons
- **Dual Watch:** Press and hold D/W button to select dual watch of selected channel and channel 16.
- **Light Mode:** Backlight on/off and light mode select

Portable maritime VHF handheld radios can be used for two purposes:

- for distress communications between the mother vessel and lifesaving appliances and between lifesaving appliances; and
- for on board communications between the controlling station and slave stations and between slave stations.

Primary emergency batteries are to be stored and sealed for emergency situations and a secondary rechargeable battery must be used only for daily on board communication in the portable VHF transceiver.

6.12 Portable VHF aeronautical radio for 121,5 and 123,1 MHz

Portable VHF aeronautical radio

- **On/Off Switch:** To push the On/Off button switch the device on or off
- **Channel Selector:** Select between two different frequencies (121,5 MHz and 123,1 MHz)
- **121,5 Indicator:** 121,5 MHz indicator LED is on if 121,5 MHz is select by the channel selector
- **Volume:** Adjust volume by pulling the volume adjusting dial. The small screen indicates the level of volume
- **Squelch:** Adjust squelch by rotate the adjusting dial. The small screen indicates the level
- **TX Indicator:** The indicator LED is on while pressing the *Push To Talk* (PTT) button
- **PTT :** Push to talk button. Push if you wish to talk.
- **Microphone:** Speak into the microphone while pushing the PTT
- **Light Mode:** Change Battery Pack by pressing two buttons if the battery is Empty

This portable VHF aero transceiver is a battery operated 200mW carrier AM transceiver for the VHF air band (118-137MHz) covering the two frequencies 121.5MHz and 123.1MHz. The unit is specially designed and manufactured as an emergency two way transceiver for communication with aircrafts and it is part of carriage requirements for passenger vessels.

7. OTHER SYSTEMS USED ON BOARD

7.1. Ultra High Frequency (UHF) handhelds

UHF handhelds are used for on board communications. They are working in the frequency range around 457MHz and 467 MHz. They are especially qualified for communications within the superstructure and between the decks house, the engine room or cargo holds of a vessel.

7.2 Automatic Identification System

AIS is an automatic tracking system used on ships and by VTS identifying and locating vessels by electronically exchanging data with other nearby ships, AIS base stations and satellites.

Information provided by AIS equipment such as unique identification (MMSI), position, course and speed can be displayed on a screen or ECDIS (See figure 122). AIS is intended to assist a vessel`s watch standing and allow officers and maritime authorities to track and monitor vessel movements and to avoid collisions. The ECDIS screen shows several ships (triangles) with their identities (MMSI) and courses.

ECDIS screen with AIS signals

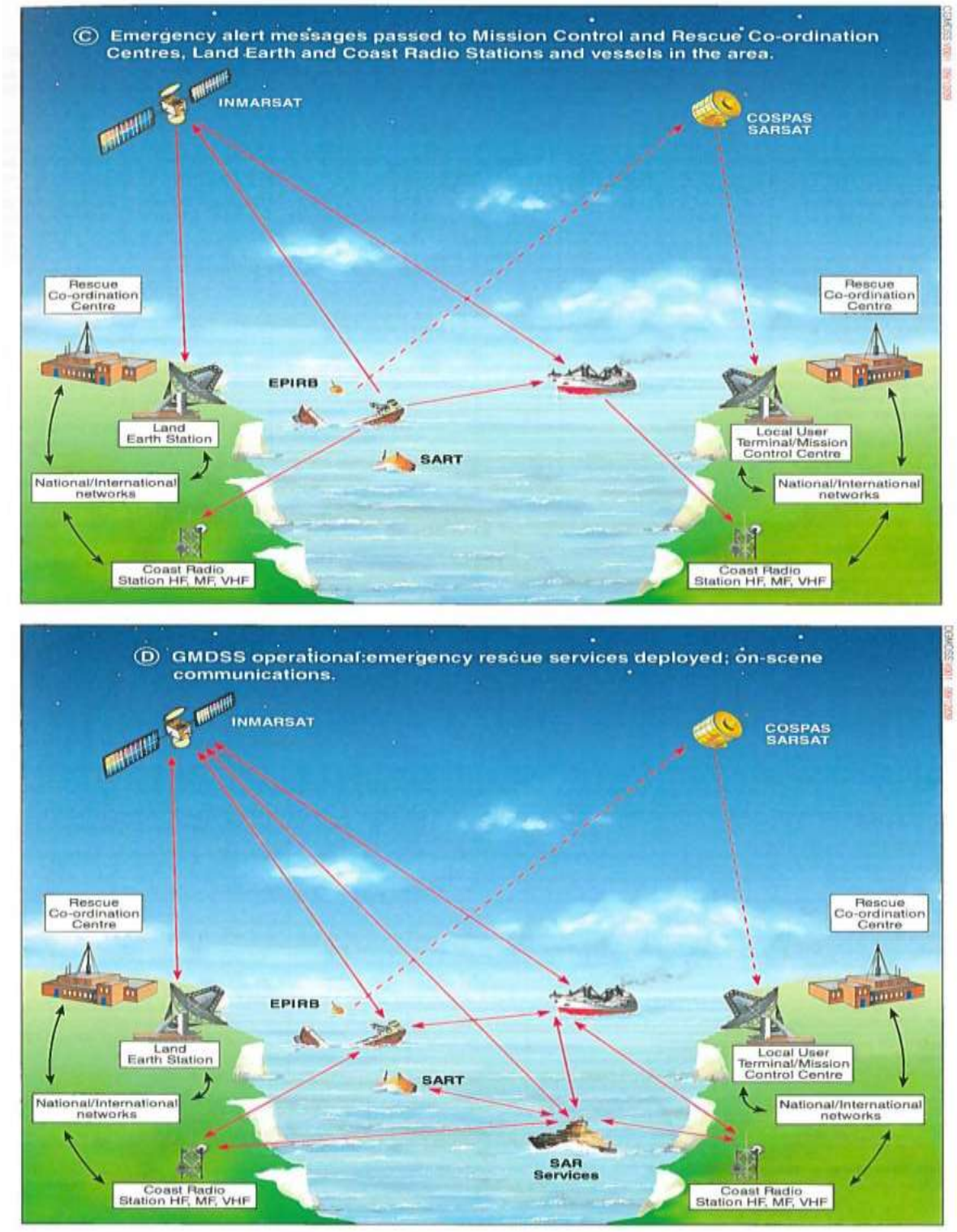
7.3. Ship Security Alert System

The ship security alert system, when activated in case of e.g. piracy or armed attack, shall:

- Initiate and transmit a ship to shore security alert to a competent authority designated by the Administration, which in these circumstances may include the Company, identifying the ship, its location and indicating that the security of the ship is under threat or has been compromised;
- Not send the ship security alert to any other ships;
- Not raise any alarm on-board the ship;
- Continue the ship security alert until deactivated and/or reset

The ship security alert system shall be capable of being activated from the navigation bridge and in at least one other location. The alarm should be send via a reliable and suitable communication system.

8. SEARCH AND RESCUE (SAR) OPERATION



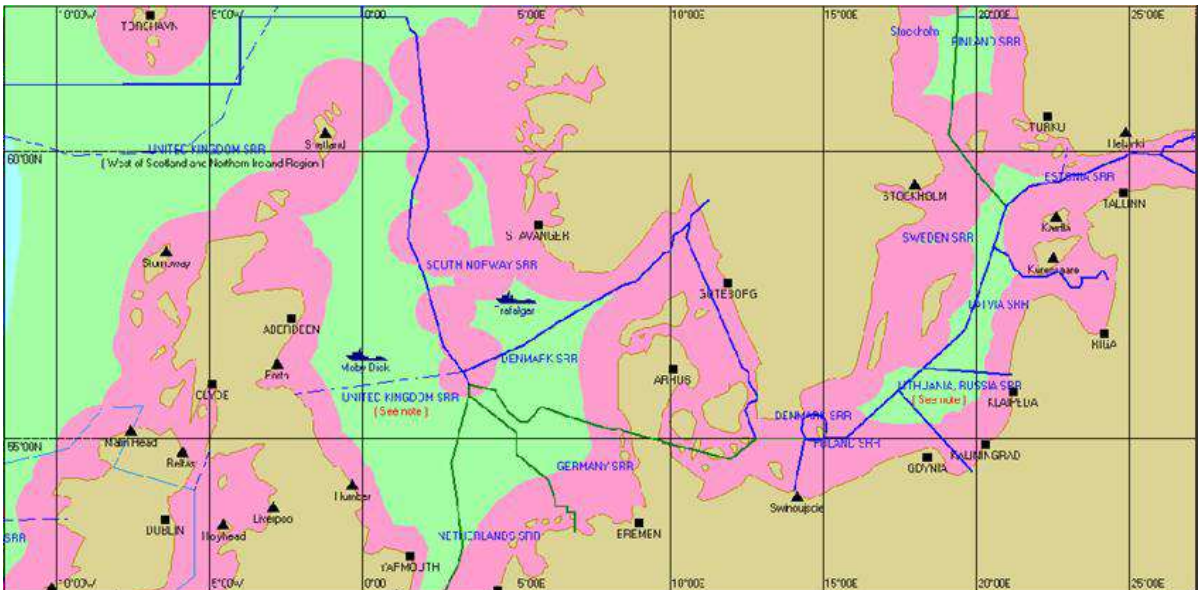
Basic concept of the GMDSS

The *International Civil Aviation Organization* (ICAO) and the IMO coordinate, on a global basis, member states' efforts to provide SAR services.

The aim is to provide an effective worldwide system, so that wherever people sail or fly, SAR services will be available if needed. The overall approach that each state takes in establishing, providing, and improving SAR services is influenced by the fact that these efforts are an integral part of a global SAR system.

8.1 Role of the Maritime Rescue Co-ordination Centre

The SAR Convention (1979) established the need for centres assigned with the task of co-ordinating rescue operations on a regional basis to be known as Maritime Rescue Coordination Centres. Under this Convention, the World's oceans were divided into areas or SAR regions for search and rescue purposes, for which contracting coastal states were to be responsible.



Example of SAR regions

The RCC is an operational facility responsible for conducting an efficient organization of SAR services and for co-ordinating the carrying out of SAR operations within an *Search and Rescue Region* (SRR) SAR action in response to any distress situation is achieved through co-operation among SAR Administrations. The MRCC nearest the distress incident will normally acknowledge the distress alert and assume responsibility for SAR co-ordination. A RCC co-ordinates, but does not necessarily provide SAR facilities throughout the internationally recognized SRR as described in the global SAR plan of the IMO.

Maritime rescue organizations

A search and rescue organization shall be established for the provision of search and rescue services in accordance with the IMO International Convention on Maritime Search and Rescue, 1979, as amended, and the Convention on International Civil Aviation.

The competent national authorities shall be responsible for the provisions of their search and rescue services.

During search and rescue operations, the competent national authorities shall be entitled to call for the collaboration and support of other Government services. Questions of the assignment of costs, connected with the conduct of a search and rescue operations, shall not be allowed to interfere with its prompt and effective execution by the departments in charge.

States being party to the SOLAS Convention, the International Convention on Maritime Search and Rescue, and the Convention on International Civil Aviation, have accepted the obligation to provide aeronautical and maritime SAR coordination services for their territories, territorial seas, and where appropriate, the high seas. SAR services must be available on a 24 hour basis.

To carry out these responsibilities, a State should either establish a national SAR organization, or join one or more other States to form a regional SAR organization. In some areas an effective and practical way to achieve this goal is to develop a regional system associated with a major ocean area and continent.

Maritime SRR's are published in the IMO SAR plan. The purpose of having SRR's is to clearly define who has primary responsibility for co-ordinating responses to distress situations in every area of the world, which is especially important for an automatic routing of distress alerts to responsible RCC's.

Knowledge of SAR systems worldwide

The SAR system, like any other system, has individual components that must work together to provide the overall service. Each SRR is associated with an RCC. The goal of ICAO and IMO conventions relating to SAR is to establish a global SAR system.

Operationally, the global SAR system relies upon States to establish their national SAR system and then co-ordinate provision of their services with other States for Worldwide coverage.

The primary system components are:

- Communications throughout the SRR and with external SAR services
- An RCC for the coordination of SAR services
- If necessary, one or more *Rescue Sub Centre* (RSC) to support an RCC within its SRR
- SAR facilities, including SRU's (SAR Units) with specialized equipment and trained personnel, as well as other resources which can to be used to conduct SAR operations.
- On-Scene Co-ordinator (OSC) assigned, as necessary, for co-ordinating the onscene activities of all participating facilities
- Support facilities that provide service in support of SAR operations

8.2 International Aeronautical and Maritime Search and Rescue (IAMSAR) Manual

ICAO and IMO have jointly developed a manual to foster co-operation between themselves, between neighbouring states and between aeronautical and maritime Authorities on SAR.

There are three volumes of the IAMSAR Manual. These volumes provide guidelines for a common aviation and maritime approach to organizing and providing SAR services.

Each IAMSAR Manual volume is written with specific SAR system duties in mind, and can be used as a stand-alone document, or, in conjunction with the other two volumes, as a means to attain a full view of the SAR system.

The Manual will assist those responsible for establishing, managing, and supporting SAR services to understand the:

- functions and importance of SAR services;
- relationships between global, regional, and national aspects of SAR;
- components and support infrastructure essential for SAR;
- training needed to coordinate, conduct, and support SAR operations,
- communications functions and requirements for SAR; and
- basic principles of managing and improving SAR services to ensure success.

Volume I is the Organization and Management volume and discusses the global SAR system concept, establishment and improvement of national and regional SAR systems, and co-operation with neighbouring States to provide effective and economical SAR services.

Volume II the Mission Co-ordination volume assists personnel who plan and coordinate SAR operations and exercises.

Volume III is the Mobile Facilities volume and is intended to be carried aboard rescue units, aircraft, and vessels to help with performance to search, rescue, or OSC functions, and with aspects of SAR that pertain to their own emergencies.

9. ROLE AND METHOD OF USE OF SHIP REPORTING SYSTEMS

Various states have implemented ship reporting systems. A ship reporting system enables the *Search and Rescue Mission Co-ordinator* (SMC) to quickly know the approximate positions, courses and speeds of vessels in the vicinity of a distress situation by means of a *Surface Picture* (SURPIC), and other information about the vessel which may be valuable, e.g., whether a doctor is aboard, know how to contact the vessels, improve possibility for rapid aid during emergencies, reduce the number of calls for assistance to vessels unfavorably located to respond and reduce the response time to provide assistance.

Masters of vessels should be encouraged to send regular reports to the Authority operating a ship reporting system for SAR. Ships are a key SAR resource for RCCs, the reporting systems enable them to quickly identify the capable vessel which will be least harmed by a diversion, enabling other vessels in the vicinity to be unaffected.

A list of many of the ship reporting systems is listed in the IAMSAR Manual Vol II.

9.1 Automated Mutual-assistance Vessel Rescue System (AMVER)

AMVER is a worldwide system operated exclusively to support SAR and make information available to all RCCs.

The AMVER System has been implemented in the US since 1958, it is operated by the United States Coast Guard and it provides important aid to the development and co-ordination of Search and Rescue efforts. On demand, the SAR authorities are quickly informed on the position and characteristics of vessels near a reported distress situation.

AMVER's greatest use is in providing SURPIC's to RCC's. A SURPIC either lists latitude/longitude or provides a graphical display of vessels near the position of a distress situation.

Merchant vessels of 1000 gross tons or more on any voyage of greater than 24 hours should participate. In general, international participation is voluntary regardless of owner's nationality or vessels flag, voyage origin, or destination.

To register and participate in AMVER "ships" have to complete the SAR(Q)form:
http://www.amver.com/sarqform.asp.

AMVER participants will note the basic format for AMVER reports corresponds to the IMO standard.

There are four types of AMVER reports:

- **Sailing Plan** (AMVER/SP//) – The Sailing Plan contains complete routing information and should be sent within a few hours before, upon, or within a few hours after departure.
- **Position Report** (AMVER/PR//) – The Position Report should be sent within 24 hours of departure and subsequently at least every 48 hours until arrival. The destination should be included.
- **Deviation Report** (AMVER/DR//) – The Deviation Report should be sent as soon as any voyage information changes, which could affect AMVER's ability to accurately predict the vessel's position. Changes in course or speed due to weather, ice, change in destination, or any other deviations from the original Sailing Plan should be reported as soon as possible.
- **Arrival Report** (AMVER/FR//) – The Arrival report should be sent upon arrival at the sea buoy or port of destination.

Reporting Format
Each AMVER message consists of report lines. There are 15 types of lines. The first line begins with the word "AMVER" followed by a slash (/), a two letter code identifies the report type and ends with a double slash (//), as shown below.

Each remaining line begins with a specific letter followed by a slash to identify the line type. The remainder of each line contains one or more date fields separated by single slashes. Each line ends with a double slash.

All reports should end with an end-of-report (Z) line. This Z-line has been new added to facilitate automatic processing of AMVER reports, because the information required for position and Deviation Reports has been increased, as recommended by numerous participants, to ensure enough information is provided to keep AMVER accurate.

Example for a Sailing Report:

AMVER/SP//	
A/SANDY JOAN/KGJF//	A/vessels name/radio call sign//
B/240635Z MAR//	B/date and time//
E/045//	E/current course //
F/198//	F/estimated average speed//
G/TOKYO/3536N/13946E//	G/port of departure/lat/long//
I/LOS ANGELES/3343N/11817W/031300Z APR//	I/destination/lat/long/eta//
L/GC/210/4200N/18000E/280400Z//	L/route information lines//
L/RL/200/4200N/16000W/300030Z//	
L/RL/161//	
M/JCS//	M/current coastal radio station or satellite number
V/MD/NURSE//	V/onboard medical resources//
X/NEXT REPORT 250800Z//	X/up to 65 characters of amplifying comments
Y/JASREP/MAREP//	Y/relay instructions//
Z/EOR//	Z/end of report//

The lines M,V,X and Y are optional items, Y line is required for US vessels.

Transmission of messages

The following methods are recommended for ships to transmit AMVER reports:

- E-mail: If a ship already has an inexpensive means of sending electronic mail to an internet address, this is a preferred method. The messages may be sent to: amvermsg@amver.org or amvermsg@amver.com .The e-mail path on shore to the AMVER center is free, but the communications service provider may still charge from ship to shore.

- AMVER/SEAS "Compressed Message" via INMARSAT-C via Telenor:
  - Ships must be equipped with INMARSAT-C transceiver with floppy drive and capability to transmit a binary file.
  - Ships must have an IBM-compatible computer with an interface between the computer and the INMARSAT transceiver.

  The AMVER/SEAS Software can be downloaded free of charge from the internet at: http://seas.amverseas.noaa.gov/seas

  The AMVER address is: *National Oceanic and Atmospheric Administration* (NOAA), the phone number must be entered in the address book of the INMASRSAT-C transceiver.

  Ships that meet the system requirements may send combined AMVER/Weather observation messages free of charge via Telenor Land Earth Stations at: 001 (Southbury) AORW, 101 (Southbury)–AORE, 201 (Santa Paula)-POR, 321 (Aussaguel) IOR.

- HF Radio-telex Service of USCG Communication Stations: Information how to send AMVER messages this way can be found at: http://www.navcen.uscg.gov/marcomms/cgcomms/call.htm

  HF Radio at no cost via USCG contractual agreements with the following companies:
  Mobile marine radio (WLO)
  Mobile (WCL)
  Marina Del Ray (KNN) Seattle (KLB)

  Telex:
  AMVER Address: (0) (230) 127594 AMVERNYK
  AMVER reports may be filed via telex using either satellite (code 43) or HF radio.
  Ships must pay the tariffs for satellite communications.

– **Fax:** Fax number to the USCG Operations System Center (OSC) in Martinsburg, West Virginia: (01) (304) 264-2505. Stations which accept AMVER messages are listed, e.g., in Admiralty List of Radio Signals Vol 1.

Further information on the AMVER program may be obtained from:

United States Coast Guard
AMVER Maritime Relations Office
USCG Battery Park Building
1 South Street 2. Floor
New York, NY 10004-1499
U.S.A.
Tel: +1 212 668-7764
Fax: (212)668-7684
Telex: 127594 AMVERNYK
Mail:benjamin.m.strong@uscg.mil

9.2 Japanese Ship Reporting System (JASREP)

The JASREP System provides up-to-date information on the movements of vessels in order, in the event of a distress incident:

- to reduce interval between the loss of contact with a vessel and the initiation of search and rescue operations in cases where no distress signal has been received;
- to permit rapid determination may be called upon to provide of vessels which can assist;
- to permit delineation of a search area of limited size in case the position of a vessel in distress is unknown or uncertain; and
- to facilitate the provision of urgent medical assistance or advice to vessels not carrying a doctor.

The JASREP is compatible with the AMVER system with which the Japan Coast Guard co-operate in information exchange on the ships positions for search and rescue purposes.

Any ship regardless of tonnage, flag or type may participate in the JASREP System as far as she is within the service area. The approximate service area is the sea enclosed by the parallel of latitude 17° N and the meridian of longitude 165° E The participation is voluntary.

There are four types of JASREP reports:

- Sailing plan
- Position report
- Deviation report
- Final report

The formats of the reports are nearly the same as described above with AMVER. Participation in this system initiates when a ship sends her sailing plan and terminates when the ship sends her final report to Japan Coast Guard.

If no position report or final report is received from a participant in no less than 27 hours subsequently the previous port, Japan Coast Guard will verify the safety.

Depending on circumstances, SAR operations will be initiated and hence position reports and final reports must be sent without fail.

Reports should be sent to a Japanese coast station. These stations may be called on VHF or 2189,5 KHz (DSC), other means such as telex or Email may be used.

9.3 Modernized Australian Ship Tracking and Reporting System (MASTREP)

The Modernized Australian Ship Tracking and Reporting System (MASTREP) as described in Marine Order 63 Vessel Reporting Systems, effective 1 January 2016, is used to track the location of vessels. Under this system:

- Positional reporting for vessels is sourced from the vessel's Automatic Identification System (AIS);
- Sailing Plans, Deviation Reports and Final Reports are not required;
- Communications with vessels continue to be available through Inmarsat, HF, satellite telephony and other means;
- Special Reports are required to support AMSA's role in shipping oversight and incident reporting management.

MASTREP is operated by the Australian Maritime Safety Authority (AMSA) as part of the services offered by the Joint Rescue Coordination Centre (JRCC Australia). JRCC Australia is staffed 24 hours per day.

MASTREP is designed to minimize the reporting requirements on vessels using International Marine Organization (IMO) mandated AIS technology to provide positional advice to AMSA. It:

- increases the timeliness and accuracy of data collected from a much larger number of vessels plying the waters within the Australian Search and Rescue Region (SRR);
- provides AMSA with the capability to significantly improve its pollution, marine casualty and search and rescue (SAR) incident responses through faster and more effective management of incidents and resources; and
- ensures that only the closest vessels will be requested to assist in a SAR incident reducing the need for vessels to steam long distances from their intended voyage plan.

MASTREP uses Position Reports, which must be transmitted by AIS in accordance with the International Convention for the Safety of Life at Sea (SOLAS), Chapter 5, Regulation 19.2.4. Position Reports must include the following information:

- Identity
- Type
- Position
- Course
- Speed
- Navigational status; vii. safety related information

The Master of a vessel must report any malfunction of the vessel's AIS equipment to JRCC Australia in accordance with Section 186 of the Navigation Act 2012.

Marine Order 63 makes the provision of Position Reports mandatory for:

- foreign vessels from the arrival at its first port in Australia until its departure from its final port in Australia; and
- all regulated Australian vessels whilst in the MASTREP area.

Domestic commercial vessels fitted with Global Maritime Distress and Safety System (GMDSS) and AIS technology are also encouraged to participate in the system as MASTREP assists AMSA in carrying out SAR activities

Marine Order 63 states the requirements to report to REEFVTS. Participation in MASTREP does not remove the continued obligation of mandatory reporting to REEFVTS. Further information on the system is published in the Great Barrier Reef & Torres Strait Vessel Traffic Service (REEFVTS) User Guide which can be obtained from AMSA's website: www.amsa.gov.au.

All Marine Incidents are to be reported to AMSA using form 'AMSA 18' and form 'AMSA 19'. Copies of these forms can be obtained from the AMSA website www.amsa.gov.au. Examples of incidents include the loss, death or serious injury of a person, the loss of or damage to a vessel, equipment failure, a collision or a pollution event. Reports should be made in accordance to the requirements of the Navigation Act 2012, Marine Orders, and the Occupational Health and Safety (Maritime Industry) Act 1993, as applicable.

Masters wishing to send information to JRCC Australia or the Maritime Assistance Service, other than that which is mandated to be reported under the relevant legislation identified in the Marine Incident Reporting section, should complete an Information Report using the standard international ship reporting format as set out IMO Resolution A.851 (20)*. Examples of non-mandatory reports include notification of navigational hazards, vessel defects or deficiencies, or other limitations which could adversely affect navigation.

Special Report Types include those for Dangerous Goods (DG), Harmful Substances (HS), and Marine Pollutants (MP). Special Reports should follow the guidelines for reporting as set out in IMO Resolution A.851 (20), as amended by IMO Resolution MEPC.138 (53).

9.4 Long Range Identification and Tracking of Ships (LRIT)

In May 2006, the IMO adopted resolutions of the 81st Maritime safety Committee which made amendments to the SOLAS 74 and introduced the establishment of the Long Range Identification and Tracking System for reasons related to national security.

The main purpose of the LRIT ship position reports is to enable a contracting Government to obtain ship identity and location information in sufficient time to evaluate the security risk. The LRIT system is mandatory since 31st December 2008 for all passenger ships, cargo ships of over 300 gross tonnes, high speed crafts and mobile offshore drilling units.

The LRIT system consists of:

- Satellite communication equipment already installed on board ship
- Communications service providers (CSP)
- Application service providers (ASP)
- LRIT data centres
- LRIT distribution plan
- International LRIT data exchange

A ship in transit sends a position report via its shipborne equipment (Inmarsat-C, D+, Iridium or HF). The message includes the shipborne equipment identifier, positional data latitude and longitude, and the date and time of the transmission and must be sent 4 times a day (every 6 hours). The frequency of messages can be changed to a maximum of once every 15 minutes through a user request.

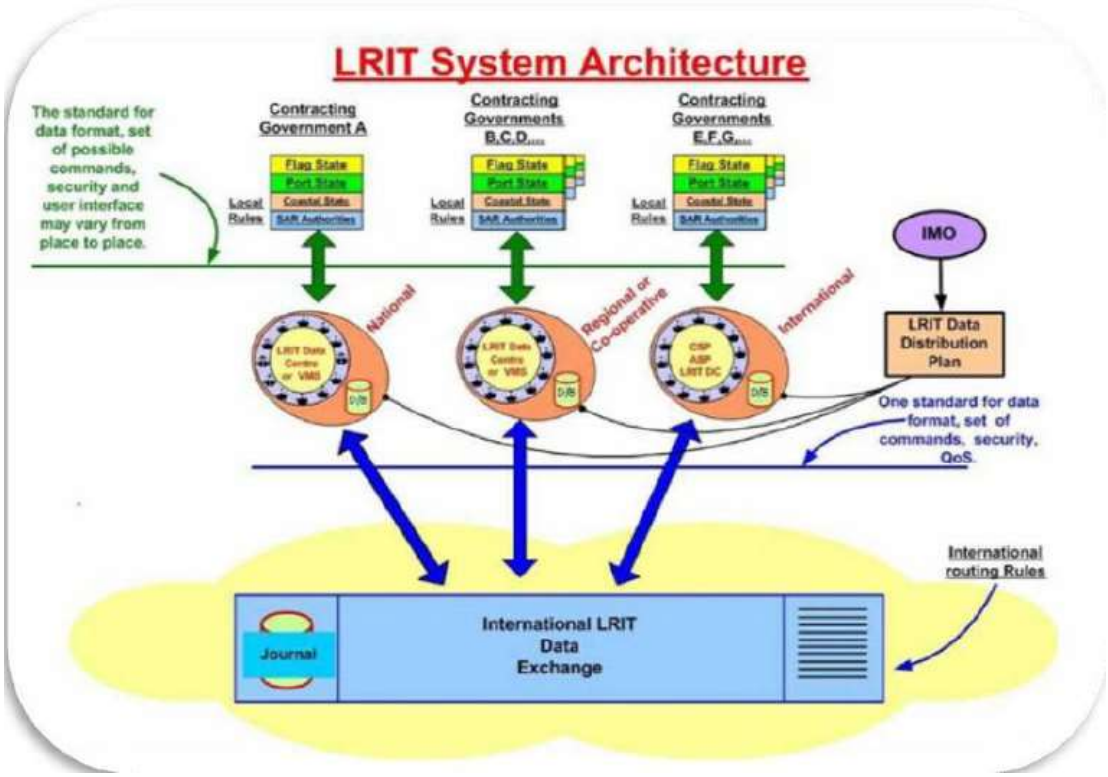
The CSP operates the satellites and the communication infrastructure and services to link the various parts of the LRIT system, using communication protocols in order to ensure the end-to-end secure transfer of the LRIT information.

The data is then transmitted to the ASP.

The ASP completes the LRIT information of the vessel by adding the ship identity (IMO and MMSI number) as well as the date and time the position report is received and forwarded by the ASP.

The extended message is then passed to a LRIT Data Centre. These centres are a system of National, Regional and Cooperative LRIT Data Centres, they collect and distribute data to Contacting Governments and Search and Rescue services according to the Data Distribution Plan, which defines rules and rights for access (which users can receive which information).

The Data Centres interact with the LRIT International Data exchange. Each administration should provide to the LRIT Data Centre it has selected, a list of the ships entitled to fly its flag, which are required to transmit LRIT information, together with other salient details and should update such lists when changes occur (see Figure 125) Ships should only transmit the LRIT information to the Data Centre selected by their administration.



LRIT system

10. MISCELLANEOUS SKILLS AND OPERATIONAL PROCEDURES FOR GENERAL COMMUNICATIONS

10.1. Use of English in written and oral form for safety communications

It is recommended to use the English language to ensure a sufficient standard communication. It is very important that distress-, urgency- and safety traffic have to be conducted in English so that everybody involved receiving this information can understand it correctly.

- Use of the IMO Standard Marine Communication Phrases

The IMO has published in its "Standard Marine Communication Phrases" special phrases for different events to ensure that crew members involved understand the meaning of such phrases how they are really meant.

- Use of the International Code of Signals

If there is the risk that the standard communication phrases are not correctly understood, the IMO *International Code of Signals* (INTERCO) can be consulted to bridge those difficulties. In case of phrases the code of signal uses codes consisting of one or more code groups of one or more letters followed by a figure describing a special situation. The use of the code of signals has to be announced by the word INTERCO

Example:

Code	Meaning
RB	I am dragging my anchor
RS	No- one is allowed on board

- Recognition of standard abbreviations and commonly used service codes (Q-Code)

Certain situations in the traffic exchange can be expressed by so called "Q-codes", consisting of three letters beginning with the letter "Q" which can be used as a question or a statement. The Q-codes are defined in the RRs and can additionally be found in appendix 6.

Example:

Q-Code	Question	Statement
QTH	What is your position?	My position is
QRV	Are you ready (to communicate)?	I am ready (to communicate)

- Use of the International Phonetic Alphabet

In radio telephony difficult words, proper names and code and figure groups have to be spelled in accordance with the International Phonetic Alphabet, which is defined in the RRs and can be found in Appendix 5.

10.2. Procedure of traffic charging

- International charging and accounting system

All public correspondence connected through terrestrial circuits or through satellite networks must be charged for. Charges for calls via coast stations can be found in the ITU List of Coast Stations or can be asked after finishing traffic exchange with a coast station

Terrestrial charges may comprise:

- Land-line charge
- Coast station Charge (CC)
- Ship charge
- Any charges for special services
- Any local taxes e.g., Value Added Tax (VAT)

In general, operator-connected calls have mostly a minimum 3 minutes charge and 1 minute incremental steps thereafter while automatic telephone and telex calls are cheaper because no operator is involved.

A number of companies provide radio traffic accounting services worldwide. Shipping companies that want to take part in an unlimited public correspondence need to conclude an appropriate contract with one of the authorised accounting companies. It is the task of an accounting authority to guarantee that the institutions involved in the exchange of radio traffic get the charges they require.

- AAIC code and its use

The AAIC designates a certain authorised accounting authority. Before transmitting chargeable radio traffic the ship station has to inform the coast station uncalled of its AAIC so that the administration will know which institution is responsible for accounting.

- Coast station-, landline and ship station charge

The total amount of chargeable radio communication consist of coast station charge, landline charge, and ship station charge (voluntarily by shipping companies) The coast station charge arises for the chargeable connection between the ship station and the coast station and it is due to the appropriate coast station.

The Land Line charge (LL) arises between the coast station and subscriber ashore and is due to the land line administrations. The ship station charge can arise on request of the ship's owner.

- Currencies used for the account of international radio communications

Different Administrations use different virtual currencies when dealing with radio traffic charges. These currencies are usually the *Special Drawing Right (SDR)* or *Goldfranc* (*Gfr)*.

The purpose of these virtual currencies is to avoid heavy loss or benefits when the exchange rate of a national currency falls or rises.

- Inmarsat communication charging systems

When an SES sends a message or makes a call via a *Coast Earth Station Operator* (CESO), that CESO will invoice the total cost of the call to the company which has been contracted to act as intermediary by the SES owner/shipping company. This intermediary company can be either an accounting authority or an *Inmarsat service provider* (ISP).

If an ISP is selected, the SES operated by the customer is only allowed to use the CESs that have a contract with that ISP in the mobile to fixed direction. In the fixed to mobile direction, all CESs will provide access to all SESs assigned with an ISP billing arrangement.

An Inmarsat ISP is an entity that has established a contract with one or more CESOs to promote and retail the services of the contracted CESO to end users. It can be used as an alternative to an AA for all SESs that are intended solely for commercial use and not to be used for distress and safety purposes. Inmarsat will only accept ISPs that have been authorised by at least one CESO If an AA is selected, the customer is allowed access to all CESs, and AAs are required as a matter of procedure to pay all the CESs where the traffic was generated. Maritime customers who intend to use the CES for distress and safety must select an AA. Inmarsat accepts only those accounting authorities that have been officially notified to the ITU for the country of registration of the SES. Normally each country has an administrative body or licensing authority such as the Ministry of Communications, which approves who can be an Accounting Authority and informs the ITU of whom it has approved.

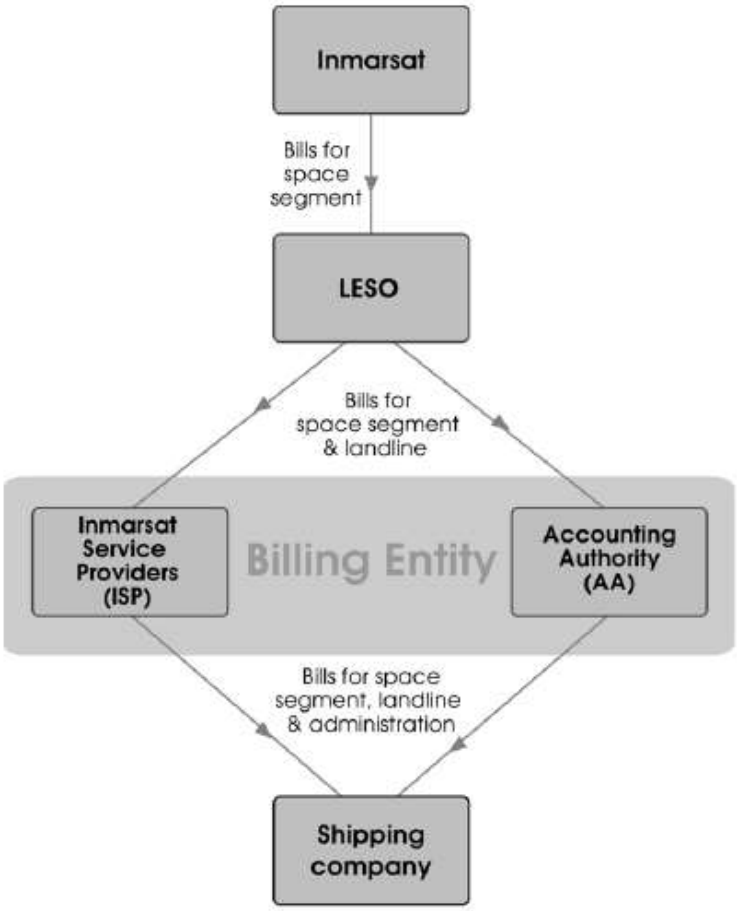
The ITU regularly publishes a List of Ship Stations and Maritime Mobile Service Identity Assignments that lists the names and addresses of all approved AAs. The billing and settlement process in use today for a ship-to-shore call via the Inmarsat system is described below and is also illustrated in Figure 128.

When a ship makes a call via the Inmarsat network, routing through several different stages is involved. These stages include the satellite link to a selected CESO (known as the 'space segment'), the coast earth station operated by an CESO and the terrestrial lines (possibly in more than one country) to the final destination.

When a ship makes a call through a CESO, the CESO checks the SES in it's database to determine with which accounting company the SES has an agreement.

The CESO calculates the cost of the call including the space segment and landline charges and then invoices that accounting company. The accounting company invoices the SES owner for the total consolidated amount plus any handling charge that has already been agreed with the owner. Details of the charges made by an accounting company for its service may be obtained directly from the billing entity (AA or ISP). The accounting company pays the individual amounts due to each CESO and the owner must pay the billing entity.

Inmarsat separately invoices each CESO for the use of the space segment.



Inmarsat billing

The Inmarsat network charges for calls made via the Inmarsat-B, -M and mini-M services in a similar way to HF/MF radiotelephony, for which calls are charged by the length of the call. The charging unit used by coast earth station operators is either six seconds or one minute.

An Inmarsat-C message is charged by the size of the message and not the duration and is charged in units of either 256 bits or 1,024 bits To find approximately how long a data message will take to send using the American Standard Code for Information Interchange (ASCII) 8 bit format, divide the total number of bits in the message by the data transmitted

through the Inmarsat service; this will give you the time in seconds. This is valid only once the call has been established and the modems have finished negotiating (approximately 20 seconds): 1 character = 8 bits = 1 byte.

Computer data (for example, a message comprising text and numbers) is often measured in kilobits, where:

- 1 kilobit (kbit) = 1,024 bits = 128 characters (bytes) = (approx) 25 words
- 1 A4 page full of text = (approx) 2,500 characters = 20 kbits

Telex communication uses a different set of character codes, known as ITA2 (International Telegraph Alphabet 2). Each ITA2 character consists of five data bits, plus one start bit, and 1.5 stop bits (7.5 bits in all). At the standard rate of 50 bits per second, this makes the speed of telex communication 400 characters per minute.

When a land-based subscriber makes a call to an Inmarsat SES, the call will be routed via his or her local telecommunications supplier to a CESO with which the supplier has an agreement.

If the local supplier is also a CES operator, the call will be directly connected through its own CES. Unlike a ship-originated call, the local supplier to which the caller subscribes is responsible for calculating and invoicing the total cost of the call.

The Inmarsat Fleet 77 offers a more convenient and cost-effective digital technology for seafarers with the introduction of the Mobile Packet Data Service (MPDS). This technology splits up data into small packets sent through channels shared by other users. The users are charged by the amount of data sent not by the time they spend online using the connection. In this way it is possible to be connected all the time and pay only for the data transmitted.

Appendix 1: Voice procedures

Distress-, Urgent-, Safety- and Routine Voice Procedure

Kind of calling		Procedure	Example
Distress Call	DSC Voice Procedure	MAYDAY MAYDAY MAYDAY this is Name Name Name /CS /MMSI	MAYDAY MAYDAY MAYDAY this is Unkas Unkas Unkas /dgku 211 231 450
Distress Message		MAYDAY Name / CS / MMSI position - Text ...	MAYDAY Unkas/dgdu 211 231 450 position - Text ...
Acknowledgement	Voice Procedure	MAYDAY Name / CS or MMSI des Havaristen this is Name / CS received MAYDAY	MAYDAY Unkas/dgku or MMSI this is Europa/dlal received MAYDAY
Distress relay Call	DSC Voice Procedure	MAYDAY RELAY MAYDAY RELAY MAYDAY RELAY Coast Station Name 3X this is Name Name Name /CS /MMSI following received on ch 16 at 1530 UTC or following in position observerd	MAYDAY RELAY MAYDAY RELAY MAYDAY RELAY Lyngby Rdo Lyngby Rdo Lyngby Rdo this is Dakota Dakota Dakota/DCDL 211 231 450 following received on ch 16 at 1530 UTC or following in position observerd
Distress Message		MAYDAY Name / CS / MMSI Text...	MAYDAY Unkas/dgdu 211 231 450 Text...
Imposing Silence	Voice Procedure	Name, CS or all stations SILENCE MAYDAY	Neptun SILENCE MAYDAY
Canellation of a false distress alert	Voice Procedure	all stations, all stations, all stations this is Name Name Name / CS /MMSI please cancel my distress alert of today time .... UTC	all stations, all stations, all stations this is Unkas Unkas Unkas /dgku 211 231 450 please cancel my distress alert of today 1700 UTC
End of Distress	Voice Procedure	MAYDAY all stations, all stations, all stations this is Name Name Name /CS /MMSI at time in UTC Name and CS SILENCE FINI	MAYDAY all stations, all stations, all stations this is Europa Europa Europa/dlal 211 321 560 at 1730 UTC Unkas/dgku SILENCE FINI
Urgent Call	DSC Voice Procedure	PANPAN PANPAN PANPAN all stations, all stations, all stations this is Name Name Name /CS /MMSI	PANPAN PANPAN PANPAN all stations, all stations, all stations this is Unkas Unkas Unkas/dgku 211 231 450
Urgent message		TEXT	in position.....
Cancellation of an urgent message	Voice Procedure	PANPAN PANPAN PANPAN all stations, all stations, all stations this is Name Name Name /CS /MMSI cancel my urgency message of day/time master	PANPAN PANPAN PANPAN all stations, all stations, all stations this is Unkas Unkas Unkas/dgku 211 231 450 cancel my urgency message of day/time master
Safety Call	DSC Voice Procedure	SECURITE SECURITE SECURITE all stations, all stations, all stations this is Name Name Name /CS /MMSI	SECURITE SECURITE SECURITE all stations, all stations, all stations this is Unkas Unkas Unkas/dgku 211 231 450
Safety message		TEXT ...	TEXT ...
Ship - Ship Calling	DSC Voice Procedure	Name / CS / MMSI this is Name / CS / MMSI Question	Europa/dlal 211 321 560 this is Unkas/dgku 211 231 450 how do you read me?
Ship - Coast Station Calling	DSC Voice Procedure	Coast Station Name this is Name / CS / MMSI Question	Rogaland Rdo this is Unkas/dgku 211 231 450 how do you read me?

Rdo = Radio
CS = Callsign
DSC = First alert or nnouncement via DSC

Appendix 2: Morse code table

Letters

A	. _	N	_ .
B	_ . . .	O	_ _ _
C	_ . _ .	P	. _ _ .
D	_ . .	Q	_ _ . _
E	.	R	. _ .
F	. . _ .	S	. . .
G	_ _ .	T	_
H	. . . .	U	. . _
I	. .	V	. . . _
J	. _ _ _	W	. _ _
K	_ . _	X	_ . . _
L	. _ . .	Y	_ . _ _
M	_ _	Z	_ _ . .

Numbers

1	. _ _ _ _	6	_ . . . .
2	. . _ _ _	7	_ _ . . .
3	. . . _ _	8	_ _ _ . .
4	. . . . _	9	_ _ _ _ .
5	. . . . .	0	_ _ _ _ _

Appendix 3: Phonetic alphabet and figure code

When it is necessary to spell out call signs, service abbreviations and words, the following letter spelling table shall be used:

Letter to be transmitted	*Code word to be used*	*Spoken as1*
A	Alfa	AL FAH
B	Bravo	BRAH VOH
C	Charlie	CHAR LEE or SHAR LEE
D	Delta	DELL TAH
E	Echo	ECK OH
F	Foxtrot	FOKS TROT
G	Golf	GOLF
H	Hotel	HOH TELL
I	India	IN DEE AH
J	Juliett	JEW LEE ETT
K	Kilo	KEY LOH
L	Lima	LEE MAH
M	Mike	MIKE
N	November	NO VEM BER
O	Oscar	OSS CAH
P	Papa	PAH PAH
Q	Quebec	KEH BECK
R	Romeo	ROW ME OH
S	Sierra	SEE AIR RAH
T	Tango	TANG GO
U	Uniform	YOU NEE FORM or OO NEE FORM
V	Victor	VIK TAH
W	Whiskey	WISS KEY
X	X-ray	ECKS RAY
Y	Yankee	YANG KEY
Z	Zulu	ZOO LOO

The syllables to be emphasized are underlined.

When it is necessary to spell out figures or marks, the following table shall be used:

Figure or mark to be transmitted	*Code word to be used*	*Spoken as2*
0	Nadazero	NAH-DAH-ZAY-ROH
1	Unaone	OO-NAH-WUN
2	Bissotwo	BEES-SOH-TOO
3	Terrathree	TAY-RAH-TREE
4	Kartefour	KAR-TAY-FOWER
5	Pantafive	PAN-TAH-FIVE
6	Soxisix	SOK-SEE-SIX
7	Setteseven	SAY-TAY-SEVEN
8	Oktoeight	OK-TOH-AIT
9	Novenine	NO-VAY-NINER
Decimal point	Decimal	DAY-SEE-MAL
Full stop	Stop	STOP

However, stations of the same country, when communicating between themselves, may use any other table recognized by their administration.

Each syllable should be equally emphasized.

Appendix 4: Q-Codes

Commercial working

Code Question	Answer/Advice
QOB Can you communicate on R/T (2182 kHz)?	I can communicate on R/T (2182 kHz)
QOC Can you communicate in R/T (channel 16)?	I can communicate on R/T (channel 16)
QOD Can you communicate in ...	I can communicate in ....
0. Dutch 1. English 2. French 3. German 4. Greek 5. Italian 6. Japanese 7. Norwegian 8. Russian 9. Spanish	0. Dutch 1. English 2. French 3. German 4. Greek 5. Italian 6. Japanese 7. Norwegian 8. Russian 9. Spanish
QOL Is your vessel fitted for reception of selective calls; if so, what is your selective call number/signal?	My vessel is fitted for reception of selective calls; my selective call number/signal is ...
QOM On what frequencies can your vessel be reached by selective call?	My vessel can be reached by selective call on frequencies ... (at ... time) by elective call
QOO Can you send on any working frequency? QRA What is your station identification?	I can send on any working frequency. My station identification is ...
QRB What is the distance between our stations? QRC What is your accounting authority?	The distance between our stations is ... My accounting authority is ...
QRD Where are you coming from and where are you bound for?	I am coming from ... and bound for ...
QRE What is your estimated time of arrival?	My estimated time of arrival (ETA) is ...
QRJ How many telephone calls have you booked?	I have ... telephone calls to book.
QRK What is the intelligibility of my signals (or those of another station)?	The signal intelligibility is ... 1. bad 2. poor 3. fair 4. good 5. excellent

Code Question	Answer/Advice
QRL Are you busy	I am busy/I am busy with ... (NAME/CALL SIGN). Please do not interfere.
QRM Is my transmission being interfered with?	Your transmission is being interfered with...
QRN Are you troubled by static (noise)?	I am being troubled by static ... 1. nil 4. severely 2. slightly 5. extremely 3. moderately
QRT Shall I stop sending?	Stop sending.
QRU Do you have anything for me?	I have nothing for you.
QRV Are you ready?	I am ready.
QRX When will you call again?	I will call again at ... hours on ... KHz/ MHz.
QRY What is my turn (to send traffic)?	Your turn is number ...
QRZ Who is calling me?	You are called by ... (on ... KHz/MHz).
QSL Can you acknowledge receipt?	I am acknowledging receipt.
QSM Shall I repeat the last telegram(s)?	Repeat the last telegram(s) (give sequence number)
QSP Will you relay to ... (NAME/CALL SIGN)?	I will relay to (NAME/CALL SIGN) ... free of charge
QSW Will you send on this frequency/... KHz/MHz (with class of emission ...)?	I am going to send on this frequency/... kHz/MHz (with class of emission ...)
QSQ Have you a doctor/other named person on board?	I have a doctor/named person on board
QSY Shall I transmit on another frequency?	Change transmission on another frequency (or on ... KHz/MHz)
QTC How many telegrams do you have to send?	I have ... telegrams for you (or NAME/ CALL/SIGN)
QTH What is your exact position?	My exact position is ... (latitude/lingituse, etc.)

Code Question	Answer/Advice
QTI* What is your TRUE course?	My TRUE course is ... degrees
QTJ* What is your speed?	My speed is ... knots
QTL* What is your TRUE heading?	My TRUE heading is ... degrees
QTQ Can you communicate with my station by means of the International Code of Signals (INTERCO)?	I am going to communicate with your station by means of the International Code of Signals (INTERCO).
QTR What is the exact time?	The exact time is ... hours
QUX Do you have any navigational warnings or gale warnings in force?	I have the following navigational/gale warnings in force ...

Q-Codes – Distress & Safety/Search & Rescue

Code Question	Answer/Advice
QOE Have you received the Safety signal sent by ... (NAME/CALL SIGN)?	I have received the Safety signal sent by (NAME/CALL SIGN)
QSE* What is the estimated drift of the survival craft?	The estimated drift of the survival craft is (figures and units).
QSF* Have you effected rescue?	I have effected rescue and am proceeding to ... base (with ... persons injured requiring ambulance)
QTD* What has the rescue vessel/air-craft recovered?	... (NAME/CALL SIGN) has recovered ... 1. ... (number) of survivors 2. wreckage 3. ... (number) of bodies
QTW* What is the condition of the survivors?	Survivors are in .... condition and urgently need
QTY* Are you proceeding to the position of the incident; if so, when will arrive?	I am proceeding to the position of the incident and expect to arrive at (time/date)
QTZ* Are you continuing to search?	I am continuing the search for (aircraft, ship, survival craft, survivors or wreckage.
QUD Have you received the Urgency signal sent by (NAME/CALL SIGN)?	I have received the Urgency signal sent by .... (NAME/CALL SIGN) at ... hours.
QUE Have you received the Distress signal	I have received the Distress signal sent by

Code Question	Answer/Advice
sent by (NAME/CALL SIGN)?	.... (NAME/CALL SIGN) at ... hours.
QUM May I resume normal working?	Normal working may be resumed.
QUN To all stations: Will vessels in my vicinity/in the vicinity of .... /latitude/longitude, etc.) please indicate their position, TRUE course and speed? To single station: Please indicate your position, TRUE course and speed?	My position, TRUE course and speed are ...
QUO* Shall I search for ... 1. aircraft 2. ship 3. survival craft in the vicinity of ... (latitude/longitude etc.)?	Please search for ... 1. aircraft 2. ship 3. survival craft in the vicinity of ... (latitude/longitude etc.)
QUP* Will you indicate your position by? 1. search light 2. black smoke trail 3. pyrotechnic lights	My position is indicated by 1. search light 2. black smoke trail 3. pyrotechnic lights
QUR* Have survivors ... 1. received survival equipment 2. been picked up by rescue vessel 3. been reached by ground rescue party?	Survivors ... 1. received survival equipment 2. been picked up by rescue vessel 3. been reached by ground rescue party?
QUS* Have you sighted survivors/wreck-age; if so, in what position?	Position of incidents is marked by ... 1. survivors in water 2. survivors in rafts 3. wreckage
QUT* Is position of incident marked?	Position of incident is marked by ... 1. flame or smoke float 2. sea marker 3. sea marker dye 4. other
QUU* Shall I home ship/aircraft to my position?	Home ship/aircraft ... (NAME/CALL SIGN) By sending on ... KHz/MHz.
QUW* Are you in search area designated as ... (designator, latitude/longitude, etc.)?	I am in the ... (designated) search area.
QUY* Is position of survival draft marked?	Position of survival draft was marked at ...

Code Question	Answer/Advice
	at hours by ... 1. flame or smoke float 2. sea marker 3. sea marker dye 4. other
QUZ" May I resume restricted working?	Distress phase is still in force; restricted working may be resumed.

Appendix 5: Frequencies used for DSC

The frequencies used for distress, urgency, and safety purposes using DSC are as follows (RR Appendix 15):

2 187.5	kHz
4 207.5	kHz
6 312	kHz
8 414.5	kHz
12 577	kHz
16 804.5	kHz
156.525	MHz (Note 1)

Note 1 – The frequency 156.525 MHz may also be used for DSC purposes other than distress, urgency, and safety.

The frequencies assignable on an international basis to ship and coast stations for DSC, for purposes other than distress, urgency, and safety, are as follows (see Note 2):

Ship stations (see Note 2)

458.5			kHz
2 177 (Note 3)	2 189.5		kHz
4 208	4 208.5	4 209	kHz
6 312.5	6 313	6 313.5	kHz
8 415	8 415.5	8 416	kHz
12 577.5	12 578	12 578.5	kHz
16 805	16 805.5	16 806	kHz
18 898.5	18 899	18 899.5	kHz
22 374.5	22 375	22 375.5	kHz
25 208.5	25 209	25 209.5	kHz
		156.525	MHz

Coast stations (see Note 2)

455.5			kHz
2 177			kHz
4 219.5	4 220	4 220.5	kHz
6 331	6 331.5	6 332	kHz
8 436.5	8 437	8 437.5	kHz
12 657	12 657.5	12 658	kHz
16 903	16 903.5	16 904	kHz
19 703.5	19 704	19 704.5	kHz
22 444	22 444.5	22 445	kHz
26 121	26 121.5	26 122	kHz
		156.525	MHz

Note 2 – The following (kHz) paired frequencies (for ship/coast stations) 4 208/4 219.5, 6 312.5/6 331, 8 45/8 436.5, 12 577.5/12 657, 16 805/16 903, 18 898.5/19 703.5, 22 374.5/22 444 and 25 208.5/26 121 are the first choice international frequencies for DSC (See RR Appendix 17, Part A, footnote j) and l)).

Note 3 – The frequency 2 177 kHz is available to ship stations for intership calling only. In addition to the frequencies listed in no. 2 above, appropriate working frequencies in the following bands may be used for DSC (see RR Chapter II, Article 5):

415 - 526.5	kHz	(Regions 1 and 3)
415 - 525	kHz	(Region 2)
1 606.5 - 3 400	kHz	(Regions 1 and 3)
1 605.5 - 3 400	kHz	(Region 2) (For the band 1 605 - 1 625 kHz, see RR No. 5.89)
4 000 - 27 500	kHz	
156 - 174	MHz	

Appendix 6: VHF frequencies

Channel designator	Notes	Transmitting Frequencies (MHz)		Inter-ship	Port operations and ship movement		Public correspondence
		From ship stations	From coast stations		Single frequency	Two frequency	
60	m)	156.025	160.625		x	x	x
01	m)	156.050	160.650		x	x	x
61	m)	156.075	160.675		x	x	x
02	m)	156.100	160.700		x	x	x
62	m)	156.125	160.725		x	x	x
03	m)	156.150	160.750		x	x	x
63	m)	156.175	160.775		x	x	x
04	m)	156.200	160.800		x	x	x
64	m)	156.225	160.825		x	x	x
05	m)	156.250	160.850		x	x	x
65	m)	156.275	160.875		x	x	x
06	f)	156.300		x			
2006	XXX)	160.900	160.900				
66	m)	156.325	160.925		x	x	x
07	m)	156.350	160.950		x	x	x
67	h)	156.375	156.375	x	x		
08		156.400		x			
68		156.425	156.425		x		
09	i)	156.450	156.450	x	x		
69		156.475	156.475	x	x		
10	h), q)	156.500	156.500	x	x		
70	f), j)	156.525	156.525	Digital selective calling for distress, safety and calling			
11	q)	156.550	156.550		x		
71		156.575	156.575		x		
12		156.600	156.600		x		
72	i)	156.625		x			
13	k)	156.650	156.650	x	x		
73	h), i)	156.675	156.675	x	x		
14		156.700	156.700		x		
74		156.725	156.725		x		
15	g)	156.750	156.750	x	x		
75	n), X1)	156.775	156.775		x		
16	f)	156.800	156.800	DISTRESS, SAFETY AND CALLING			
76	n), X1)	156.825	156.825		x		
17	g)	156.850	156.850	x	x		
77		156.875		x			
18	m)	156.900	161.500		x	x	x

Channel designator	Notes	Transmitting Frequencies (MHz)		Inter-ship	Port operations and ship movement		Public corres-pondence
		From ship stations	From coast stations		Single frequency	Two frequency	
78	A1), A2), A3)	156.925	161.525		x	x	x
1078		156.925	156.925		x		
2078		161.525	161.525		x		
19	A1), A2), A3)	156.950	161.550		x	x	x
1019		156.950	156.950		x		
2019		161.550	161.550		x		
79	A1), A2), A3)	156.975	161.575		x	x	x
1079		156.975	156.975		x		
2079		161.575	161.575		x		
20	A1), A2), A3)	157.000	161.600		x	x	x
1020		157.000	157.000		x		
2020		161.600	161.600		x		
80	B1), E1)	157.025	161.625		x	x	x
21	B1), E1)	157.050	161.650		x	x	x
81	B1), E1)	157.075	161.675		x	x	x
22	B1), E1)	157.100	161.700		x	x	x
82	B1), D1), E1)	157.125	161.725		x	x	x
23	B1), D1), E1)	157.150	161.750		x	x	x
83	B1), D1), E1)	157.175	161.775		x	x	x
24	B1), C1), D1), E1)	157.200	161.800		x	x	x
84	B1), C1), D1), E1)	157.225	161.825		x	x	x
25	B1), C1), D1), E1)	157.250	161.850		x	x	x
85	B1), C1), D1), E1)	157.275	161.875		x	x	x
26	B1), C1), D1), E1)	157.300	161.900		x	x	x
86	B1), C1), D1), E1)	157.325	161.925		x	x	x
27	YYY)	157.350	161.950			x	x
87	YYY)	157.375	157.375		x		
28	YYY)	157.400	162.000			x	x
88	YYY)	157.425	157.425		x		
AIS 1	f), l), p)	161.975	161.975				
AIS 2	f), l), p)	162.025	162.025				

Appendix 7: MF frequencies

495 – 1.800 kHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
495-505	MARITIME MOBILE	
505-526.5 MARITIME MOBILE 5.79 5.79A 5.84 AERONAUTICAL RADIONAVIGATION	**505-510** MARITIME MOBILE 5.79	**505-526.5** MARITIME MOBILE 5.79 5.79A 5.84 AERONAUTICAL RADIONAVIGATION Aeronautical mobile Land mobile
	510-525 MARITIME MOBILE 5.79A 5.84 AERONAUTICAL RADIONAVIGATION	
	525-535 BROADCASTING 5.86 AERONAUTICAL RADIONAVIGATION	
526.5-1 606.5 BROADCASTING 5.87 5.87A		**526.5-535** BROADCASTING Mobile 5.88
	535-1 605 BROADCASTING	**535-1 606.5** BROADCASTING
	1 605-1 625 BROADCASTING 5.89 5.90	
1 606.5-1 625 FIXED MARITIME MOBILE 5.90 LAND MOBILE 5.92		**1 606.5-1 800** FIXED MOBILE RADIOLOCATION RADIONAVIGATION
1 625-1 635 RADIOLOCATION 5.93	**1 625-1 705** FIXED MOBILE BROADCASTING 5.89 Radiolocation 5.90	
1 635-1 800 FIXED MARITIME MOBILE 5.90 LAND MOBILE 5.92 5.96	**1 705-1 800** FIXED MOBILE RADIOLOCATION AERONAUTICAL RADIONAVIGATION	5.91

5.84 The conditions for the use of the frequency 518 kHz by the maritime mobile service are prescribed in Articles **31** and **52**. (WRC-07)

5.85 Not used.

5.86 In Region 2, in the band 525-535 kHz the carrier power of broadcasting stations shall not exceed 1 kW during the day and 250 W at night.

5.87 *Additional allocation:* in Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia,Niger and Swaziland, the band 526.5-535 kHz is also allocated to the mobile service on a secondary basis. (WRC-12)

5.87A *Additional allocation:* in Uzbekistan, the band 526.5-1 606.5 kHz is also allocated to the radionavigation service on a primary basis. Such use is subject to agreement obtained under No. **9.21** with administrations concerned and limited to ground-based radiobeacons in operation on 27 October 1997 until the end of their lifetime. (WRC-97)

5.88 *Additional allocation:* in China, the band 526.5-535 kHz is also allocated to the aeronautical radionavigation service on a secondary basis.

5.89 In Region 2, the use of the band 1 605-1 705 kHz by stations of the broadcasting service is subject to the Plan established by the Regional Administrative Radio Conference (Rio de Janeiro, 1988).

The examination of frequency assignments to stations of the fixed and mobile services in the band 1 625-1 705 kHz shall take account of the allotments appearing in the Plan established by the Regional Administrative Radio Conference (Rio de Janeiro, 1988).

5.90 In the band 1 605-1 705 kHz, in cases where a broadcasting station of Region 2 is concerned, the service area of the maritime mobile stations in Region 1 shall be limited to that provided by ground-wave propagation.

5.91 *Additional allocation:* in the Philippines and Sri Lanka, the band 1 606.5-1 705 kHz is also allocated to the broadcasting service on a secondary basis. (WRC-97)

5.92 Some countries of Region 1 use radiodetermination systems in the bands 1 606.5-1 625 kHz, 1 635-1 800 kHz, 1 850-2 160 kHz, 2 194-2 300 kHz, 2 502-2 850 kHz and 3 500-3 800 kHz, subject to agreement obtained under No. 9.21. The radiated mean power of these stations shall not exceed 50 W.

5.93 *Additional allocation:* in Angola, Armenia, Azerbaijan, Belarus, the Russian Federation, Georgia, Hungary, Kazakhstan, Latvia, Lithuania, Mongolia, Nigeria, Uzbekistan, Poland, Kyrgyzstan, Slovakia, Tajikistan, Chad, Turkmenistan and Ukraine, the bands 1 625-1 635 kHz, 1 800-1 810 kHz and 2 160-2 170 kHz are also allocated to the fixed and land mobile services on a primary basis, subject to agreement obtained under No. 9.21. (WRC-12)

5.94 and 5.95 Not used.

5.96 In Germany, Armenia, Austria, Azerbaijan, Belarus, Denmark, Estonia, the Russian Federation, Finland, Georgia, Hungary, Ireland, Iceland, Israel, Kazakhstan, Latvia, Liechtenstein, Lithuania, Malta, Moldova, Norway, Uzbekistan, Poland, Kyrgyzstan, Slovakia, the Czech Rep., the United Kingdom, Sweden, Switzerland, Tajikistan, Turkmenistan and Ukraine, administrations may allocate up to 200 kHz to their amateur service in the bands 1 715-1 800 kHz and 1 850-2 000 kHz. However, when allocating the bands within this range to their amateur service, administrations shall, after prior consultation with administrations of neighbouring countries, take such steps as may be necessary to prevent harmful interference from their amateur service to the fixed and mobile services of other countries. The mean power of any amateur station shall not exceed 10 W. (WRC-03)

1 800 - 2 194 kHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
1 800-1 810 RADIOLOCATION 5.93 **1 810-1 850** AMATEUR 5.98 5.99 5.100 5.101	**1 800-1 850** AMATEUR	**1 800-2 000** AMATEUR FIXED MOBILE except aeronautical mobile RADIONAVIGATION Radiolocation
1 850-2 000 FIXED MOBILE except aeronautical mobile 5.92 5.96 5.103	**1 850-2 000** AMATEUR FIXED MOBILE except aeronautical mobile RADIOLOCATION RADIONAVIGATION 5.102	5.97
2 000-2 025 FIXED MOBILE except aeronautical mobile (R) 5.92 5.103	**2 000-2 065** FIXED MOBILE	
2 025-2 045 FIXED MOBILE except aeronautical mobile (R) Meteorological aids 5.104 5.92 5.103		
2 045-2 160 FIXED MARITIME MOBILE LAND MOBILE 5.92 **2 160-2 170** RADIOLOCATION 5.93 5.107	**2 065-2 107** MARITIME MOBILE 5.105 5.106	
	2 107-2 170 FIXED MOBILE	
2 170-2 173.5	MARITIME MOBILE	
2 173.5-2 190.5	MOBILE (distress and calling) 5.108 5.109 5.110 5.111	
2 190.5-2 194	MARITIME MOBILE	

5.97 In Region 3, the Loran system operates either on 1 850 kHz or 1 950 kHz, the bands occupied being 1 825-1 875 kHz and 1 925-1 975 kHz respectively. Other services to which the band 1 800-2 000 kHz is allocated may use any frequency therein on condition that no harmful interference is caused to the Loran system operating on 1 850 kHz or 1 950 kHz.

5.98 *Alternative allocation*: in Angola, Armenia, Azerbaijan, Belarus, Belgium, Cameroon, Congo (Rep. of the), Denmark, Egypt, Eritrea, Spain, Ethiopia, the Russian Federation, Georgia, Greece, Italy, Kazakhstan, Lebanon, Lithuania, the Syrian Arab Republic, Kyrgyzstan, Somalia, Tajikistan, Tunisia, Turkmenistan, Turkey and Ukraine, the band 1 810-1 830 kHz is allocated to the fixed and mobile, except aeronautical mobile, services on a primary basis. (WRC-12)

5.99 *Additional allocation:* in Saudi Arabia, Austria, Iraq, Libya, Uzbekistan, Slovakia, Romania, Slovenia, Chad, and Togo, the band 1 810-1 830 kHz is also allocated to the fixed and mobile, except aeronautical mobile, services on a primary basis. (WRC-12)

5.100 In Region 1, the authorization to use the band 1 810-1 830 kHz by the amateur service in countries situated totally or partially north of 40° N shall be given only after consultation with the countries mentioned in Nos. 5.98 and 5.99 to define the necessary steps to be taken to prevent harmful interference between amateur stations and stations of other services operating in accordance with Nos. 5.98 and 5.99.

5.102 *Alternative allocation:* in Bolivia, Chile, Mexico, Paraguay, Peru and Uruguay, the band 1 850-2 000 kHz is allocated to the fixed, mobile except aeronautical mobile, radiolocation and radionavigation services on a primary basis. (WRC-07)

5.103 In Region 1, in making assignments to stations in the fixed and mobile services in the bands 1 850-2 045 kHz, 2 194-2 498 kHz, 2 502-2 625 kHz and 2 650-2 850 kHz, administrations should bear in mind the special requirements of the maritime mobile service.

5.104 In Region 1, the use of the band 2 025-2 045 kHz by the meteorological aids service is limited to oceanographic buoy stations.

5.105 In Region 2, except in Greenland, coast stations and ship stations using radiotelephony in the band 2 065-2 107 kHz shall be limited to class J3E emissions and to a peak envelope power not exceeding 1 kW. Preferably, the following carrier frequencies should be used: 2 065.0 kHz, 2 079.0 kHz, 2 082.5 kHz, 2 086.0 kHz, 2 093.0 kHz, 2 096.5 kHz, 2 100.0 kHz and 2 103.5 kHz. In Argentina and Uruguay, the carrier frequencies 2 068.5 kHz and 2 075.5 kHz are also used for this purpose, while the frequencies within the band 2 072- 2 075.5 kHz are used as provided in No. 2.165.

5.106 In Regions 2 and 3, provided no harmful interference is caused to the maritime mobile service, the frequencies between 2 065 kHz and 2 107 kHz may be used by stations of the fixed service communicating only within national borders and whose mean power does not exceed 50 W. In notifying the frequencies, the attention of the Bureau should be drawn to these provisions.

5.107 *Additional allocation:* in Saudi Arabia, Eritrea, Ethiopia, Iraq, Libya, Somalia and Swaziland, the band 2 160-2 170 kHz is also allocated to the fixed and mobile, except aeronautical mobile (R), services on a primary basis. The mean power of stations in these services shall not exceed 50 W. (WRC-12)

5.108 The carrier frequency 2 182 kHz is an international distress and calling frequency for radiotelephony. The conditions for the use of the band 2 173.5-2 190.5 kHz are prescribed in Articles 31 and 52. (WRC-07)

5.109 The frequencies 2 187.5 kHz, 4 207.5 kHz, 6 312 kHz, 8 414.5 kHz, 12 577 kHz and 16 804.5 kHz are international distress frequencies for digital selective calling. The conditions for the use of these frequencies are prescribed in Article 31.

5.110 The frequencies 2 174.5 kHz, 4 177.5 kHz, 6 268 kHz, 8 376.5 kHz, 12 520 kHz and 16 695 kHz are international distress frequencies for narrow-band direct-printing telegraphy. The conditions for the use of these frequencies are prescribed in Article 31.

5.111 The carrier frequencies 2 182 kHz, 3 023 kHz, 5 680 kHz, 8 364 kHz and the frequencies 121.5 MHz, 156.525 MHz, 156.8 MHz and 243 MHz may also be used, in accordance with the procedures in force for terrestrial radiocommunication services, for search and rescue operations concerning manned space vehicles. The conditions for the use of the frequencies are prescribed in Article 31. The same applies to the frequencies 10 003 kHz, 14 993 kHz and 19 993 kHz, but in each of these cases emissions mus 3 kHz about the frequency.

3 230-5 003 kHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
3 230-3 400	FIXED MOBILE except aeronautical mobile BROADCASTING 5.113 5.116 5.118	
3 400-3 500	AERONAUTICAL MOBILE (R)	
3 500-3 800 AMATEUR FIXED MOBILE except aeronautical mobile 5.92	**3 500-3 750** AMATEUR 5.119	**3 500-3 900** AMATEUR FIXED MOBILE
3 800-3 900 FIXED AERONAUTICAL MOBILE (OR) LAND MOBILE	**3 750-4 000** AMATEUR FIXED MOBILE except aeronautical mobile (R)	
3 900-3 950 AERONAUTICAL MOBILE (OR) 5.123		**3 900-3 950** AERONAUTICAL MOBILE BROADCASTING
3 950-4 000 FIXED BROADCASTING	5.122 5.125	**3 950-4 000** FIXED BROADCASTING 5.126

5.118 *Additional allocation:* in the United States, Mexico, Peru and Uruguay, the band 3 230- 3 400 kHz is also allocated to the radiolocation service on a secondary basis. (WRC-03)

5.119 *Additional allocation:* in Honduras, Mexico and Peru, the band 3 500-3 750 kHz is also allocated to the fixed and mobile services on a primary basis. (WRC-07)

5.121 Not used.

5.122 *Alternative allocation:* in Bolivia, Chile, Ecuador, Paraguay, Peru and Uruguay, the band 3 750-4 000 kHz is allocated to the fixed and mobile, except aeronautical mobile, services on a primary basis. (WRC-07)

5.123 *Additional allocation:* in Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe, the band 3 900-3 950 kHz is also allocated to the broadcasting service on a primary basis, subject to agreement obtained under No. 9.21.

5.125 *Additional allocation:* in Greenland, the band 3 950-4 000 kHz is also allocated to the broadcasting service on a primary basis. The power of the broadcasting stations operating in this band shall not exceed that necessary for a national service and shall in no case exceed 5 kW.

5.126 In Region 3, the stations of those services to which the band 3 995-4 005 kHz is allocated may transmit standard frequency and time signals.

5.127 The use of the band 4 000-4 063 kHz by the maritime mobile service is limited to ship stations using radiotelephony (see No. 52.220 and Appendix 17).

5.128 Frequencies in the bands 4 063-4 123 kHz and 4 130-4 438 kHz may be used exceptionally by stations in the fixed service, communicating only within the boundary of the country in which they are located, with a mean power not exceeding 50 W, on condition that harmful interference is not caused to the maritime mobile service. In addition, in Afghanistan, Argentina, Armenia, Azerbaijan, Belarus, Botswana, Burkina Faso, the Central African Rep., China, the Russian Federation, Georgia, India, Kazakhstan, Mali, Niger, Pakistan, Kyrgyzstan, Tajikistan, Chad, Turkmenistan and Ukraine, in the bands 4 063-4 123 kHz, 4 130-4 133 kHz and 4 408-4 438 kHz, stations in the fixed service, with a mean power not exceeding 1 kW, can be operated on condition that they are situated at least 600 km from the coast and that harmful interference is not caused to the maritime mobile service. (WRC-12)

5.130 The conditions for the use of the carrier frequencies 4 125 kHz and 6 215 kHz are prescribed in Articles 31 and 52. (WRC-07)

5.131 The frequency 4 209.5 kHz is used exclusively for the transmission by coast stations of meteorological and navigational warnings and urgent information to ships by means of narrow-band direct-printing techniques. (WRC-97)

5.132 The frequencies 4 210 kHz, 6 314 kHz, 8 416.5 kHz, 12 579 kHz, 16 806.5 kHz, 19 680.5 kHz, 22 376 kHz and 26 100.5 kHz are the international frequencies for the transmission of maritime safety information (MSI) (see Appendix 17).

5.132 A Stations in the radiolocation service shall not cause harmful interference to, or claim protection from, stations operating in the fixed or mobile services. Applications of the radiolocation service are limited to oceanographic radars operating in accordance with Resolution 612 (Rev.WRC-12). (WRC-12)

5.132B *Alternative allocation:* in Armenia, Austria, Belarus, Moldova, Uzbekistan and Kyrgyzstan, the frequency band 4 438-4 488 kHz is allocated to the fixed and mobile, except aeronautical mobile (R), services on a primary basis. (WRC-12)

Appendix 8: HF Duplex Channels

Coast Station – Ship Station

Channel No.	4 MHz band			
	Coast stations		Ship stations	
	Carrier frequency	Assigned frequency	Carrier frequency	Assigned frequency
401	4 357	4 358.4	4 065	4 066.4
402	4 360	4 361.4	4 068	4 069.4
403	4 363	4 364.4	4 071	4 072.4
404	4 366	4 367.4	4 074	4 075.4
405	4 369	4 370.4	4 077	4 078.4
406	4 372	4 373.4	4 080	4 081.4
407	4 375	4 376.4	4 083	4 084.4
408	4 378	4 379.4	4 086	4 087.4
409	4 381	4 382.4	4 089	4 090.4
410	4 384	4 385.4	4 092	4 093.4
411	4 387	4 388.4	4 095	4 096.4
412	4 390	4 391.4	4 098	4 099.4
413	4 393	4 394.4	4 101	4 102.4
414	4 396	4 397.4	4 104	4 105.4
415	4 399	4 400.4	4 107	4 108.4
416	4 402	4 403.4	4 110	4 111.4
417	4 405	4 406.4	4 113	4 114.4
418	4 408	4 409.4	4 116	4 117.4
419	4 411	4 412.4	4 119	4 120.4
420	4 414	4 415.4	4 122	4 123.4
421	4 417	4 418.4	4 125	4 126.4
422	4 420	4 421.4	4 128	4 129.4
423	4 423	4 424.4	4 131	4 132.4
424	4 426	4 427.4	4 134	4 135.4
425	4 429	4 430.4	4 137	4 138.4
426	4 432	4 433.4	4 140	4 141.4
427	4 435	4 436.4	4 143	4 144.4
428	4 351	4 352.4	–	–
429	4 354	4 355.4	–	–

Channel No.	6 MHz band			
	Coast stations		Ship stations	
	Carrier frequency	Assigned frequency	Carrier frequency	Assigned frequency
601	6 501	6 502.4	6 200	6 201.4
602	6 504	6 505.4	6 203	6 204.4
603	6 507	6 508.4	6 206	6 207.4
604	6 510	6 511.4	6 209	6 210.4
605	6 513	6 514.4	6 212	6 213.4
606	6 516	6 517.4	6 215	6 216.4
607	6 519	6 520.4	6 218	6 219.4
608	6 522	6 523.4	6 221	6 222.4

Channel No.	8 MHz band			
	Coast stations		Ship stations	
	Carrier frequency	Assigned frequency	Carrier frequency	Assigned frequency
801	8 719	8 720.4	8 195	8 196.4
802	8 722	8 723.4	8 198	8 199.4
803	8 725	8 726.4	8 201	8 202.4
804	8 728	8 729.4	8 204	8 205.4
805	8 731	8 732.4	8 207	8 208.4
806	8 734	8 735.4	8 210	8 211.4
807	8 737	8 738.4	8 213	8 214.4
808	8 740	8 741.4	8 216	8 217.4
809	8 743	8 744.4	8 219	8 220.4
810	8 746	8 747.4	8 222	8 223.4
811	8 749	8 750.4	8 225	8 226.4
812	8 752	8 753.4	8 228	8 229.4
813	8 755	8 756.4	8 231	8 232.4
814	8 758	8 759.4	8 234	8 235.4
815	8 761	8 762.4	8 237	8 238.4
816	8 764	8 765.4	8 240	8 241.4
817	8 767	8 768.4	8 243	8 244.4
818	8 770	8 771.4	8 246	8 247.4
819	8 773	8 774.4	8 249	8 250.4
820	8 776	8 777.4	8 252	8 253.4
821	8 779	8 780.4	8 255	8 256.4
822	8 782	8 783.4	8 258	8 259.4
823	8 785	8 786.4	8 261	8 262.4
824	8 788	8 789.4	8 264	8 265.4
825	8 791	8 792.4	8 267	8 268.4
826	8 794	8 795.4	8 270	8 271.4
827	8 797	8 798.4	8 273	8 274.4
828	8 800	8 801.4	8 276	8 277.4
829	8 803	8 804.4	8 279	8 280.4
830	8 806	8 807.4	8 282	8 283.4
831	8 809	8 810.4	8 285	8 286.4
832	8 812	8 813.4	8 288	8 289.4
833	8 291	8 292.4	8 291	8 292.4
834	8 707	8 708.4	–	–
835	8 710	8 711.4	–	–
836	8 713	8 714.4	–	–
837	8 716	8 717.4	–	–

Channel No.	12 MHz band			
	Coast stations		Ship stations	
	Carrier frequency	Assigned frequency	Carrier frequency	Assigned frequency
1201	13 077	13 078.4	12 230	12 231.4
1202	13 080	13 081.4	12 233	12 234.4
1203	13 083	13 084.4	12 236	12 237.4
1204	13 086	13 087.4	12 239	12 240.4
1205	13 089	13 090.4	12 242	12 243.4
1206	13 092	13 093.4	12 245	12 246.4
1207	13 095	13 096.4	12 248	12 249.4
1208	13 098	13 099.4	12 251	12 252.4
1209	13 101	13 102.4	12 254	12 255.4
1210	13 104	13 105.4	12 257	12 258.4
1211	13 107	13 108.4	12 260	12 261.4
1212	13 110	13 111.4	12 263	12 264.4
1213	13 113	13 114.4	12 266	12 267.4
1214	13 116	13 117.4	12 269	12 270.4
1215	13 119	13 120.4	12 272	12 273.4
1216	13 122	13 123.4	12 275	12 276.4
1217	13 125	13 126.4	12 278	12 279.4
1218	13 128	13 129.4	12 281	12 282.4
1219	13 131	13 132.4	12 284	12 285.4
1220	13 134	13 135.4	12 287	12 288.4
1221	13 137	13 138.4	12 290	12 291.4
1222	13 140	13 141.4	12 293	12 294.4
1223	13 143	13 144.4	12 296	12 297.4
1224	13 146	13 147.4	12 299	12 300.4
1225	13 149	13 150.4	12 302	12 303.4
1226	13 152	13 153.4	12 305	12 306.4
1227	13 155	13 156.4	12 308	12 309.4
1228	13 158	13 159.4	12 311	12 312.4
1229	13 161	13 162.4	12 314	12 315.4
1230	13 164	13 165.4	12 317	12 318.4
1231	13 167	13 168.4	12 320	12 321.4
1232	13 170	13 171.4	12 323	12 324.4
1233	13 173	13 174.4	12 326	12 327.4
1234	13 176	13 177.4	12 329	12 330.4
1235	13 179	13 180.4	12 332	12 333.4
1236	13 182	13 183.4	12 335	12 336.4
1237	13 185	13 186.4	12 338	12 339.4
1238	13 188	13 189.4	12 341	12 342.4
1239	13 191	13 192.4	12 344	12 345.4
1240	13 194	13 195.4	12 347	12 348.4
1241	13 197	13 198.4	12 350	12 351.4

Channel No.	16 MHz band			
	Coast stations		Ship stations	
	Carrier frequency	Assigned frequency	Carrier frequency	Assigned frequency
1601	17 242	17 243.4	16 360	16 361.4
1602	17 245	17 246.4	16 363	16 364.4
1603	17 248	17 249.4	16 366	16 367.4
1604	17 251	17 252.4	16 369	16 370.4
1605	17 254	17 255.4	16 372	16 373.4
1606	17 257	17 258.4	16 375	16 376.4
1607	17 260	17 261.4	16 378	16 379.4
1608	17 263	17 264.4	16 381	16 382.4
1609	17 266	17 267.4	16 384	16 385.4
1610	17 269	17 270.4	16 387	16 388.4
1611	17 272	17 273.4	16 390	16 391.4
1612	17 275	17 276.4	16 393	16 394.4
1613	17 278	17 279.4	16 396	16 397.4
1614	17 281	17 282.4	16 399	16 400.4
1615	17 284	17 285.4	16 402	16 403.4
1616	17 287	17 288.4	16 405	16 406.4
1617	17 290	17 291.4	16 408	16 409.4
1618	17 293	17 294.4	16 411	16 412.4
1619	17 296	17 297.4	16 414	16 415.4
1620	17 299	17 300.4	16 417	16 418.4
1621	17 302	17 303.4	16 420	16 421.4
1622	17 305	17 306.4	16 423	16 424.4
1623	17 308	17 309.4	16 426	16 427.4
1624	17 311	17 312.4	16 429	16 430.4
1625	17 314	17 315.4	16 432	16 433.4
1626	17 317	17 318.4	16 435	16 436.4
1627	17 320	17 321.4	16 438	16 439.4
1628	17 323	17 324.4	16 441	16 442.4
1629	17 326	17 327.4	16 444	16 445.4
1630	17 329	17 330.4	16 447	16 448.4
1631	17 332	17 333.4	16 450	16 451.4
1632	17 335	17 336.4	16 453	16 454.4
1633	17 338	17 339.4	16 456	16 457.4
1634	17 341	17 342.4	16 459	16 460.4
1635	17 344	17 345.4	16 462	16 463.4
1636	17 347	17 348.4	16 465	16 466.4
1637	17 350	17 351.4	16 468	16 469.4
1638	17 353	17 354.4	16 471	16 472.4
1639	17 356	17 357.4	16 474	16 475.4

Channel No.	16 MHz band			
	Coast stations		Ship stations	
	Carrier frequency	Assigned frequency	Carrier frequency	Assigned frequency
1640	17 359	17 360.4	16 477	16 478.4
1641	17 362	17 363.4	16 480	16 481.4
1642	17 365	17 366.4	16 483	16 484.4
1643	17 368	17 369.4	16 486	16 487.4
1644	17 371	17 372.4	16 489	16 490.4
1645	17 374	17 375.4	16 492	16 493.4
1646	17 377	17 378.4	16 495	16 496.4
1647	17 380	17 381.4	16 498	16 499.4
1648	17 383	17 384.4	16 501	16 502.4
1649	17 386	17 387.4	16 504	16 505.4
1650	17 389	17 390.4	16 507	16 508.4
1651	17 392	17 393.4	16 510	16 511.4
1652	17 395	17 396.4	16 513	16 514.4
1653	17 398	17 399.4	16 516	16 517.4
1654	17 401	17 402.4	16 519	16 520.4
1655	17 404	17 405.4	16 522	16 523.4
1656	17 407	17 408.4	16 525	16 526.4

Channel No.	18/19 MHz band			
	Coast stations		Ship stations	
	Carrier frequency	Assigned frequency	Carrier frequency	Assigned frequency
1801	19 755	19 756.4	18 780	18 781.4
1802	19 758	19 759.4	18 783	18 784.4
1803	19 761	19 762.4	18 786	18 787.4
1804	19 764	19 765.4	18 789	18 790.4
1805	19 767	19 768.4	18 792	18 793.4
1806	19 770	19 771.4	18 795	18 796.4
1807	19 773	19 774.4	18 798	18 799.4
1808	19 776	19 777.4	18 801	18 802.4
1809	19 779	19 780.4	18 804	18 805.4
1810	19 782	19 783.4	18 807	18 808.4
1811	19 785	19 786.4	18 810	18 811.4
1812	19 788	19 789.4	18 813	18 814.4
1813	19 791	19 792.4	18 816	18 817.4
1814	19 794	19 795.4	18 819	18 820.4
1815	19 797	19 798.4	18 822	18 823.4

Channel No.	22 MHz band			
	Coast stations		Ship stations	
	Carrier frequency	Assigned frequency	Carrier frequency	Assigned frequency
2201	22 696	22 697.4	22 000	22 001.4
2202	22 699	22 700.4	22 003	22 004.4
2203	22 702	22 703.4	22 006	22 007.4
2204	22 705	22 706.4	22 009	22 010.4
2205	22 708	22 709.4	22 012	22 013.4
2206	22 711	22 712.4	22 015	22 016.4
2207	22 714	22 715.4	22 018	22 019.4
2208	22 717	22 718.4	22 021	22 022.4
2209	22 720	22 721.4	22 024	22 025.4
2210	22 723	22 724.4	22 027	22 028.4
2211	22 726	22 727.4	22 030	22 031.4
2212	22 729	22 730.4	22 033	22 034.4
2213	22 732	22 733.4	22 036	22 037.4
2214	22 735	22 736.4	22 039	22 040.4
2215	22 738	22 739.4	22 042	22 043.4
2216	22 741	22 742.4	22 045	22 046.4
2217	22 744	22 745.4	22 048	22 049.4
2218	22 747	22 748.4	22 051	22 052.4
2219	22 750	22 751.4	22 054	22 055.4
2220	22 753	22 754.4	22 057	22 058.4
2221	22 756	22 757.4	22 060	22 061.4
2222	22 759	22 760.4	22 063	22 064.4
2223	22 762	22 763.4	22 066	22 067.4
2224	22 765	22 766.4	22 069	22 070.4
2225	22 768	22 769.4	22 072	22 073.4
2226	22 771	22 772.4	22 075	22 076.4
2227	22 774	22 775.4	22 078	22 079.4
2228	22 777	22 778.4	22 081	22 082.4
2229	22 780	22 781.4	22 084	22 085.4
2230	22 783	22 784.4	22 087	22 088.4
2231	22 786	22 787.4	22 090	22 091.4
2232	22 789	22 790.4	22 093	22 094.4
2233	22 792	22 793.4	22 096	22 097.4
2234	22 795	22 796.4	22 099	22 100.4
2235	22 798	22 799.4	22 102	22 103.4
2236	22 801	22 802.4	22 105	22 106.4
2237	22 804	22 805.4	22 108	22 109.4
2238	22 807	22 808.4	22 111	22 112.4
2239	22 810	22 811.4	22 114	22 115.4
2240	22 813	22 814.4	22 117	22 118.4
2241	22 816	22 817.4	22 120	22 121.4
2242	22 819	22 820.4	22 123	22 124.4
2243	22 822	22 823.4	22 126	22 127.4
2244	22 825	22 826.4	22 129	22 130.4
2245	22 828	22 829.4	22 132	22 133.4
2246	22 831	22 832.4	22 135	22 136.4
2247	22 834	22 835.4	22 138	22 139.4
2248	22 837	22 838.4	22 141	22 142.4
2249	22 840	22 841.4	22 144	22 145.4

Channel No.	22 MHz band			
	Coast stations		Ship stations	
	Carrier frequency	Assigned frequency	Carrier frequency	Assigned frequency
2250	22 843	22 844.4	22 147	22 148.4
2251	22 846	22 847.4	22 150	22 151.4
2252	22 849	22 850.4	22 153	22 154.4
2253	22 852	22 853.4	22 156	22 157.4

Channel No.	25/26 MHz band			
	Coast stations		Ship stations	
	Carrier frequency	Assigned frequency	Carrier frequency	Assigned frequency
2501	26 145	26 146.4	25 070	25 071.4
2502	26 148	26 149.4	25 073	25 074.4
2503	26 151	26 152.4	25 076	25 077.4
2504	26 154	26 155.4	25 079	25 080.4
2505	26 157	26 158.4	25 082	25 083.4
2506	26 160	26 161.4	25 085	25 086.4
2507	26 163	26 164.4	25 088	25 089.4
2508	26 166	26 167.4	25 091	25 092.4
2509	26 169	26 170.4	25 094	25 095.4
2510	26 172	26 173.4	25 097	25 098.4

Appendix 9: Voice Ship – Ship frequencies

Table of single-sideband transmitting frequencies (kHz) for simplex (single-frequency) operation and for intership cross-band (two-frequency) operation

4 MHz band[1]		6 MHz band		8 MHz band[2]		12 MHz band[3]	
Carrier frequency	Assigned frequency	Carrier frequency	Assigned frequency	Carrier frequency	Assigned frequency	Carrier frequency	Assigned frequency
4 146	4 147.4	6 224	6 225.4	8 294	8 295.4	12 353	12 354.4
4 149	4 150.4	6 227	6 228.4	8 297	8 298.4	12 356	12 357.4
		6 230	6 231.4			12 362	12 363.4
						12 365	12 366.4

1 These frequencies may be used for duplex operation with coast stations operating on Channel Nos. 428 and 429 (see Sub-Section A).

2 These frequencies may be used for duplex operation with coast stations operating on Channel Nos. 834 up to and including 837 (see Sub-Section A).

3 For use of frequencies 12 359 kHz and 16 537 kHz, see Nos. 52.221A and 52.222A. (WRC-2000)

16 MHz band[3]		18/19 MHz band		22 MHz band		25/26 MHz band	
Carrier frequency	Assigned frequency	Carrier frequency	Assigned frequency	Carrier frequency	Assigned frequency	Carrier frequency	Assigned frequency
16 528	16 529.4	18 825	18 826.4	22 159	22 160.4	25 100	25 101.4
16 531	16 532.4	18 828	18 829.4	22 162	22 163.4	25 103	25 104.4
16 534	16 535.4	18 831	18 832.4	22 165	22 166.4	25 106	25 107.4
		18 834	18 835.4	22 168	22 169.4	25 109	25 110.4
16 540	16 541.4	18 837	18 838.4	22 171	22 172.4	25 112	25 113.4
16 543	16 544.4	18 840	18 841.4	22 174	22 175.4	25 115	25 116.4
16 546	16 547.4	18 843	18 844.4	22 177	22 178.4	25 118	25 119.4

ABBREVIATION LIST

AA : Accounting Authority
AAIC : Accounting Authority Identification Code
AGC: Automatic Gain Control
AIS : Automatic Identification System
ALRS : Admiralty List of Radio Signals
AM : Amplitude Modulation
AMSA : Australian Maritime Safety Authority
AMVER : Automated Mutual-assistance Vessel Rescue System
AOR-E : Atlantic Ocean Region-East
AOR-W : Atlantic Ocean Region – West
ARQ : Automatic request for repeat
ASCII : American Standard Code for Information Interchange
ASP : Application service providers
AtoN : Aids to Navigation
ATU : Antenna Tuning Unit
AUSREP: Australian Ship Reporting System
Bps : bits per second
CC : Coast station Charge
CES : Coast Earth Station
CESO : Coast Earth Station Operator
ch70 : VHF channel70
CP : Public Correspondence
CR : Restricted public Correspondence
CS : Coast Stations
CSP : Communications service providers
DCE : Data Circuit terminating Equipment
DSB : Double-Sideband
DSC : Digital Selective Calling
DTE : Data Terminal Equipment
EGC : Enhanced Group Call
EHF : Extra High Frequency
ENID : EGC network Identification
EPIRB : Emergency Position Indicating Radio Beacon
Fax : Facsimile
FEC : Forward Error Correction
FM : Frequency Modulation
FSK : Frequency Shift Keying
GEOSAR: Geostationary Search and Rescue
Gfr: Goldfranc
GLONASS: Global Navigation Satellite System
GMDSS : Global Maritime Distress and safety System
GNSS : Global Navigational Satellite System
GOC : General Operator's Certificate
GPS : Global Positioning System
GSO : Geostationary Orbit
HF : High Frequency

HSD : High Speed Data
IAMSAR: International Aeronautical and Maritime Search and Rescue
ICAO : International Civil Aviation Organization
IMN : Inmarsat Number
Inmarsat: International Mobile Satellite Organization
INTERCO: International Code of Signals
IOR : Indian Ocean Region
ISP : Inmarsat service provider
ITU : International Telecommunication Union
JASREP : Japanese Ship Reporting System
LEOSAR : Low Earth Orbit Search and Rescue
LF : Low Frequency
LL : Land Line charge
LRIT : Long Range Identification and Tracking of Ships
LUF : Lowest usable frequency
LUT : Local User Terminals
MCC: Mission Control Centre
Metarea: Metrological areas
MF : Medium Frequency
MID : Maritime Identification Digits
MMSI : Maritime Mobile Service Identity
MPDS : Mobile Packet Data Service
MRCC : Maritime Rescue Co-ordination Centre
MSI : Maritime Safety Information
MUF : Maximum Usable Frequency
Navarea: Navigational areas
NAVTEX: Navigational Text Message
NBDP : Narrow Band Direct Printing
NCS : Network Co-ordination Station
NDN : Non-Delivery Codes Notification
Nm : Nautical miles
NOAA : National Oceanic and Atmospheric Administration
NOC : Network Operations Centre
OSC : On-Scene Co-ordinator
OTF : Optimum Traffic Frequency
POR : Pacific Ocean Region
PSDN : Packet Switched Data Network
PSTN : Public Switched Telephone Network
PTT : Push To Talk
R/T : Radio Telephony
RCC : Rescue Co-ordination Centre
RF : Radio Frequency
ROC : Restricted Operator's Certificate
RR : Radio Regulations
RSC : Rescue Sub Centre
SAR : Search and Rescue
SART : Search and Rescue Transponder
SCC : Satellite Control Centre

SDR : Special Drawing Right
SES : Ship Earth Station
SHF : Super High Frequency
SMC : Search and Rescue Mission Co-ordinator
SOLAS : International Convention for the Safety of Life at Sea
SRR : Search and Rescue Region
SSA S: Ship Security Alarm System
SSB : Single Sideband
STCW : International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 as amended
SURPIC : Surface Picture
UHF : Ultra High Frequency
UTC : Universal Co-ordinated Time
VAT : Value Added Tax
VHF : Very High Frequency
VLF : Very Low Frequency
VTS : Vessel Traffic Service