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An integrated approach to maritime satellite communications in Mozambique : its impact on the Mozambique maritime infrastructure

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AN INTEGRATED APPROACH TO MARITIME SATELLITE COMMUNICATIONS IN MOZAMBIQUE:

Its impact on the Mozambique Maritime infrastructure

By

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Mozambique

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DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

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ABSTRACT

This dissertation examines the worldwide current development of Maritime Satellite Communications technology; the INMARSAT organization and its Maritime Services, either for safety of life at sea or commercial and social applications, as well as the introduction of the new Global Maritime Distress and Safety System (GMDSS), Search and Rescue (SAR) operations and the Communication systems for use in the GMDSS that comprise Satellite and Terrestrial Communications.

In addition, the research has addressed special attention to the review of the current state of maritime communications in Mozambique, the role that the national telecommunications company (TDM) plays in the maritime communications. The government efforts leading to the introduction of the GMDSS communications system in Mozambique and the activities of the national Maritime Safety Authority (SAFMAR) are also discussed in this paper.

The need of co-operation with neighboring countries in order to build up the efficient Maritime Rescue Co-ordination Centre (MRCC) is considered.

The routing arrangement with Coast Earth Stations providing services in INMARSAT-A, B, C and M in all four ocean regions coverage by INMARSAT geostationary satellites is shown to be the transitional stage to the full introduction of new technology based in Maritime Satellite Communications in Mozambique.

The need of training for those whose tasks are to operate the day-to-day GMDSS communications in Mozambique is discussed, as well as the role of Escola Nàutica de Moçambique (ENM) regarding the training of personnel for General Operator's Certificate (GOC), where the use of PC-based simulators, in addition to the real-life equipment already available at ENM is also considered.

The concluding chapter sum up the key issues discussed in this dissertation and gives more emphasis on the need of proper training of personnel to serve the GMDSS radio stations either ashore or onboard ships equipped with this technology, where proper use of the English language is required.

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LIST OF ABBREVIATIONS

AMC	Australian Maritime College
AMUs	Audio Multiplexer Units
ANFRENA	Agencia Nacional de Frete e Navegação (national shipping agency)
AOR-East	Atlantic Ocean Region East
AOR-West	Atlantic Ocean Region West
CBS	Computer Based System
CBT	Computer Based Training
CENCOMAR	Centro das Comunicações Marìtimas
CES	Coast Earth Station
COSPAS-SARSAT	Cosmicheskaya Sistyema Poiska Avariynych Sudov - Search And Rescue Satellite-Aided Tracking
CSS	Co-ordinator Surface Search
DANIDA	Danish International Development Agency
DMG	Distress Message Generator
DHSD	Duplex High Speed Data
DSC	Digital Selective Calling
EGC	Enhanced Group Call
ELT	Emergency Locating Transmitter
EMODRAGA	Empresa Moçambicana de Dragagens
ENM	Escola Nàutica de Moçambique

EPIRB	Emergency Position Indicating Radio Beacon
GAPROMAR	Gabinete de coordenação dos Projectos da Marinha Mercante
GHz	GigaHertz
GMDSS	Global Maritime Distress and Safety System
GOC	General Operator's Certificate
GOM	Government of Mozambique
HF	High Frequency
HSD	High Speed Data
ICAO	International Civil Aviation Organisation
ICO	Intermediate Circular Orbit
ID	Identification
IHO	International Hydrgraphic Organisation
IMN	INMARSAT Mobile Number
IMO	International Maritime Organisation
IMOSAR	IMO Search and rescue
INHAHINA	Instituto Nacional de Hidrografia e Navegação
INMARSAT	International Mobile Satellite Organisation
IOR	Indian Ocean Region
ISDN	Integrated Services Digital Network
ISID	International Ship Information Database
INTELSAT	International Telecommunications Satellite Organisation
ITU	International Telecommunications Union
KHz	KiloHertz
LUT	Local User Terminal
MCC	Mission Control Centre
MF	Medium Frequency

MHz	MegaHertz
MRCC	Maritime Rescue Co-ordination Centre
MSA	Maritime Safety Agency
MSI	Maritime Safety Information
MTC	Ministèrio dos Transportes e Comunicações
NAVIQUE, E.E	Empresa Moçambicana de Navegação, Empresa Estatal
NAVINTER	Empresa Moçambicana de Navegação Internacional
NAVTEX	Narrow-band direct printing telegraphy system for transmission and reception of maritime information
NBDP	Narrow Band Direct Printing
NCS	Network Co-ordination Station
NORAD	Norwegian Agency for Development
OSC	On-Scene Commander
PGS	Poseidon GMDSS Simulator
POR	Pacific Ocean Region
PLB	Personal Locator Beacon
RCC	Rescue Co-ordination Centre
RSC	Rescue Sub-Centre
SADC	Southern Africa Development Community
SAFMAR	Serviço Nacional de Administração e Fiscalização Marìtima (National Maritime Safety Authority)
SAR	Search and Rescue
SART	Search and Rescue Radar Transponder
SATNAV	Satellite Navigation
SES	Ship Earth Station
SHIPDECO A/S	Norwegian Shipping Development Company
SOLAS	Safety of Life at Sea

SRR	Search and Rescue Region
SRU	Search and Rescue Unit
STCW	Standards of Training, Certification and Watchkeeping
TDM	Telecomunicações de Moçambique
VHF	Very High Frequency
WMO	World Meteorological Organisation
WMU	World Maritime University

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INTRODUCTION

The use of developed Maritime Communications technology is seen as the only way in which the world maritime community can improve the safety of life and properties at sea, especially if all countries involved in the shipping business have to respond satisfactorily to the implementation of the new Global Maritime Distress and Safety System (GMDSS).

The author's intention in this dissertation is to evaluate the recent developments in Maritime Communications technology. This objective achieved in Chapter 1 to Chapter 3 of this paper. However, the idea is to establish which communications technology can best fit the reality of the situation in Mozambique.

Chapter 4 contains a review of current communication systems in Mozambique, while Chapter 5 examines the ways of upgrading Mozambique Maritime Communication systems, that comprises the introduction of the new Global Maritime Distress and Safety System (GMDSS); and an integrated approach to Maritime Satellite Communications in Mozambique.

Training and certification of GMDSS radio personnel in Mozambique is dealt with in Chapter 6, whilst Chapter 7 contains final conclusions and recommendations.

However, the author conducted this study in order to find out how Mozambique can be integrated into the new Maritime Communications environment and make proper use of the modern technology available worldwide. This study is mainly based on the operational procedures of Maritime Communications equipment. Hence, few technical aspects were discussed.

The research methodology applied to this study comprises interviews and discussions with different personalities involved in Maritime Communications in Mozambique. For instance lecturers in the radio department at Nautical School of Mozambique (ENM); maritime radiocommunications surveyors at the national Maritime Safety Authority; and personnel at the national Telecommunications company (TDM). However, the library of the World Maritime University was the main source of the materials that the author read during this study; in addition to learning through lectures and seminars. In addition, discussions were held with the course Professor and visiting Professors at the World Maritime University, including consultations with the INMARSAT maritime adviser and other maritime communications experts during field studies.

However, a number of difficulties in gathering relevant written materials from the author's home country were encountered during the research. Despite this, the author is confident that the out-come of the research forms a sound basis for the future development of Maritime Communications in Mozambique.

CHAPTER 1

INMARSAT Satellite Communication Systems

1.1 - A GENERAL OVERVIEW

The need for improvement in the safety of life at sea through the development of communications technology has been a major concern of the International Maritime Organisation (IMO) since 1966. Therefore, in November 1973, by Resolution A.305(VIII), the IMO Assembly decided to convene an International Conference to approve the principle of creating the International Maritime Satellite Organisation now known as International Mobile Satellite Organisation (INMARSAT).

The International Mobile Satellite Organisation (INMARSAT) was established in 1979, following the conference reconvened in September 1976 which adopted the INMARSAT agreements. However, in order to start operations, INMARSAT had to acquire satellites by leasing them from the United States' MARISAT System, the European Space Agency (ESA), and modified International Telecommunications Satellite Organisation (INTELSAT) Satellites.

1.2 - The INMARSAT Organisation

An international organisation with its headquarters in London, INMARSAT has been in operation since 1982. The INMARSAT organisation is patterned after the INTELSAT system and comprises three bodies:

1 - the Assembly

2 - the Council, and

3 - the Directorate

The Assembly is composed of 79 member countries (as of September 1995) and each country has one vote in its meetings, which are held every two years. The mission of the Assembly, inter alia, is:

- to formulate general policy and long-term objectives of INMARSAT; and
- to establish financial, technical, and working standards for the organisation.

The Council functions in a similar way to a corporate board of directors and is composed of eighteen signatories with the largest investment shares, plus four from developing countries that are appointed by the Assembly. In order to implement the policy decisions of the Assembly, the INMARSAT Council meets three times a year.

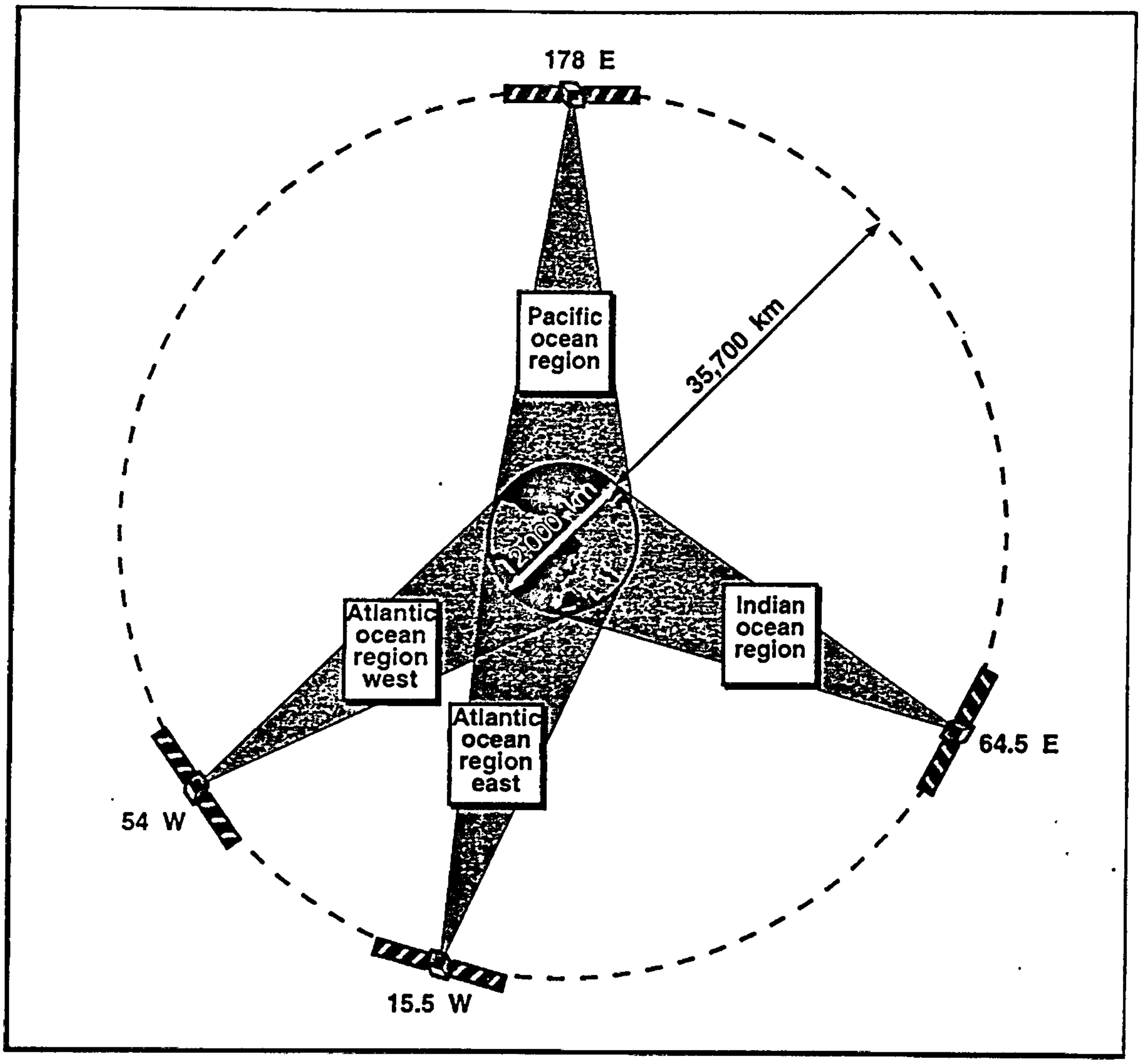
The day-to-day operations of the organisation are carried out by the Directorate with an approximately 500-member staff of different nationalities at the headquarters in London.

1.3 - The INMARSAT system and maritime services

INMARSAT is responsible for the procurement and operation of the space segment of the global mobile satellite communications system as well as the improvement of distress and safety of life at sea communications. In addition, INMARSAT satellites provide high quality voice, telex, data and facsimile services.

The second generation INMARSAT-2 Satellites (that comprises four satellites) were launched during the period 1990-1992. In doing so INMARSAT began moving ahead into the complete control and operation of world-wide mobile satellite communications, aeronautical communications, and land-based mobile communications. However, INMARSAT has a contract with Martin Marietta Astro

Figure 1 - View of INMARSAT Satellites in geostationary orbit above the four Ocean Regions



(Source: INMARSAT)

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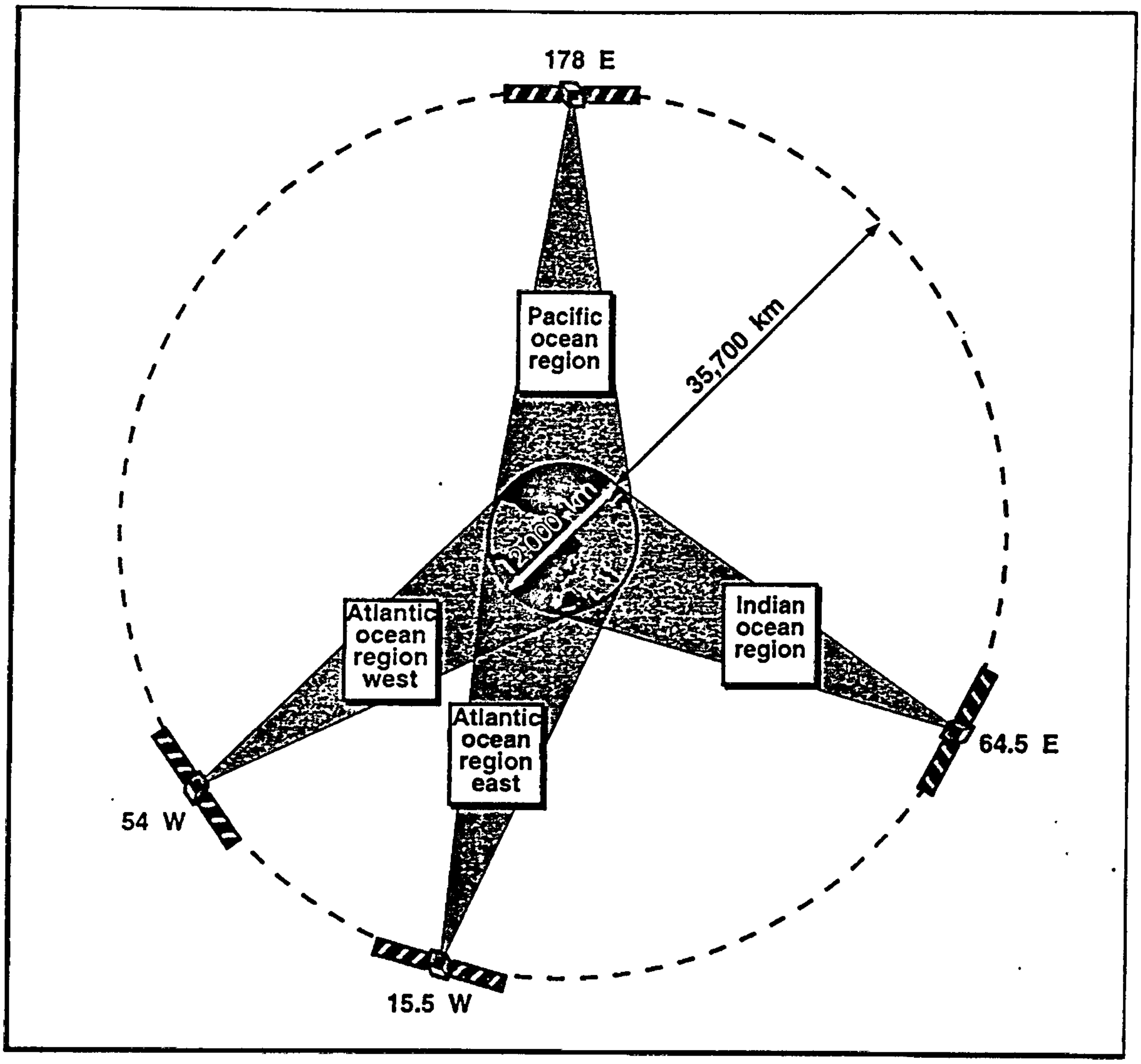

(Source: INMARSAT)

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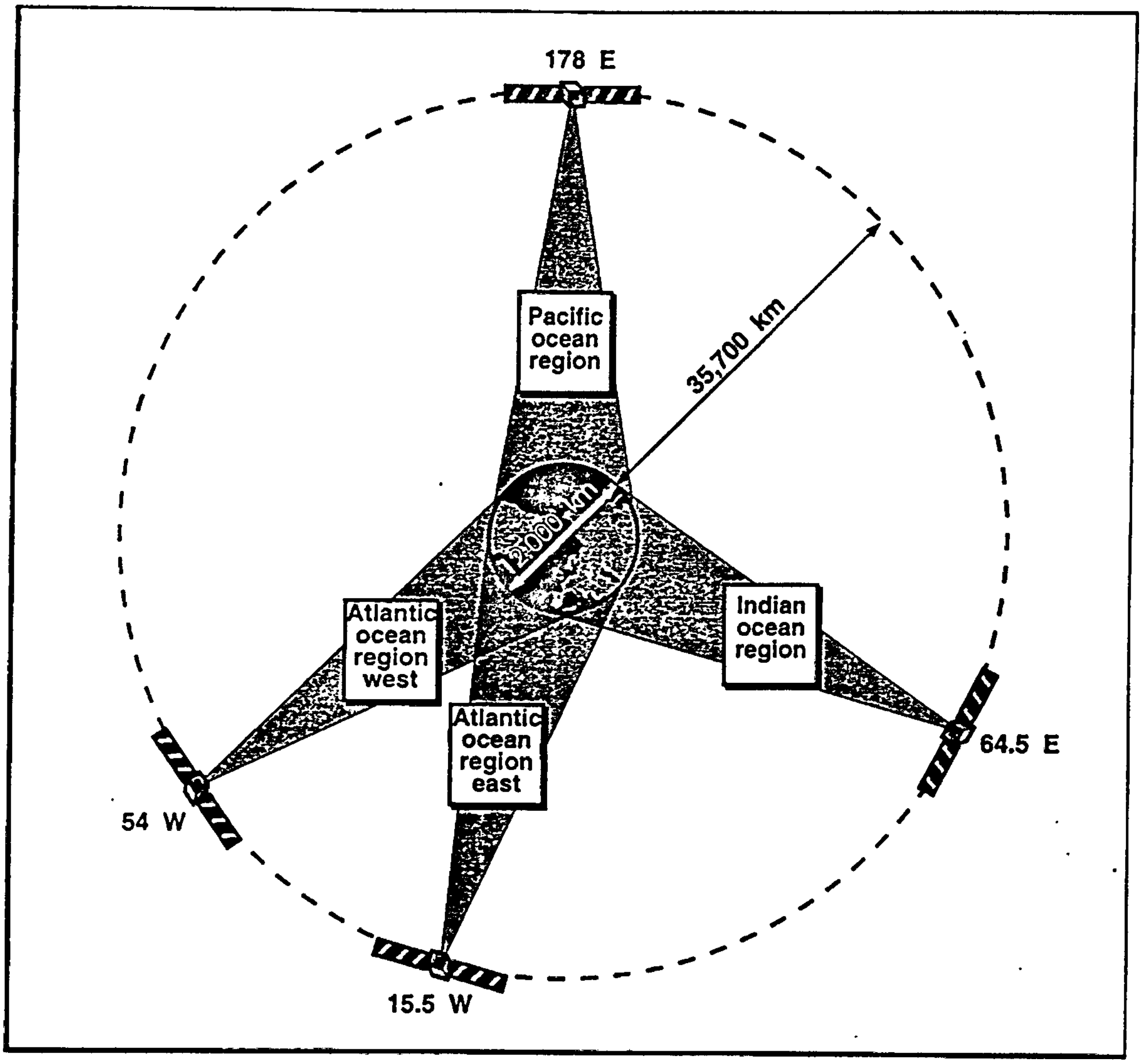


(Source: INMARSAT)

leading to the introduction of the more powerful third-generation INMARSAT-3 Satellites (that comprises four larger satellites) with launching scheduled to begin by the end of this year.

The INMARSAT communication systems comprises three major components: the Space Segment, the Ground Segment, and the Ship Earth Stations (SESs).

1.4 - The Space Segment

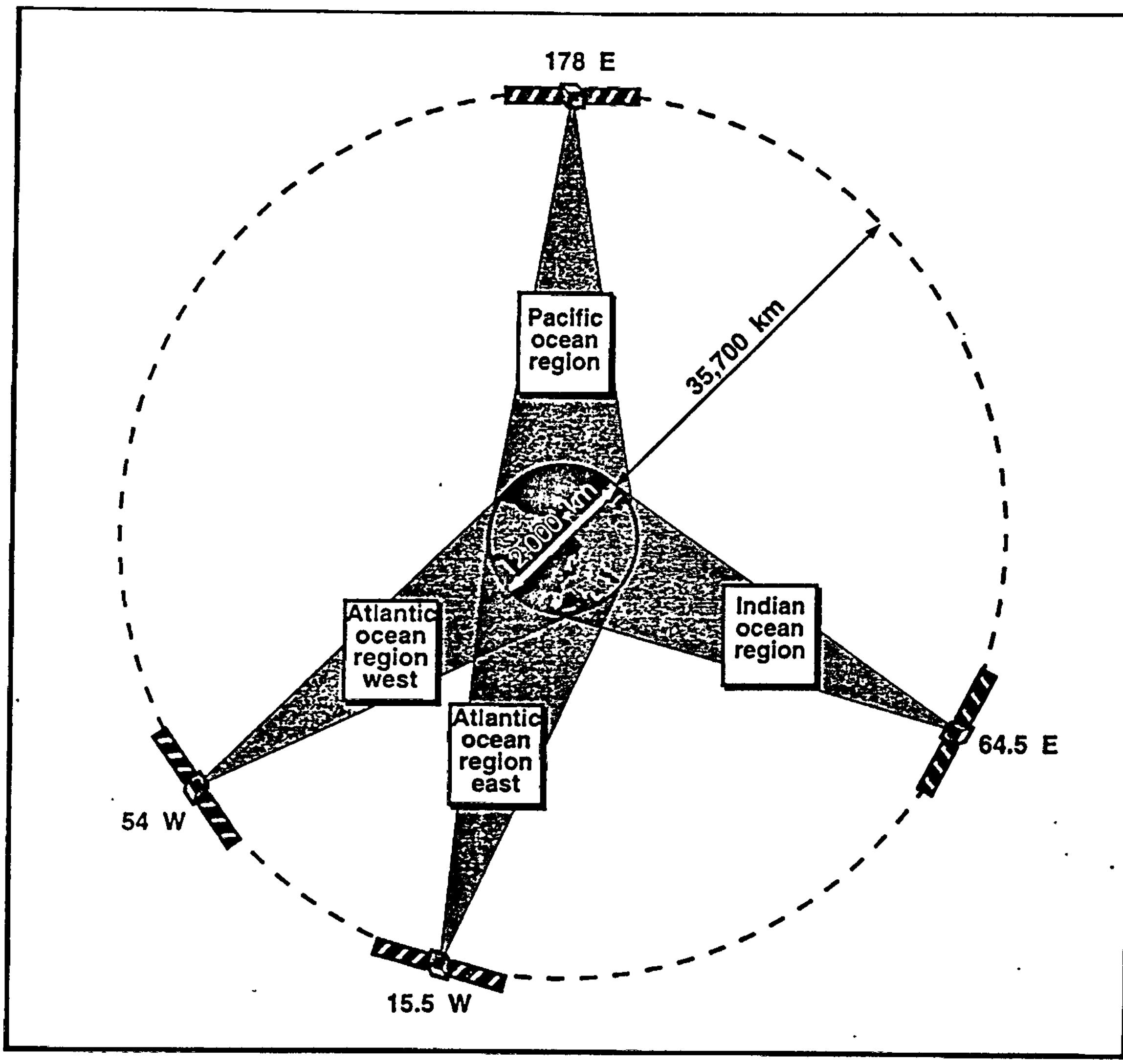
The Space Segment is maintained and operated by INMARSAT and comprises four geostationary satellites. Each satellite has an orbit above the earth's equator and in order to keep the same relative position to the earth, the satellite has to move in its orbit at the same speed as the earth in its rotation.

Each working satellite has one backup satellite in orbit. In case of failure of the working satellite, the backup will ensure that transmissions continue without any delay. The satellites are provided with solar panels to generate the electrical power for their functions. They are also provided with continuously charged batteries to provide backup power in case of an eclipse. Each of the geostationary satellites has a specific area of coverage sometimes referred to as its "footprint". The four areas of coverage are as follows:

- **Atlantic Ocean Region - East (AOR-East)**
- **Atlantic Ocean Region - West (AOR-West)**
- **Indian Ocean Region (IOR)**
- **Pacific Ocean Region (POR) (see figure 1.1).**

However, INMARSAT cannot perform reliable communications in latitudes greater than 70° North and South.

Figure 1 - View of INMARSAT Satellites in geostationary orbit above the four Ocean Regions



(Source: INMARSAT)

1.5 - The Ground Segment

The global network of Coast Earth Stations (CESs), the Network Co-ordination Stations (NCSs), and the Network Operations Centre (NOC), build up the **ground segment**.

The Coast Earth Stations (CESs), are owned and operated by INMARSAT Signatories (see Appendix A). The CESs provide an essential link between the satellites and the telecommunications networks on the earth's surface.

Communications from land to the ships at sea (SESs), are effected through the Coast Earth Stations. Parabolic antennas of between 11 m to 14 m diameter are usually used. These antennas are used to transmit signals at 6 GHz to the satellites and to receive signals from the satellites at 4 GHz

In each ocean region, communications are monitored and controlled by the Network Co-ordination Station (NCS). The NCS in each ocean region is responsible for the INMARSAT systems (telephone, telex, data, and facsimile) which communicate with the Coast Earth Stations in that ocean region, and with the other NCSs. The Network Operations Centre (NOC) in INMARSAT's headquarters plays an important role in maintaining connections between the NCSs and the satellites.

1.6 - The Ship Earth Stations

Ship Earth Stations are transmitting/receiving antennas installed on ships or on fixed installations at sea (e.g. offshore oil rigs) or ashore. The SESs transmit signals at 1.6 GHz and receive them at 1.5 GHz. Nowadays there are five types of shipboard INMARSAT satellite terminals:

- **INMARSAT - A**
- **INMARSAT - B**
- **INMARSAT - C**
- **INMARSAT - M**
- **INMARSAT - E**

The functions of these terminals will be described in subsequent chapters.

1.7 - INMARSAT's current activities

The development of technology is proceeding with time and INMARSAT has made a major step forward in this area by launching the **ship's black box**. This ship transmitting buoy, known **as the Starec buoy,** was recently developed by INMARSAT in co-ordination with the Norwegian firm LINKOM and the Japan Radio Company. The device is designed to improve maritime safety. Ships equipped with a Starec buoy can be surveyed while at sea at any time. According to an article in *The Telegraph* (1995, v. 28 n.1-January) this new float-free buoy,

> can measure and record position, course, speed, excess water in the bilge, status of bow and stern doors and hull stresses over a 24-hour period. The Starec buoy can float free in the event of an emergency, and send a distress signal to shore. If the ship sinks this buoy will float free and an authority on shore can command it to transmit all recorded data in its memory, providing immediate information about what might have gone wrong.

1.7.1- Project 21 / INMARSAT P

INMARSAT has a project known as Project 21 under which is considering building a new **Intermediate Circular Orbit (ICO)** Satellite system for 21st century. This project is aimed to the development and implementation of INMARSAT P. Hand-held phone, fax and data services to users anywhere in the world will be provided by this digital system.

CHAPTER 2

INMARSAT's operations and emergency services

2.1 - The INMARSAT-A System

Since the 1970s INMARSAT-A has been in operation for distress and safety purposes. In 1982, INMARSAT introduced this system into commercial operations. Currently INMARSAT-A terminals with a large radome covered stabilised parabolic dish are installed in more than 17,450 ships.

Most large oil tankers and other large sea-going ships are fitted with the INMARSAT-A system. In addition, fishing trawlers and luxury yachts are also major users. The functions of the INMARSAT-A system in the maritime environment are to offer commercial services, distress and safety of life at sea communications and social communications for crew members.

The INMARSAT-A Mobile Satellite Communications system is an analogue system that provides two-way direct dial telephone, telex, fax, electronic mail (E-mail) and data communications, from ship to shore and vice versa at a slow transmission rate of 9.6 kilobits per second (Kibts/sec).

High Speed Data (HSD) at rates of 56 and 64 Kbits/sec is the new option that has been developed by the manufacturers of INMARSAT-A, with the aim of meeting the needs of certain users. The HSD version is capable of transmitting large amounts of data. High definition still photographs and compressed video can also be sent from and received on an INMARSAT-A SES (Brödje, 1994, p47). This technology will enable shipping company superintendent or other experts to provide advice to a captain or chief engineer concerning repairs that might be necessary while a ship is at sea.

.2.2 - The INMARSAT-C system

In January 1991 the INMARSAT-C system was introduced with a smaller omni-directional and lighter antenna than that of INMARSAT-A. This system overcomes the disadvantage of INMARSAT-A by offering global maritime and aeronautical communications at lower cost.

INMARSAT-C is also an analogue system that offers means of sending two-way telex, E-mail and data communications at slow speed (at the rate of 600 bits per second) using store-and-forward transmission. However, this system does not provide voice communications. The INMARSAT-C operational frequencies are as follows:

- **Transmission 1626.5 - 1645.5 MHz**
- **Reception 1530.0 - 1545.0 MHz**

Currently, fishing vessels, yachts and small and large cargo vessels are fitted with INMARSAT-C, as are many shore-based installations.

2.3 - The INMARSAT-B System

INMARSAT-B, the latest INMARSAT system, was introduced in 1994, to take the place of INMARSAT-A. Developed because of commercial reasons, this new technology is designed to provide greater cost-effectiveness to the users in the maritime field.

There are no significant changes concerning the size of the terminal and the type of services provided by INMARSAT-A. However, INMARSAT-B is a full digital system that easily makes use of the space segment. The system offers high quality two-way direct dial telephone, telex and data communications, either single-channel or multi-channel, at a rate of up to 64 Kbits/sec. This enables the system to handle large amounts of data in a short period of time with lower charges. Moreover, INMARSAT-B is also capable of offering facsimile services at the rate of 9.6 Kbits/sec.

With the recent improvements made by the Japanese ANRITSU CORPORATION, the system is in addition capable of offering calls with privacy protection and by credit card calls. In brief, INMARSAT-B gives the mariners at sea and managers ashore access to better communications at lower charges.

Nowadays, there are almost 14 Coast Earth Station Operators providing INMARSAT-B services, and INMARSAT-B maritime terminals are available in 3 different models (Bonacic, 1995, p5).

2.4 - The INMARSAT - M system

INMARSAT-M is another new system developed by INMARSAT using the same technology as INMARSAT-B. This system was introduced during the course of the INMARSAT-B project to meet the crucial needs of coastal craft such as yachts and fishing vessels. The system has been available since the beginning of 1993.

The services offered by INMARSAT-M include two-way direct dial telephone with medium quality voice at 4,100 bits per second, low-speed fax and computer data communications at 2,400 bits per second. These services are cheaper and they are provided to users all over the world through compact size terminals.

Yachts and fishing vessels are the major users of INMARSAT-M, although some cruise liners and commercial vessels have also been equipped with this system. Moreover, the INMARSAT-M system is available for installation on road vehicles.

Nowadays, the growth of INMARSAT terminals installed world-wide is considerable. Brödje (1995,p37) noted that:

> as of June 1995, more than 25,000 Inmarsat-A, nearly 18,000 Inmarsat-C, nearly 6,000 Inmarsat-M and more than 800 Inmarsat-B user terminals have been commissioned on land, sea and in the air for use with the Inmarsat system. About 650 aeronautical earth station terminals have been commissioned for use on aircraft.

2.5 - The IMO requirements for the Global Maritime Distress & Safety System (GMDSS)

The IMO has specified the minimum set of communications equipment required for the GMDSS. The INMARSAT-C system performs reliable global communications concerning Maritime Safety Information (MSI) and distress alerts between ship earth stations and coast earth stations. This has led to INMARSAT-C being accepted by the IMO as fulfilling the requirements of the GMDSS. In addition, the INMARSAT-A and INMARSAT-B systems have been approved by IMO as complying with the new safety regulations under the GMDSS. However, at present INMARSAT-M does not comply with the IMO requirements.

2.6 - Introduction to the GMDSS - general overview

As mentioned in Chapter 1, the International Maritime Organisation established International Maritime Satellite Organisation, in order to further its primary objectives (safer ships and cleaner oceans) by providing reliable distress and safety of life at sea communications through a Satellite system.

However, INMARSAT seemed to become more involved in providing commercial communications than distress and safety communications. Therefore, after the adoption of the International Convention on Maritime Search and Rescue in 1979 (1979 SAR Convention), the IMO Assembly, in order to enhance the execution of the plan prescribed in this convention, had to develop the new Global Maritime Distress and Safety System (GMDSS). This was done in co-ordination with some other United Nations specialised agencies such as the International Telecommunications Union (ITU), the World Meteorological Organisation (WMO) and other international organisations such as the International Hydrographic Organisation (IHO), the International Maritime Satellite Organisation (INMARSAT) and the Space system for search of distress vessels - Search And Rescue Satellite-Aided Tracking (COSPAS-SARSAT).

However, with the aim of making the GMDSS system mandatory on board ships, the IMO Assembly convened in November 1988 a GMDSS Conference, the so called **"Conference of Contracting Governments to the International Convention for the Safety of life at Sea, 1974 on the Global Maritime Distress and Safety System."** This conference adopted amendments to the SOLAS Convention 1974 concerned with radio communications for the Global Maritime Distress and Safety System (GMDSS). The implementation of the GMDSS started on 1 February 1992, and will be completed on 1 February 1999. Therefore, vessels being constructed on or after 1 February 1995 are required to be fitted with GMDSS equipment.

2.6.1 - The old radio communications system

Under the previous International Telecommunications Union (ITU) radio regulations defined in the SOLAS Convention, 1974 certain classes of ships were obliged to carry on board radio equipment to keep continuous listening on the international distress frequencies. All cargo ships of 1600 gross registered tons (grt) and over, and all passenger ships were required to carry Morse telegraphy at 500 KHz. Therefore a highly-trained Morse telegraphy operator was required on board. In addition, all cargo ships of 300 or more gross registered tons (grt), and all passenger ships were required to carry a radiotelephony system operating on 2182 KHz and 156.8 MHz.

The shipborne medium frequency equipment has a limited transmission range of 100-150 nautical miles. A ship beyond this range, when in distress, cannot be rendered assistance from shore-based search and rescue authorities. In this situation only neighbouring ships were able to receive the distress signal and consequently provide the necessary assistance. If there was no ship in the vicinity, the crew and passengers will unfortunately be able to die, because of lack of long range communications.

2.6.2 - Communication systems for use in the GMDSS

The GMDSS is specially designed to handle both satellite communications and terrestrial communications.

2.6.2.1 - Satellite communications

With the GMDSS, a communications network is required, and this can easily be achieved using the satellites provided by INMARSAT. The L-band (1.5 and 1.6 GHz) fitted in SESs or satellite EPIRBs is used for distress alerting. In addition, broadcasts of Maritime Safety Information (MSI) to ships trading in areas outside the coverage of the NAVTEX system are made through the INMARSAT SafetyNET System.

The COSPAS-SARSAT (space system for search of distress vessels - Search And Rescue Satellite-Aided Tracking) system, which uses polar-orbiting satellite EPIRBs in the 406 MHz frequency band, offers a distress alerting capability. The identity and position of a ship in distress or its survival craft can be sent through the system by manually or automatically activated float-free satellite EPIRBs.

2.6.2.2 - Terrestrial communications

The GMDSS also provides terrestrial communications. In order to perform reliable distress alerting and safety communications, terrestrial radio communications (in the VHF, MF and HF bands) are being upgraded to fully automated Digital Selective Calling (DSC). The by terrestrial communications services provided are as follows:

- **long-range service**
- **medium-range service**
- **short-range service**

2.6.2.2.1 - Long-range service

The long-range service in areas outside INMARSAT coverage is only provided on high frequency (HF) channels in both the ship-to-shore and shore-to-ship directions. This service employs the following frequencies: 4,6,8,12 and 16 MHz. HF is commonly used as a backup system in areas covered by INMARSAT.

2.6.2.2.2 - Medium-range service

The medium radio frequency (MF) of 2 MHz provides medium-range service. The frequency of 2187.5 KHz upgraded to DSC is used for distress alerting and safety communications in the ship-to-shore and shore-to-ship directions. The frequency of 2182 KHz is allocated to distress and safety traffic by radiotelephony. Furthermore, it can be used in search and rescue (SAR) co-ordinating activities and on-scene communications. Distress and Safety traffic also can be handled by using a narrow band direct-printing (NBDP) system on 2174.5 KHz (IMO, 1992a, p.6).

2.6.2.2.3 - Short-range service

The short-range service is provided by the following very high frequencies (VHF):

- 156.525 MHz (channel 70) upgraded to DSC for distress and safety calls; and
- 156.8 MHz (channel 16) used in radiotelephony to handle distress and safety traffic as well as SAR co-ordinating and on-scene communications.

VHF does not provide direct-printing telegraphy service.

2.6.3 - The implementation of the new GMDSS

The implementation of the new GMDSS is the full responsibility of the Administration of each Contracting Party. Therefore the international rules and regulations of the GMDSS must be carefully interpreted by that Administration in the context of the prevailing conditions. This should be done under the auspices of Chapter IV of the International Convention for the Safety of Life at Sea, 1974.

2.6.4 - Advantages of the GMDSS

The primary function of the GMDSS, is to improve distress and safety of life at sea communications through advanced technology that ensures the reliability of both terrestrial and satellite communications. It is important to highlight that the GMDSS also provides terrestrial communications and that its key advantage is that it encompasses automated radiocommunication systems for satellite as well as terrestrial communications. The Digital Selective Calling (DSC) capability is another significant advantage of the new GMDSS.

The GMDSS allows a ship in distress to send a distress signal to the search and rescue authorities ashore and simultaneously alert the ships in the vicinity. The shore-based search and rescue centre also can alert the ships in the vicinity and co-ordinate the assistance and search and rescue operations.

With full implementation of the GMDSS on 1 February 1999, the Morse telegraphy will cease to be used at sea. Consequently the traditional Morse telegraphy operator will no longer be employed on board ships. Therefore, nowadays distress and safety communications, as well as commercial and social communications provided by the GMDSS can be handled by the shipmaster and his officers on board, while keeping a proper look out.

2.6.5 - Disadvantages of the GMDSS

The main disadvantage of the GMDSS for developing countries is the cost. They may be not able to handle the costs of purchasing the equipment and the expenses which will arise due to the special care that is needed to keep the equipment in good working condition (e.g. an air-conditioning system and the necessary power supply) as well as general maintenance. In addition, the implementation of the GMDSS system will cause serious unemployment problems. A large number of radio officers onboard will be made redundant.

2.6.6 - Vessels to be subject to the GMDSS

The GMDSS technology is available to provide all types of communication for every type and size of vessel. However, the carriage of GMDSS equipment will be mandatory on board vessels operating under the SOLAS Convention 1974, namely:

- cargo vessels of 300 gross registered tons (grt) and over; and
- all passenger vessels engaged in international voyages.

On vessels other than those mentioned above, the carriage of the GMDSS equipment will be optional.

2.6.7 - Functional requirements

A ship operating in a sea area defined under the GMDSS should be equipped in order to be able to perform the following nine communications functions as required by IMO:

1) Distress alerting, ship-to-shore
2) Distress alerting, shore-to-ship
3) Distress alerting, ship-to-ship
4) Search and rescue co-ordination communications
5) On-scene communications
6) Locating signals
7) Transmitting and receiving Maritime Safety information (MSI)
8) General radio communication
9) Bridge-to-bridge communications

(Source: IMO)

2.6.8 - The GMDSS carriage requirements

Contrary to the previous radio regulations, where the communications equipment carried on board was determined by the ship's size in terms of gross registered tons, with the GMDSS the minimum level of equipment to be carried on board to ensure safety of life at sea and other communications will be determined by the declared ship's area of operations.

2.6.8.1 - Sea areas

In the GMDSS, the oceans and coastal waters are divided into four distinct sea areas. The IMO has already laid down the specifications of radio communications equipment to be carried on board ships operating in certain areas (see appendix B).

The Administration of each Contracting Government has the responsibility to declare its own sea area(s), bearing in mind the level of communications to be provided in order to ensure reliable distress and safety, commercial and social communications in the area(s). The sea area(s) can be declared in co-ordination with neighbouring countries.

There are many coastal states with fleets under the SOLAS Convention 1974, but they have not yet determined their sea area(s). However, it has already been agreed that a non declared sea area is considered as A3. Hence, even ships sailing on short voyages, as long as they are international, are required to carry on board long-range GMDSS equipment as well as a highly trained operator. The sea areas are defined as follows:

Table 2 - Sea areas

Sea area A1 - means an area within the radiotelephone coverage of at least one VHF coast station in which continuous DSC alerting is available.
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.
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.
Sea area A4 - means an area outside sea areas A1, A2 and A3 (the polar regions beyond INMARSAT coverage).

Source: GMDSS Handbook-IMO

As can be seen Digital Selective Calling (DSC) is the key element in the GMDSS equipment requirements. Even ships trading in the range of a VHF coast station must have continuous DSC alerting.

2.6.9 - Digital Selective Calling (DSC)

Digital Selective Calling is a new technology that allows radio communications to be connected automatically. The principle of this technology is almost the same as with the telephone. In the GMDSS, DSC is applied to the VHF, MF, and HF radio communications frequency bands. Radios upgraded to DSC are able to announce an incoming call by sounding an alarm, so that the operator does not need to keep watch standing beside the radio. He/she can do other things while waiting for a call. The automatic transmission of distress alerts is of great importance, so that a rescue co-ordination centre (RCC) can be alerted that a ship is in danger and take proper action with the minimum of delay.

2.7 - The rôle of INMARSAT in the GMDSS

The world-wide INMARSAT satellite coverage is of particular importance in the GMDSS. The fully automated satellites are capable of transmitting a distress alert from ship-to-shore and the subsequent acknowledgement of the alert without any delay. The rescue co-ordination centre (RCC), after notification by the CES, can relay the distress alert if necessary and co-ordinate the search and rescue operations immediately.

2.7.1 - Distress alerting from ship-to-shore

The INMARSAT systems approved by IMO for use in the GMDSS in case of emergency situations offer priority access to their satellite channels. Distress priority alerting, when selected, will automatically route the distress call to the appropriate associated RCC (when the RCC is interconnected with the CES), and therefore special attention is requested. Otherwise, the distress alert will be routed automatically to the CES and then processed to the appropriate shore-based RCC. Usually the CES is connected to the RCC by dedicated lines or by a public network.

2.7.1.1 - Distress alerting through INMARSAT-A

A ship equipped with the INMARSAT-A system can, when in imminent danger, send a distress alert using a warning technique known as distress priority provided by the system itself. This allows the message with distress priority indication to be easily pointed out at the CES.

The distress call can be made when all satellite channels are providing non-distress communications. Therefore, a satellite channel is also instantly assigned as there is a distress priority alert and if there is no dedicated channel, the system will automatically pre-empt one of the channels so that it can be devoted to the SES in distress. In a few seconds the distress message will be automatically routed through the CES to the associated RCC. This operation is fully automatic and does not require any operator.

However, the processing of distress calls is automatically monitored by the NCS in each ocean region in order to ensure proper procedures. Simply pressing the "distress button" on certain SESs has made the routing of distress priority messages easier and faster for the shipmasters and the officers. For more details about how to send a distress call using an INMARSAT-A SES, see Appendixes C and D.

2.7.1.2 - Distress alerting through INMARSAT-B

An INMARSAT-B SES is provided with means that allow it to start distress calls using either telephony or telegraphy. The operational procedures for these services are similar. However, the SES Network Record has memorised the identification (ID) of all coast earth stations (CES) as well as the respective ocean regions. Hence, to send a distress message to the CES, the SES has to use the correct ID. The changing of the CES's ID will be effected automatically when the ship passes from one ocean region to another.

In addition, distress calls in both services are automatically monitored by the NCS in each ocean region. If a CES is slow to acknowledge a distress call from a SES, that might be due to the failure of the SES to use the correct ID or to other reasons. When this happens, the NCS will transmit a "distress access request relay" message to the back-up CES. On receiving this message, the back-up CES will process and send it to the RCC in the same form as an SES-originated distress message.

The technique known as Distress Message Generator (DMG) allows a ship equipped with INMARSAT-B to transmit pre-programmed telex distress messages. Information about the ship's identity, position, course, speed (that can be updated automatically) and the type of emergency can be transmitted using this technique. This has to meet the format of the DMG message required by IMO. However, a "distress button" is available in the system to be used when the time is too limited to send a distress alert.

2.7.1.3 - Distress alerting by INMARSAT-C

Ships fitted with the INMARSAT-C system can send distress alerts to a CES by two different methods, namely the SES terminal menus and the remote distress button. The selected menus are provided with updated information regarding the ship's identification, position, course, speed and the kind of distress. This information can be introduced manually or obtained automatically from the integrated navigation instruments. However, to send this message to the associated RCC, the operator has to select the CES within the current ocean region. Of course, the nearest CES is advisable. If there is not enough time, the remote distress button is commonly used as an alternative to sending a distress alert, through the SES terminal menu.

2.7.1.4 - Distress communications

The previous sections have presented the basic procedures that a ship in distress situation will follow sending a distress alert to shore through INMARSAT systems. However, ships fitted with INMARSAT SES equipment can directly contact the desired RCC. INMARSAT strongly recommend that, in addition to following the calling procedures for routing calls, careful selection of the complete international telephone, fax or telex number is necessary.

Since the introduction of distress priority indication in the INMARSAT systems, the use of dedicated frequencies for distress and safety communications is no longer necessary. Nowadays distress messages are routed through the general communication channels on a distress priority basis, guaranteeing that they are received at the RCC with the necessary urgency.

2.7.2 - Shore-to-ship distress alerting

The INMARSAT-C SafetyNET service is mostly used by search and rescue authorities ashore to relay distress alerts. Therefore, only ships equipped with an INMARSAT-C SES are capable of receiving such messages. However, ships equipped with INMARSAT-A and INMARSAT-B SESs are not capable of receiving distress alerts. Hence special arrangements have been made so that shore-to-ship distress alert relays can also be received by these SES terminals. These arrangements comprise three modes, namely: *"all ships call"* *"geographical area calls"* and *"group calls to selected ships"*.

2.7.3 - Enhanced Group Call (EGC)

Enhanced Group Call is the main feature of INMARSAT-C system. It can be incorporated in the INMARSAT-C SES or provided as a separate unit. An authorised Information Producer utilise its capability to broadcast messages to selected groups of INMARSAT SESs fitted with an EGC receiver.

The messages broadcasted by the EGC SafetyNET^{SM} service can address Maritime Safety Information (MSI) to all or to selected SESs fitted with an ECG receiver within an ocean region or a defined geographical area such as a Navarea/Metarea. Likewise, the EGC FleetNET^{SM} service is used to broadcast commercial information to subscribers (INMARSAT, 1995, p6-14).

2.7.4 - Search-and-rescue (SAR) co-ordination communications

As previously mentioned in this Chapter, communications play an essential role in the co-ordination and control of search-and-rescue operations. The INMARSAT system provides a reliable connection between the RCC and the ship in distress, while linking other ships involved in assisting operations. Ships fitted with INMARSAT SES equipment can transmit a distress message to an RCC located at a great distance, and the RCC can immediately provide them with the necessary assistance or advice of actions to be taken.

2.7.5 - On-scene SAR communications

In the GMDSS, the VHF and MF frequency bands are normally employed for on-scene SAR communications. They link the SAR units to the on-scene commander (OSC) or co-ordinator surface search (CSS). Although, this operation requires terrestrial communications, INMARSAT satellites can be used where necessary.

2.7.6 - The INMARSAT-E system

The INMARSAT-E system functions over the INMARSAT geostationary satellites. This system is intended to provide a means of ship-to-shore distress alerting in the L-band. A vessel carrying an INMARSAT-E EPIRB (Emergency Position Indicating Radio Beacon) has greater chances of transmitting a distress alert. However, this signal can only be received in the INMARSAT-E distress alerting network, which is responsible for forwarding it to the INMARSAT-E RCC with a minimum of delay.

In order to enable the RCC to precisely locate the vessel or its survival craft, the EPIRB is built with a SATNAV (Satellite Navigation) that provides information concerning position, course and speed. If the vessel sinks, this device can float free and automatically start the transmission of distress alerting. In addition the EPIRB can be activated manually.

2.8 - Introduction to the COSPAS-SARSAT system

COSPAS-SARSAT (Space system for search of distress vessels - Search And Rescue Satellite Aided Tracking) is a satellite-aided search and rescue system jointly introduced and operated by organisations in Canada, France, the United States and Russia. The system employs polar-orbiting satellites and performs global distress alerting.. It is intended to facilitate the location of distress beacons. COSPAS-SARSAT comprises three categories of beacons: maritime EPIRBs, aeronautical Emergency Locating Transmitter (ELT) and Personal Locator Beacon (PLB). These beacons transmit distress alerts on the frequencies, 121.5 MHz and 406 MHz. It is important to highlight that there are EPIRBs used in INMARSAT satellites and others used in COSPAS-SARSAT satellites.

In the COSPAS-SARSAT system, an EPIRB, when activated, sends a distress alert to the satellite, which then relays it to the ground receiving station. The Local User Terminal (LUT) applies the Doppler effect differentiation to the incoming signal in order to determine the beacon's position and its identity. This information will then be routed to the Mission Control Centre (MCC), which will forward it to the appropriate RCC to initiate the SAR operations. Therefore, The COSPAS-SARSAT float-free satellite EPIRBs working on the 406 MHz frequency play an important role in the GMDSS. However, the COSPAS-SARSAT system is designed to handle only distress communications and a distress alert is transmitted in one direction: from the ship to the RCC.

2.9 - False alerts in the GMDSS

The introduction of distress alerting facilities in the GMDSS equipment has been considered a major step forward in increasing the chances of sending distress alerts at sea. However, inadvertent or incorrect operation of this equipment has increasingly caused false alert transmissions. The pie chart below gives an analysis of the false alerts received by the Maritime Rescue Co-ordination Centre at Falmouth (UK) during the period January - September 1994.

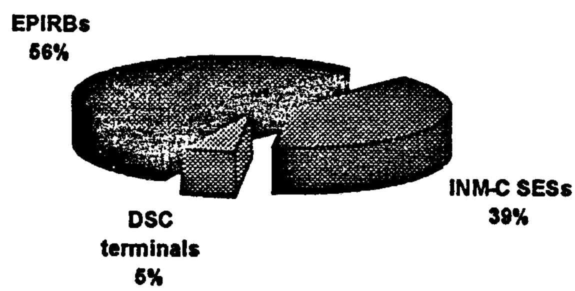


Figure - 2 Analysis of total 594 false alerts received at Falmouth

(Source of data: MSA)

It is difficult to estimate how many resources have been wasted by the Falmouth MRCC and other in responding to these false alerts. This situation constitutes a major threat to a ship in an emergency situation, because, for example, after the search and rescue forces have been involved in four false distress alerts, the SAR forces might respond inadequately to the fifth one, which might be a real distress situation.

2.9.1 - Measures to prevent false alerts

The Marine Safety Agency (MSA) - Department of Transport (UK) in Merchant Shipping Notice no. 1606 recommends measures to be taken to prevent this unfortunate situation. These measures range from actions to be taken by owners, masters and skippers to those to be taken by manufacturers, suppliers, installers and instructors.

2.9.1.1 - Actions to be taken by masters or skippers

Before appointing somebody to send a distress alert, it is strongly recommended that the master or skipper provide him with enough instruction and knowledge about the operational procedures for the GMDSS equipment. In addition, periodic training for all crew members is required to familiarise them with the equipment so that they will know what to touch and what not to touch.

2.9.1.2 - MF/HF DSC shipborne equipment

When the operator on board a ship operating in an A2 sea area receives a MF DSC distress alert on 2187.5 KHz, he should wait for the coast station to acknowledge it and send the distress relay before transmitting a DSC acknowledgement. When the ship receives distress traffic on 2182 KHz, the radio operator should acknowledge by means of radio-telephone (R/T).

However, if a ship operating outside an A2 sea area receives a distress alert with no doubt that the ship in distress is in the vicinity, the radio operator should acknowledge with a minimum of delay using R/T. DSC acknowledgement should be used where necessary. In addition, the RCC should be informed to take proper actions.

When receiving a distress alert on HF DSC, a ship should not acknowledge. The radio operator should listen on the other distress and safety frequencies (e.g. the radio-telephone and radiotelex frequencies) to find out if further DSC distress alerts are being sent. However, if there is no acknowledgement by the coast station, the radio operator is allowed to relay the distress alert.

2.9.1.2.1 - Silencing alerts sent inadvertently

A specific procedure should be observed by a ship to silence alerts sent inadvertently. The following procedure is recommended by the MSA - Department of Transport (1995) in the UK.

> if a MF DSC alert is sent inadvertently, then a message should be transmitted on 2182 KHz as follows: 'MAYDAY hello all stations (followed by ship identity number and ship name) cancel my DSC distress alert of (insert time) transmitted on 2187.5 KHz'. If the inadvertent distress alert has been acknowledged by a RCC then a message should be sent to that RCC as follows: 'MAYDAY, name of RCC, (followed by ship identity number and ship name). Cancel my DSC distress alert of (insert time) transmitted on 2187.5 KHz'. If an HF DSC alert is sent inadvertently, then the same procedures (above) should be followed using the appropriate HF frequencies.

2.9.1.3 - INMARAST SES terminals

The INMARSAT systems used in the GMDSS feature all the facilities that make it easier to send a distress alert, from menus to a red distress button. Therefore, special care is required when using or demonstrating these facilities. For example, when quitting from the menu on the screen after looking at the contents of the distress message generator, it is important to make sure that an inadvertent distress alert is not transmitted.

2.9.1.3.1 - Actions to be taken when an inadvertent distress alert is transmitted

In the circumstances that an INMARSAT SES transmits an inadvertent distress alert, with acknowledgement or not, the ship should contact the CES in order to cancel the INMARSAT distress alert.

2.9.1.4 - Satellite EPIRBs (406 MHz)

As described in 2.7.6, this device is designed to enable a ship to send a distress alert when in danger. It might also happen to be activated accidentally. In both situations the ship should use other means to call the RCC to clarify what might have gone wrong. In order to facilitate the locating of the ship and the assistance where necessary, the beacon should not be switched off before the RCC has been contacted.

2.9.1.5 - Actions to be taken by manufacturers, suppliers, installers and instructors

Everybody who deals with GMDSS equipment should have enough knowledge concerning all aspects of the system, including the problems that might arise when a false distress alert is transmitted.

Written and precise instructions with regard to operational procedures should be kept next to the installed GMDSS equipment to be consulted by the operator in case of doubt.

The facilities in the equipment used to send distress alerts should be protected, so that a distress alert can only be transmitted when intentionally activated. In addition, the activation of the distress button to initiate a distress alert transmission should require two independent actions, so that there is no possibility of inadvertent operation.

A light or alarm should be used to indicate an activated distress alert, whether deliberate or accidental.

CHAPTER 3

Other applications of INMARSAT satellite communications technology

3.1 - Fleet management

Nowadays computer systems are no longer seen as tools devoted only to engineering and navigational purposes. Indeed, ships are the maritime branches of shipping companies, in the overall businesses that are involved. The exchange of data communications traffic between shipping companies and ships at sea regarding commercial and operational procedures is a prerequisite for success in the maritime business. Although ships often spend a lot of time far from their shore-based offices, perhaps thousands of miles, this is no longer a problem because an interface between computer systems, modem and INMARSAT satellite communication terminals is now possible. This permits the transmission of large amounts of data in both directions: shore-to-ship and ship-to-shore. These data include the cargo manifest, the storage plan, crew wages and so on. In addition, satellite communications enable the shore-based management to be linked with the ship, facilitating decision-making in the entire business.

3.1.1 - The role of INMARSAT in facilitating the delivery of supplies onboard

Satellite communications play a major role in increasing the efficiency of routine management activities. One principle of good management is that ships should be asked to spend less time in port, because this reduces costs. Therefore, a ship's requirements such as provisions, bunkers and spares should be provided in advance so that the ship can get them delivered promptly on arrival.

Major suppliers, such as the National Ship Chandlers (Natal) based in Durban, South Africa, make use of the INMARSAT network to establish contact with ships while at sea, in order to know what they need to have onboard on arrival. In this way the supplier can ensure that ships' requirements are satisfied.

3.2 - Still video transmission via satellite communications

As discussed at the beginning of Chapter 2, the INMARSAT-A terminal is capable of transmitting, receiving and processing high resolution video pictures. However, this technology requires the use of suitable personal computers (PCs), e.g. Macintosh or IBM, capable of displaying live moving video on screen. These computers consist of a video frame grabber board, a video camera or still video camera and compatible asynchronous modems.

The pictures to be transmitted are taken by a video camera that is connected to the PC and then digitised and compressed for forward transmission via modem or saved as file on the PC for subsequent transmission. Alternatively the operator, on receiving a file, can handle the picture and transfer it to the appropriate expert through the computer system, if necessary.

3.2.1 - Areas of application

Still video transmission will enable a shipping company superintendent or other expert to receive video pictures of damaged equipment on board a ship. It will also provide advice to the captain or chief engineer concerning repairs that might be necessary while the ship is at sea.

This technology also will enable maritime insurance companies or brokers to receive pictures of accidents at sea for the purpose of insurance claims. For environmentalists, still video transmission will be of vital importance. They will be able to receive a live moving video reporting the amount of an oil spill at sea and the direction in which the oil is being driven by currents. They will also be able to predict the damage to the marine environment that might be caused by oil spillage. In addition, this technology will facilitate the co-ordination of cleanup operations. In addition, underwater video camera technology allows welding operations or general maintenance activities conducted on offshore oil rigs to be monitored by experts ashore through live moving video.

3.2.1.1 - Distance education

Live distance teaching can also be delivered using compressed video through INMARSAT-A high speed data. This could be done in a situation such as that of World Maritime University (WMU), which has many branches all around the world. If, for example, there were an updating seminar concerned with maritime education and training, the lecturer from WMU could deliver his lecture to the students in their home countries or the nearest countries where a WMU branch is available. The students would not need to travel to WMU in Sweden.

Answers to any questions that might arise during the lecture could be provided at the same time. Even debate involving students at different locations could be handled in compressed video through INMARSAT-A advanced technology.

3.3 - Video telephone through INMARSAT

The development of technology has recently brought out a new version of the telephone known as the videophone. This device comprises a video monitor, camera, phone and handset. The videophone is designed to allow people who are talking on the telephone to see each other, exchanging smiles and other types of body language. A button is pressed to initiate a call, which will be accompanied by the appearance of other person's picture on the screen with high quality voice on both sides. As with a television, the colour image can be adjusted if required. The videophone can also be used to provide voice only without an image, i.e. as a conventional telephone.

There are two types of INMARSAT videotelephone systems: analogue and digital. The analogue system provides a 7 cm (3 inch) colour screen to display an updated picture four times a second, while the digital system provides a 10 cm (5 inch) colour screen. A digital videophone must be connected to an INMARSAT-A terminal provided with the Duplex High Speed Data (DHSD) option at the rate of 64 kbps. On shore it is connected to a 64 kbps channel of an Integrated Services Digital Network (ISDN) line.

3.3.1 - Desktop video conferencing

Desktop video conferencing employs the same technology as the video telephone. Likewise, desktop conferencing allows users to initiate calls to other people from the PC screen. The connection follows the same procedure as with a normal telephone. This device consists of a PC, a small camera on top of the PC, a phone and a handset.

In 1992, the desktop video conferencing manufacturers agreed on a common standard known as H320, which standardises the technology needed to compress and decompress the images, sound and data transmitted on telephone lines that make live electronic meetings possible. This agreement was intended to overcome the problem of every manufacturer producing equipment based on their own standard, which would make the sharing of data with equipment from other manufacturers impossible.

Desktop video conferencing can be used for a number of purposes. For instance, business meetings can be conducted face-to-face through desktop video conferencing, that consequently will contribute in saving money and cutting the time and expenses of business travel. In addition, insurance companies can use this technology to obtain a customers' signature and exchange documents on PCs located in different sites.

3.4 - Onboard training via satellite communications

Ships are being equipped with very sophisticated technology whose operation requires well trained personnel. Mariners often find themselves without time to attend upgrading or refresher courses at an institution ashore. The solution is to bridge the gap with an onboard training program based on distance education.

Onboard training is the only way that a mariner can acquire the knowledge and skills that are required of him. There is no better site for practical training than the workplace.

Onboard training can be conducted using satellite communication connections no matter where the ship is trading. An effective link between the tutor in the institution and the mariner at sea can be achieved. INMARSAT-A, with its capability of providing a Duplex High Speed Data (DHSD) service at rates of 56 and 64 kbit/sec., seems to be the most appropriate choice in this case, although the Enhanced Group Call (EGC), a function of INMARSAT-C in its FleetNET service, can also be utilised for onboard training.

Furthermore, the acquisition of knowledge and skills onboard ships is strengthened by the use of computer based training (CBT). This is the case of those computers available onboard for operational purposes.

For any educational purpose, resource material is of great importance. Library information and other databases can be gathered on CD-ROM and interactive compact disc (CD-I) systems for onboard training. Through advanced technology as many as 2,000 books may be combined on one compact disc (CD). The CDs available for training onboard include Lloyds Classification Society Rulefinder (Lloyd's and IMO regulations), Fairplay World Shipping Encyclopaedia, the IMO's Dangerous Goods Code as well as the IMO Vegas database (Muirhead - 1995, p9).

Using satellite communications, cadets at sea can receive assignments and transmit them back to the tutor for marking and subsequent return while at sea in a matter of days. Where queries arise, either related to the assignment or the course itself, cadets can contact the tutor at the institution either by fax, telex or telephone using dedicated lines. Answers can be provided at the same time.

Advanced technology onboard ships often leads to the reduction of manpower. Therefore, there may not be enough time for a master or officer to monitor a cadet's performance in the tasks and skills assigned to him. Once more, the training institution or appropriate body ashore can carry out the monitoring and evaluation as well as provide advice on faults and deficiencies through satellite communications. Muirhead (1995, p11) noted that:

A pilot programme to monitor onboard deck cadet training programmes on selected Australian-owned ships commenced early in 1993, with the financial support of both INMARSAT and Telstra in Australia. Inmarsat/Telstra links and Enhanced Group Calling (EGC) FleetNet system are being used to monitor the progress of trainees in their onboard task and guided study programmes form part of the watchkeeping officer training. During this sea-going phase, cadets are "reminded" by the Australian Maritime College (AMC) on telex via the FleetNET ECG service of deadlines for submission as each assignment becomes due. Reports on practical tasks and assignments are sent by the cadets via INMARSAT to AMC tutors for assessment and return. This process takes days instead of months.

3.5 - The role of INMARSAT in the Ship Information Database to be set up by IMO

There is a need to realise the idea of creating an International Ship Information Database (ISID), as proposed by the government of the United States to IMO. However, it is important to bear in mind the distance between interested parties in the shipping industry if the information supplied to the ISID is to be world-wide. The solution is to bridge the gap with INMARSAT satellite communications, which would perform a key role in providing vital information to the database.

The information to be supplied to the database should be of vital importance in promoting the main objectives of IMO, namely 'safer ships' and 'cleaner oceans'.

The capabilities of INMARSAT-A and INMARSAT-C will enable interested parties in the shipping industry (e.g. shipowners, operators, charters, classification societies, flag states, regional port states authorities and insurers) to send to IMO information regarding certain ships, as well as exchange data between each other. In addition, they will have access to information within the ISID that might be helpful to them in making suitable decisions regarding specific ships in their individual interests.

Using satellite communications, port States will be able to access the ISID to obtain information concerning the safety status of a ship calling at one of their ports prior to her arrival. Through satellite communications classification societies, such as Lloyds Classification Society based in London, will be able to use the information in the ISID to monitor a surveyor's performance in Mozambique or to help them in making a decision regarding a change of class that might be necessary. In addition, insurers will be able to access the information available in the ISID to determine at what premium to insure a specific ship.

CHAPTER 4

Review of current communication systems in Mozambique

4.1 - Introduction

Mozambique is a country located in Southern East Africa, in the Indian Ocean, with a long coastline of about 1,458 nautical miles. The regional ports of Maputo, Beira, Quelimane, Nacala and Pemba, as well as the local ports of Inhambane, Vilankulos, Chinde, Macuse, Pebane, Angoche, Ilha de Moçambique, Ibo, Mocimboa de Praia and Palma make the overall picture of the Mozambican coast. See table 4.

The geographical location of Mozambique and its strategic position in the Southern Africa region constitute an important factor for the economic development of the country. In addition, this feature of Mozambique plays a crucial role for the economic development of the land-locked countries in that their seaborne trade is made throughout the regional ports of Maputo, Beira and Nacala. Other countries which are members of the Southern Africa Development Community (SADC), also make use of these ports for their economic growth, see appendix E.

Maritime transportation plays an active role for the development of the Mozambican economy as well as in the Southern Africa region in general. Hence, effective transport is only possible with reliable maritime communications, in order to ensure safety of life at sea as well as for commercial and social issues.

Table 4 - DISTANCE TABLE IN NAUTICAL MILES

530	1431	1277	1183	1128	1004	985	945	882	807	758	658	638	530	488	440	408	180	MOMBASA
1380	1293	1139	1039	990	866	847	807	744	669	620	520	500	392	350	310	270	DAR ES SALAAM	
1112	1063	912	783	760	642	622	595	536	452	405	301	251	154	111	72	PALMA		
1075	1004	853	748	701	583	563	536	477	407	346	242	216	117	72	MOCIMBOA DA PRAIA			
1019	948	797	685	645	527	507	480	421	337	290	186	150	45	IBO				
979	903	752	651	602	482	462	435	376	292	245	141	110	PEMBA					
898	827	688	573	544	406	386	359	300	212	169	64	NACALA						
840	769	618	515	480	348	378	301	242	154	106	ILHA DE MOZAMBIQUE							
756	685	538	447	389	260	235	205	141	69	ANGOCHE								
707	636	472	380	340	199	174	142	80	MOMA									
650	579	430	311	263	131	100	74	PEBANE										
605	534	386	269	208	73	48	MACUSE											
598	523	361	254	197	63	QUELIMANE												
558	489	327	201	149	CHINDE													
481	389	264	132	BEIRA														
374	312	171	VILANKULOS															
254	182	INHAMBANE																
72	INHAMPURA																	
MAPUTO																		

MOZAMBIQUE CHANNEL

302	DURBAN		
493	266	EAST LONDON	
694	398	140	PORT ELIZABETH

Modified from: Navique E.E. (1993)

4.2 - Telephone Network communications

Telecomunicações de Moçambique (TDM) is the government entity responsible for telephone network communications in Mozambique. Nowadays, this company has made possible connections between districts in all provinces, as well as interconnecting them with the world at large, through telephone or fax. In Mozambique, satellite communications technology is in an advanced state of development.

Currently, TDM is working hard in order to expand the telephone network through the entire country. On-going activities regarding the establishment of landbased installations, that consist of parabolic antennae, which are to be used for transmission and reception of signals to or from the satellite, are being developed in certain localities. As can be seen today, from Malehice - Chibuto it is possible to make a direct telephone call or send a fax to anywhere in the world, as well as to receive them.

Very soon, telephone network communications are expected to make a good contribution to the overall maritime communications in Mozambique. This is to be described in more detail in subsequent lines.

4.3 - The current state of Maritime Communications

4.3.1 - General overview

The idea leading to the establishment of Coastal Radio Stations in Mozambique has been developed since the period of 1980-1981. To realise this idea, the Government of Mozambique (GOM) signed an agreement with an Italian company, which intended to install them in Maputo, Beira and Nacala, these being the major ports in the country. Following this agreement, the Italian company started to send a considerably quantity of very sophisticated radiocommunications and aerial/tower equipment. Some of this equipment was installed. Nevertheless, the idea of building up the coastal radio stations came unstuck. As a result, the major part of the equipment distributed in Beira and Nacala, was collected and sent back to Maputo. An obvious result of such transfer of delicate equipment ended with damage as well as loss.

In 1989 a thorough study concerning maritime communications in Mozambique was conducted by Consultel, Spai-Rome. This study came up with the plan known as the Master Plan for Maritime Communications. The main idea in this plan was also the establishment of Coastal Radio Stations in the country. However, this time the Mozambican's long coastline was divided into 4 categories of coastal radio stations, where the principal stations were to be built in Maputo, Beira and Nacala, while the second and third categories of stations were to be installed in Inhambane, Quelimane, Pemba, Angoche, Mocimboa da Praia, Vilankulos, Chinde, Songo and Metangula respectively. Finally the fourth category of stations was devoted to Pebane and Zumbo.

However, the establishment of these stations was not based on the new system of Maritime Communications, the GMDSS. The use of maritime frequency bands upgraded to Digital Selective Calling (DSC) was not taken into consideration, in the radiocommunications equipment to be installed. In addition the already existing equipment was also not taken into account. But the budget for this project was calculated in US Dollars 13,440,000 (in 1989). This amount also did not include training of personnel, as well as maritime Search and Rescue (SAR) equipment or other facilities necessary to enhance safety at sea. Consequently this plan also did not eventuate.

In April 1993, the Mozambican Government represented by the Gabinete de Coordenação de Projectos da Marinha Mercante (GAPROMAR) signed a contract with the Norwegian Shipping Development Company ($SHIPDECO_{AS}$) leading to a Study on Communication Net for Safety at Sea in Mozambique, as well as the revision of the existing Master Plan for Maritime Communications.

A team composed of three experts in maritime communications representing $SHIPDECO_{AS}$ and two counterparts acting on behalf of Ministèrio dos Transportes e Comunicações (MTC) and Telecomunicações de Moçambique (TDM) conducted the study.

This study was mainly based on consultations, meetings, discussions, interviews with those in the institutions dealing or interested in Maritime Safety Communications at Sea in Mozambique, as well as inspections to the sites for both transmitting and receiving stations in Maputo and Beira. In addition, certain international organisations acting in Mozambique such as the World Bank, NORAD and DANIDA were also consulted.

This study resulted in a project for the re-establishment of a Coastal Radio Service in Mozambique. Of course nowadays, in planning the establishment of maritime communications that are to enhance safety of life at sea, the GMDSS system is the best choice. Therefore, in the report presented by $SHIPDECO_{AS}$, the basic idea is to encourage the Government of Mozambique (GOM) to declare a Sea Area A2, in order to introduce the GMDSS communications system in the Mozambican waters, based upon the carriage requirements in the operational Sea Area A2.

Contrary to the Master Plan presented by Consultel, Spai-Rome 1989, SHIPDECO$_{AS}$ is of the opinion that only one main Coast Radio Station needs to be installed in Maputo. In addition, there are to be five secondary stations, each covering approximately 150 nautical miles (MF frequency band) along the Mozambican coastline, namely Inhambane, Beira, Quelimane, Nacala and Pemba.

This project extols the establishment of a Maritime Search and Rescue Centre in Maputo, as well as training of personnel. Furthermore, the equipment already existing in the country is to be upgraded, in order to meet the GMDSS requirements. This is the case of VHF and MF frequency bands that are to be upgraded to Digital Selective Calling (DSC).

The budget for the implementation of this project is estimated in US Dollars 1.899 million (as of October 1993).

As mentioned above, since many years ago, the government of Mozambique has been fighting in order to establish proper Maritime Radiocommunications along the coast, that unfortunately is still to be established. However, there is a need for communications at sea. So, a number of entities with certain interest in shipping, such as the national shipping company, Empresa Moçambicana de Navegação, Empresa Estatal (NAVIQUE, E.E.), fishing companies, as well as the agents of foreign ships calling at Mozambican ports, in order to keep themselves in constant contact with their ships, have established private HF radiocommunication networks in different sites. This has been also the practice of Maritime Administrations in Maputo, Inhambane, Beira, Quelimane, Nacala and Pemba, so as, to some extent to provide help for ships moving to or from their harbours.

Although the telephone communications are being developed so quickly in the country, they do not yet cover in totality the area along the coast. Therefore, point-to-point communications have been made through private communication networks using maritime frequency bands. In addition to the above mentioned companies and maritime administrations, the Empresa Moçambicana de Dragagens (EMODRAGA) and the Instituto Nacional de Hidrografia e Navegação (INAHINA) are also the major owners of private radiocommunications.

However, there are no regulations in terms of radiocommunication procedures. Hence everyone uses his/her own style that for instance has caused confusion and misunderstanding in the overall communication network.

4.3.2 - Analysis of equipment used in the existing radio stations and present personnel

4.3.2.1 - Maputo Coast Radio Station

Based on the previous signed contracts, TDM has already taken forward steps in order to attempt the establishment of a Coastal Radio Station in Maputo. This station is composed of three parts as follows: the VHF station in Maputo, the receiver station at Sommerschield and the transmitter station at Matola. A large amount of aerial/tower equipment, including parts of existing sophisticated electronic equipment are already installed on this site.

The VHF station in Maputo is located in "Mira-d'ouro", with a clear view to the sea, monitoring all the traffic coming in or going out of Maputo port, while the receiving station and the transmitting station are located in areas far from the sea view, due to the need for taking advantage of existing infrastructures. TDM owns a plot of land and buildings that are air-conditioned on these sites. In addition, TDM has already available remote control lines, power supply and stand-by diesel generators.

The receiver station at Sommerschield comprises three operator consoles, modern air-conditions and a 30 KVA stand-by diesel generator. Indeed maritime frequency bands, including all methods of maritime communication, that from Morse, radio telephony to radiotelex can be handled in this station. The TDM network through cable and digital connections facilitates the remote control of transmitter station at Matola and the VHF station in Maputo.

At the receiver station, there are thirteen Morse-operators with different educational backgrounds. Some with high-school leaver (eleventh "grade of previous schooling system) and others with less than that, possibly sixth grade of schooling. As regards English language, five of them have general knowledge and ability to speak, while the other eight have no ability at all, they only communicate in the Portuguese language.

At Matola, the station consists of five Danish HF radio-transmitters and two Danish MF radio-transmitters, devoted to maritime communications, where they share the same building with many other transmitters (used for other than maritime purposes). In addition, air-conditioning systems as well as a 60 KVA stand-by generator are available for use in this station. However, the transmitters are not linked to any aerials.

The present personnel in the transmitter station at Matola is composed of five employees, as follows: one technician, one operator, two auxiliary technicians and one looking after the generator. These workers are exercising their duties in the maritime transmitter station, as well as in the other transmitters in the building.

Table 4.1

Radio equipment of the TDM available for the Coast Radio Station in Maputo

• 3 MF receivers, Dansk radio model M 1500 (Skanti R 5000 or 5001)
• 7 HF receivers, Dansk radio model M 6000
• 1 Antenna multicoupler, TVR 3x3
• 2 MF transmitters 400W, Dansk radio S 1250
• 5 HF transmitters 1 KW, Dansk radio model S 76000
• 2 HF transmitters 1 KW, Dansk radio model 7600 (in Beira)
• 2 HF transmitters 1 KW, Dansk radio model S 76000 (in Nacala)
• 8 Data Modem ITT
• 6 Remote control Unit, Dansk radio, model FS 6001 for S 76000
• 2 VHF transceivers, LABES channel 16 simplex
• 4 RCU Dansk radio model FS 6002 for S 76000
• 3 Receivers, Dansk radio model 3000
• 1 VHF transceiver LABES channel 27 duplex
• 1 VHF transceiver LABES channel 25 duplex
• 1 VHF transceiver LABES channel 28 duplex
• 2 Cabinets with antennae Couplers, LABES (VHF site Maputo)
• 3 Remote control and telephone terminal, LABES model CSF-1A/B
• RF antenna matrix (incomplete)
• 2 telephone terminal, ITT/STANDARD model DR-278A
• Push-to-talk microphone, desktop
• 3 Morse keys
• 2 telephone sets
• 1 HF Receiver, Dansk Radio model M.6000, out of service
• 1 HF Transmitter, Dansk Radio model S.7600, out of service

Modified from: SHIPDECO A/S (1993)

4.3.2.2 - Maritime Administrations

All Maritime Administrations along the Mozambican coast, namely Maputo, Inhambane, Beira, Quelimane, Nacala and Pemba employ Danish VHF, MF and HF transmitter/receivers. These maritime frequency bands are used to communicate with vessels in Mozambican waters, either by radiotelephony or radiotelex, where applicable, although HF frequency band is also being used for point-to-point network between Maritime Administrations and other entities, such as NAVIQUE, INAHINA, EMODRAGA etc., in place of telephone that is now being installed in the Maritime Administrations.

The Station Radio Naval Maputo at present employs five people. Two of them are highly trained Morse-telegraphy Operators. However, no-one has a radiotelephone operator's licence. Nevertheless, to a certain extent they operate on the radiotelephone as well as radiotelex. With regard to their knowledge of the English language, it is not good enough for the proper operation of maritime radiocommunications, if looking at the necessary assistance required for foreign ships calling at this port or passing through the Mozambican waters.

One radio operator (Morse, telephone and telex) with background from Escola Náutica de Moçambique is at present looking after the Maritime Administration radio station in Inhambane. At the same time he acts as the local Maritime Administrator. Two persons are assisting him in maritime communications as well as in other administrative matters. The operator has a weak knowledge of the English language, whilst the assistants are completely unaware of the English language.

Nowadays, the radio station at Beira Maritime Administration employs three radio operators, one of whom works in the system part-time. As with the already mentioned radio stations, poor knowledge of the English language is also noted in people working for this station. Concerning certification, nobody holds a proper certificate (licence) in this station as well.

In Quelimane Maritime Administration, one radio operator with basic knowledge from Escola Náutica de Moçambique (ENM) is in charge of this radio station. Knowledge of English language is to a fairly large extent weak. This situation extends to the remaining Maritime Administrations of Nacala and Pemba, where a radio operator with background from ENM is acting in each of these Maritime Administrations.

4.3.2.3 - Other entities involved in maritime communications

Apart from Maritime Administrations and ships, there are many other users of maritime communications in the country, namely NAVIQUE, State fisheries and affiliated companies, INAHINA and EMODRAGA. These companies also own VHF and HF radiocommunications, and operate them in maritime frequencies, in order to perform the following functions:

- **Point-to-point radiotelephone/radiotelex network**
- **Ship-to-shore radiotelephone network**
- **Shore-to-ship radiotelephone/radiotelex network**
- **Ship-to-ship radiotelephone network**

The national shipping company, NAVIQUE, owns the major percentage of cargo ships, where each ship has one radio station. At present radiocommunications equipment onboard is operated by masters and officers, no radio operator being carried. Although the co-operation with Maritime Administrations is very strong, this company operates its own radio station, known as Navique radio station. This station is manned by four operators. Three of them have a background from ENM, and knowledge of the English language is somewhat weak in all of them.

The Instituto Nacional de Hidrografia e Navegação (INAHINA), (the owner of a research ship "BAZARUTO"), among other activities is involved in radio navigational aids, buoys, lighthouses, routeing of ships, and so on, for NAVAREA VII. Three HF transmitter/receiver stations are at present being operated by this company, for point-to-point communication network, as well as with its research ship "BAZARUTO" that also has a HF station operated by the master and officers onboard.

4.3.2.4 - Present fleet of ships in Mozambique

The great majority of the fleet of ships in Mozambique belongs to the fishing industry combining both foreign registered ships and national registered ships engaged in fishing activities. The Mozambican fishing vessels make up about 80 % of the total national fleet of ships. Therefore, to a large extent the fleet of ships in Mozambique as a whole, plays an active part in the overall maritime communications in the country.

As of May 1993, 147 licences were issued by the TDM-national register for payment of licences, for 127 ships. This was to allow them to legally operate maritime VHF and HF radiocommunication frequency bands, separately or with a combination of both frequencies.

The fleet's composition in Mozambique, as of April 1993 is reported to be somewhat as follows:

Table 4.2: Mozambican fleet (1993)

SHIPOWNER	Number of Ships
NAVIQUE E.E.	9
INAHINA	1
EMODRAGA	7
CFM Sul	5
Transmarítma	6
Administração Maritima de Maputo	3
Foreign registered ships	33
Beira Emopesca	17
Quelimane Emopesca	9
Angoche Emopesca	7
Pescamar	13
Frigo Peixe	3
Mosopesca	9
Efripel	16
Sopesca	5
FAO	1
Cipesca	3
CFM Centro	3
Administração Maritima da Beira	5
Administração de Igane	1
Combinado Pesqueiro	1
Sul Pesca	1
Pesca Indico	19
Others	15
Total	192

Modified from: KPMG Peat Marwick

CHAPTER 5

Upgrading Mozambique Maritime Communication Systems

5.1 - General

During the last two decades, Mozambique was immersed in a civil war that destroyed the country's economy. However, the peace agreement was signed in October 1992. Therefore, the Government of Mozambique (GOM) is now privatising companies and the industry owned and controlled by the State of Mozambique. Hence, national and foreign investments are encouraged to restore the country's economy. Furthermore, Mozambique has presented its proposal in order to be admitted as a member of the Commonwealth, that is more likely to be fortuitously accepted in the coming Commonwealth summit convened for November this year in Auckland (New Zealand). This posture of the Government of Mozambique (GOM) is a milestone for the development of the Mozambican economy. The number of foreign ships calling at Mozambican ports, carrying goods for Mozambique as well as for the Commonwealth member countries in the Southern Africa region, will increase tremendously.

5.2 - Establishment of SAFMAR

The Serviço Nacional de Administração e Fiscalização Maritima (SAFMAR) is the Maritime Safety Authority established in Mozambique since the first quarter of this year. Its creation was approved by the Mozambican Cabinet through decree number

34/94, published in the Supplement of the Republic Bulletin number 35, of 1st September 1994.

SAFMAR took over the activities carried out by the previous Maritime Safety Department, that was performing its functions under supervision of the National Directorate of Marine Affairs in Mozambique. During this period the activity of the Maritime Safety Department was mainly based on ship surveying.

However, SAFMAR is an institution with national legal responsibility, as well as the administrative and financial autonomy. Nevertheless this organisation is subordinate to the Minister of Transport and Communications. Among others, the organisation is intended to carry out the following main activities:

Table 5 - SAFMAR Activities

Ship registration
Ship surveying
Ship certification
Approval of drawings
Registration of Seafarers
Certification of Seafarers
Causality investigation
Elaboration of Safety Legislation and related matters
Interpretation of existing legislation
Dangerous Goods
Marine Pollution Prevention
Search and rescue (SAR) at sea
Surveillance of Mozambican waters
Maritime distress, safety of life at sea ,Communications

Modified from : SHIPDECO A/S (1993)

For the execution of its functions, SAFMAR is organised at the headquarters (Maputo) through a directorate, supported by three departments namely Administration and Finance, Maritime Safety (that comprises maritime registrations of ships and seafarers, ships surveying and maritime communications), and finally Maritime Supervision (Fiscalização Maritima). Along the entire country, the Maritime Administrations and the Maritime Delegations complete the total organisation of SAFMAR.

However, Maritime Communications are expected to play a crucial role in the overall SAFMAR activities. Apart from enhancing safety of life at sea, maritime communications can be used also by senior maritime experts at the headquarters to monitor the performance of ship surveyors to be stationed in Beira, Quelimane, Nacala and Pemba, bearing in mind that the number of experienced surveyors in the country is very limited and there are other tasks assigned to them. Therefore, there will not be enough time for them to travel to these sites in order to instruct the newly trained ship surveyors, in how to perform efficiently in the field until they can get experience.

More often, in carrying out this task of surveying a ship, a number of problems arise concerned with decision making, whether to or not to detain a certain ship that does not appear to comply with the requirements. According to the Protocol of 1988 relating to the International Convention for the Safety of life at sea, 1974, Regulation 19 (f),

> When exercising control under this regulation all possible efforts shall be made to avoid a ship being unduly detained or delayed. If a ship is thereby unduly detained or delayed it shall be entitled to compensation for any loss or damage suffered.

5.3 - Maritime Authority Communications Centre in Mozambique

The Centro das Comunicações Maritimas (CENCOMAR) is the sector within the Maritime Safety Department in the SAFMAR, responsible for the establishment of reliable maritime safety communication networks in Mozambique

In addition, this sector is to set up and supervise the procedures that are to be observed ashore, as well as onboard ships, while communicating in Mozambican waters.

As cited previously CENCOMAR is working in close co-operation with $SHIPDECO_{AS}$, in order to establish a Coast Radio Station in Maputo, followed by five more radio stations to be installed in Inhambane, Beira, Quelimane, Nacala and Pemba. Actually Maputo relies on two stations, the main Coast Radio Station (operated by TDM) and the Centre of Maritime Communications.

These stations aim to handle in a convenient manner, the maritime safety communications, search and rescue (SAR) operations and surveillance along the Mozambican coast. However, the equipment to be installed is to comply with the GMDSS sea area A2 requirements.

5.3.1 - The introduction of GMDSS in Mozambique

SAFMAR (Government entity) is now implementing the new GMDSS communications system. However, this is to be based upon the reality of the situation in Mozambique, where a precarious economic stability prevails.

Nevertheless, a minimum set of automated radiocommunication equipment to ensure distress and safety of life communications in Mozambican waters is being installed in all stations along the coast.

Under the GMDSS carriage requirements, Mozambique is strongly advised by $SHIPDECO_{AS}$ to declare its sea area of operation the sea area A2, that is within the radiotelephone coverage of six MF radio stations, where a continuous DSC alerting capability will be available.

5.3.1.1 - The Centre of Maritime Communications in Maputo

This Centre will be created upon the establishment of a GMDSS communications system in Mozambique. However, the Centre is established in sea area A2. Therefore, the equipment to be installed includes MF DSC on 2187.5 KHz that is to be used for the reception of distress alerts and safety calls. Its propagation will cover an area of about 250 - 280 nautical miles.

In addition this Centre will be able to transmit distress and safety traffic by radiotelephony and radiotelex on 2182 KHz. The VHF frequency band will be used for communications with ships in the harbour, as well as with the Coast Radio Station network in Maputo. The co-ordination and supervision of activities leading to promote safety of life at sea in all stations in the country will be made through this Centre.

The point-to-point communication networks that are to be provided in this Centre will allow the Maritime Administration in Maputo to be in link at any time with all other maritime administrations in Mozambique, that for instance are to be linked with the maritime delegations either by VHF or HF frequency band.

5.3.1.2 - Maputo Coast Radio Station

The existing Coast Radio Station in Maputo, is to be proclaimed the Main Coast Radio Station in Mozambique, as proposed by $SHIPDECO_{AS}$. In terms of geographical location in the country, the Main Coast Station should be placed in Beira, but because of previously mentioned reasons it cannot be moved there at the present moment.

However, the equipment that comprises this Station is to be upgraded to Digital Selective Calling (DSC), in order to meet the GMDSS sea area A2 requirements. This is to be done with all equipment existing in the country that is still in good working condition, so that it can be used in the new stations along the coast.

Maputo Coast Radio Station is the only facility officially declared to carry out activities in both MF and HF frequency bands. These frequencies will be used for distress alerts and safety traffic. Public correspondence will be sent through this station, which will then have to forward it to the respective destination.

Maputo Coast Radio Station is to have three operating consoles (boxes) in the following configuration:

The receiving station at Summershild, as well as the transmitting station at Matola, in operating console 1 will operate a MF telegraphy and MF/HF telephony, as well as HF telegraphy and VHF transceiver, while operating console 2 will handle MF/HF radiotelephony, radiotelex and VHF transceiver as well. Operating console 3 will carry out the operation of MF/HF radiotelephony, as well as VHF transceiver, in both receiving and transmitting stations. In addition, a DSC unit will be installed at the transmitter station, as well as at the receiver station for reception of distress alerts and safety calls on 2187.5 KHz MF DSC frequency band. Furthermore, distress alerts will be received on the following frequency bands, with DSC capability: HF 4 MHz (4207.5 KHz), HF 6 MHz (6312.0 KHz), HF 8 MHz (8414.5 KHz), HF 12 MHz (12577.0 KHz) and HF 16 MHz (16804.5 KHz). The operators at the receiver station will keep watch on 500 KHz and 2182 KHz. (SHIPDECO A/S, 1993, pp-35).

5.3.1.3 - The MF DSC radio stations in Mozambique

Five more radio stations are being installed in all Maritime Administrations along the Mozambique coast, namely in Inhambane, Beira, Quelimane, Nacala and Pemba. These stations are intended to provide the medium range service on 2182 KHz radiotelephony and 2187.5 KHz with DSC. All stations will carry the same set of equipment and each station will be able to cover on 2187.5 KHz DSC an area of about 250 - 280 nautical miles. Hence ships within this range, if fitted with adequate equipment, will be able to send distress alerts and safety calls to the radio station (Maritime Administration) in the area where the ship will be navigating. Each station will be given an identity code.

On receiving this distress alert that is to be accompanied by a suitable display or print-out of the self identification of the originating ship, as well as the type of distress, the coast station will transmit the acknowledgement using the 2187.5 KHz MF DSC frequency band, as well as relay it to the ships in the vicinity. Hopefully ships in the vicinity will try to communicate with the distressed ship using radiotelephony on the associated radiotelephone distress and safety traffic frequency.

The distance between Pemba radio station and Nacala radio station is about 110 nautical miles, therefore the propagation range of MF DSC seems to be overlapping them. This situation is similar to the other radio stations along the coast. It can happen that the distress alert is received in another station that is located far from the ship in distress, for example Beira radio station can receive a distress alert that is from a ship located in the area of Pebane. In this case Beira has an obligation to acknowledge the distress call and relay it to Quelimane using 2187.5 KHz MF DSC or another means of communications available with minimum of delay. Quelimane radio station, after having received this information, should contact the ship in distress and notify the maritime authority, as well as the ships in the vicinity in order to take action leading to provide necessary assistance to the distressed ship.

However, the MF frequency band in a sea area A2 also provides radiotelephone communications on 2182 KHz, that is intended to be used for distress and safety traffic covering an area of about 150 nautical miles, from the stations in all maritime administrations along the coast, including in Maputo Coast Station, as well as in the Centre of Maritime Communications. The 2182 KHz will also be used for a listening watch in all stations.

Apart from the medium range service on 2182 KHz and 2187.5 KHz (DSC) to be provided in all radio stations, the VHF transceivers will also be provided, and the stations will keep watch on channel 16. In addition, HF frequencies will be available for point-to-point communication networks.

If a ship is in eminent danger in the Mozambique channel, within 150 nautical miles from the Mozambique coastline, using either 2182 KHz (ground waves) or 2187.5 KHz (DSC), failure to get in link with the desired station or another station depending upon her location, can bridge the gap, routing the distress or safety message to Maputo Coast radio station, using HF maritime frequencies. Then this station will acknowledge the message, forward it to the MRCC in Maputo, and also relay it to the maritime administration radio station in the area of the scene, using any other means of communication, as well as to ships in the vicinity if there are any keeping watch on HF frequency.

5.4 - NAVTEX service in Mozambique

NAVTEX is an international automatic direct-printing coastal warning service, basically used to promulgate meteorological and navigational warning information, as well as other urgent maritime safety information. NAVTEX has been mandatory onboard GMDSS ships since 1st August 1993.

World-wide NAVTEX employs 518 KHz in its English language service to broadcast the Maritime Safety Information (MSI) within a specific geographical area.

Mozambique lies in the geographical area VII co-ordinated by South Africa. Therefore, routine meteorological forecasts and all tropical storm warnings pertaining to the Mozambique Channel are promulgated to ships fitted with a dedicated receiver, as well as to Mozambican coast radio stations, for 10 minutes every four hours.

However, the NAVTEX receiver is fitted with selective message rejection that allows the mariner and the coast radio station operators in Mozambican waters to receive only the maritime safety information that starts from East London to Maputo and then covers the Mozambique Channel.

The SAFMAR coastal radio stations in Maputo, Inhambane, Beira, Quelimane, Nacala and Pemba, after having received NAVTEX message have to make sure that the mariner has received it in an efficient and effective manner, bearing in mind that most mariners in fishing vessels have weak knowledge of the English language. Hence close co-operation with other national entities, such as INAHINA and the Meteorological services can help the situation to a certain extent by rebroadcasting the maritime safety information in the Portuguese language using a frequency that will not jam other services.

It is also important to consider the vital usefulness of meteorological and navigational information that is nationally gathered by the meteorological services in Mozambique. As can be recalled INAHINA has a strong co-operation with the United Kingdom regarding publication of Notices to Mariners in Mozambique. In addition, INAHINA has been receiving information from different sources, for example information on weather maps from Toulouse (France) received via South Africa. This information is intended to be used for the preparation of Notices to Mariners as well.

5.5 - Personnel to be employed in the Coast radio Stations

One of the biggest problems in Mozambique is unemployment. However, the Government of Mozambique (GOM) is making great efforts in order to overcome this problem. Thus, companies and other entities are asked to co-operate with the GOM in this matter. Hence, SAFMAR in planning for the personnel to carry out the day-to-day activities in the Maritime Radio Stations has to bear in mind the already existing personnel in the field. To a certain extent, they have limitations in terms of qualifications to handle the new technology provided in the GMDSS system including the English language problem. However, special arrangements are to be taken that follow from their submission for further training leading to the General Operator's Certificate (GOC). This is dealt with in more detail in the next chapter.

5.6 - Carriage requirements in Mozambique

Radiocommunications equipment and other facilities installed ashore, always determine the type of Radiocommunications equipment to be carried onboard ships. Therefore, ships trading in the Mozambican waters should carry a set of equipment to comply with the GMDSS equipment being installed along Mozambique coast, in order to be able to transmit and receive distress and safety calls in case of an emergency at sea.

However, the equipment to be carried onboard ships in this area of operation should allow them to transmit and receive commercial communications as well. Following is the minimum set of communications equipment that should be carried onboard:

- MF Radiocommunications with DSC capability
- VHF Radiocommunications with DSC capability
- HF Radiocommunications
- One NAVTEX receive
- Equipment for Narrow Band Direct Printing (NBDP)
- One float free COSPAS-SARSAT EPIRB

5.7 - Operators onboard Mozambican ships

With the implementation of the GMDSS communications system the radio operators onboard ships are to be made redundant. Therefore, master and officers are to carry out the radiocommunications activities onboard. This is the case also for skippers onboard fishing vessels operating in the Mozambican waters. However, the GMDSS onboard equipment requires proper operation procedures, bearing in mind the danger of the GMDSS false alerts transmission (see section 2.9).

Under the GMDSS requirements only personnel with the General Operator's Certificate (GOC), are allowed to operate the equipment. Therefore, Shipmasters and Officers in Mozambican ships, as well as the Skippers on fishing vessels are obliged to undertake training courses for the General Operator's Certificate (GOC).

5.8 - Maritime Rescue Co-ordination Centre (MRCC)

The establishment of Maritime Safety Communications in Mozambique has to be accomplished with the establishment of a Maritime Rescue Co-ordination Centre (MRCC) that does not yet exist in the country. As mentioned in Chapter 4, maritime transportation in Mozambique is of vital importance for SADC member countries. However, to a certain extent SAR operations in Mozambican waters can be their crucial concern as well. The reason behind it is that civil aviation accidents involving a landlocked country's aircraft can occur in Mozambican waters. Obviously the efficient and effective SAR operations are those that could be provided by Mozambique, if it is to consider the distance and time to be spent in order to save lives.

However, Civil Aviation in Mozambique has raised the idea of establishing a search and rescue centre in Beira, and this is still under discussion. Although SAFMAR-CENCOMAR is forwarding its idea of establishing the Maritime Rescue Co-ordination Centre in Maputo, in the same building with the Centre of Maritime Communications, there is no adequate means to guarantee SAR operations if necessary.

Summing-up, the establishment of SAR services is a common concern among Civil Aviation and Maritime Authorities, bearing in mind that maritime and aeronautical search and rescue (SAR) organisations are complementary. However, based on the IMO Search and Rescue Manual (IMOSAR Manual) and ICAO SAR Manual, whenever possible, maritime RCC and aeronautical RCC should be located in the same site. Otherwise, they should be located as near as possible for the reliability of communications.

According to article 12 (2) of the Convention on the High seas, 1958,

> every coastal state shall promote the establishment and maintenance of an adequate and effective search and rescue service regarding safety on and over the sea - where circumstances so require - by way of mutual regional arrangements co-operate with neighbouring states for this purpose.

Mozambique is immersed in an economic crisis, so alone cannot afford adequate means for the establishment of SAR services. Hence the solution is to bridge the gap with direct involvement of all SADC member countries in this matter leading to the development of the SAR centre. This centre will be manned by duly trained personnel as well as fitted with proper equipment such as radiocommunications, helicopters, rescue ships and boats, that will be used to locate distress alerts and provide necessary assistance with the minimum of delay.

5.8.1 - Structure of the SAR service

Upon the establishment of the SAR service, a number of factors are to be taken into consideration such as: the organisation of the service itself, and the clear definition of responsibilities in the area. Establishing an SAR service in Mozambique, Beira should be the best site for the Search and Rescue Region (SRR) headquarters, because is located in the centre of the country and this feature should make the co-ordination of search and rescue operations more easier. This should be followed by the RCCs placed in Maputo and Nacala, while the rescue sub-centres (RSCs) can be established in Inhambane, Quelimane, Angoche, Pemba and Mocimboa de Praia.

From an organisation point of view, the On-scene Commanders (OSCs) and Search and Rescue Units (SRUs) play an important role in the co-ordination of search and rescue activities.

The availability of resources and equipment, as well as properly trained people to handle the tasks in an effective and efficient manner; the reliability of the communications network to facilitate the co-ordination of SAR operations between rescue units and on-scene commander, as well as with those in the distress scene, and with the SAR authorities ashore, are key elements in supporting the performance of the SAR forces. First aid personnel must also be kept in readiness in the field of the SAR operations. Documentation during the SAR process is another factor to be taken into consideration. Finally, the RCCs should keep watch 24 hours a day in order to be able to respond to any emergency.

5.9 - Charge for the services

SAFMAR-CENCOMAR is to bet on the guarantee of maritime distress and safety communications as well as SAR operations for all commercial and fishing vessels either with national or foreign registration, including those from other ports in the world, calling at the Mozambican ports, and those passing through these waters. Thus, there is a need for maintenance of this equipment, in order to be ready to provide continuous assistance to these ships.

However, this only can be achieved by introducing a special fee (low-charge) for all ships calling at the national ports, in the same manner as has been done with navigational aids charges, for example charge for the use of lighthouse, buoys in the channel, and soon.

The author believes that if SAFMAR is to take measures leading forward to the implementation of this idea, strong support will be gained from all shipowners, especially those in developed countries because for them it is clear that every ship is subject to any type of accident anywhere. Even if their ships are so equipped with modern and very sophisticated survival equipment, capable of sending a distress call from a ship located in the Mozambican waters to, for example, Aussaguel (France), Goonhilly (UK) or EIK (Norway), it is true that reasonable assistance for that ship is available from Mozambique.

5.10 - An integrated approach to Maritime Satellite Communications in Mozambique

It is obvious that the Mozambican economy today does not justify at all the establishment of Maritime Satellite Communications, but as mentioned previously, the expectations of the economy growth are high and therefore, the need for such communications system can be anticipated.

However, Mozambique is now establishing the GMDSS communications system based on terrestrial equipment. Nevertheless it is essential to appreciate the recent development of communications technology, described in Chapters 1, 2 and 3 of this paper. The GOM has to take advantage of this new maritime communication technology based on satellite communications provided by INMARSAT, in order to be able to provide reliable safety, commercial and social communications to the ships that later on will be flying the Mozambican flag in each of the four ocean regions, coverage by INMARSAT geostationary satellites. In addition, shipping agencies in Mozambique could be able to communicate with foreign ships while in international waters, as well as communicate with the ship owners/operators in a more convenient manner. Therefore, the Government of Mozambique (GOM) should decide for a suitable alternative to bridge the gap by means of making Routing Arrangements with Coast Earth Stations operators in other countries.

5.10.1 - Routing Arrangements

The best option to try out this new technology is that the national Telecommunications Company (TDM) has to make routing arrangement with one Coast Earth Station (CES) in each of the four ocean regions, providing INMARSAT-A, B, C and M services. For instance, the Coast Earth Station 12 (BURUM) in the Netherlands operated by PTT Telecom provides services for INMARSAT-A, B, C and M systems in all ocean regions, although INMARSAT-C system is not yet available for the Pacific Ocean Region (POR). This station can be contacted by telephone + 31 2550 62 440 and facsimile (fax) + 31 2550 62 424. Therefore, the Government of Mozambique represented by TDM, if it decides to do so, should sign a contract with this station, so that it can provide a gateway to the INMARSAT-A, B, C and M services in all ocean regions except INMARSAT-C services in the Pacific Ocean Region (POR). The author propose the CES 12 (BURUM) because for the time being it is the only one providing almost all INMARSAT services in all ocean regions, making negotiations easier and the subsequent signing of contracts. However, for the INMARSAT-C services in the Pacific Ocean Region, the contract should be signed with the CES PERTH in Australia operated by TELSTRA. This station can be contacted by telephone + 61 2311 1302 and facsimile (fax) + 61 2311 3846. However, the government may decide for other CESs (see appendix A). It is important to clarify that the contract leading to routing arrangement is free of charge. However, the services will be charged but of course at a low cost.

The routing arrangements are aimed at making it possibly for subscribers to the public telecommunications networks in Mozambique through telephone land line to access the selected Coast Earth Station, which contains a specific Identification Code (ID), thus functioning as a gateway to the INMARSAT satellite communications. Hence telephone, telex and fax messages could be sent from Mozambique to a ship located in one of the four ocean regions by means of ordinary telephone, telex or fax terminals connected to the international networks. In addition, a large amount of data could be transmitted quickly and easily from personal computers (PC's) at the office to PC's anywhere in the world. However, this only can be possible if the PC's are connected to the telephone line through a modem or are connected to an INMARSAT SES, in the case of ships.

In conclusion, messages from Mozambique will be routed to this station which will be able to forward such messages to the intended destination through either INMARSAT-A, B, C or M systems, depending on how the ship is equipped and the services that each INMARSAT system is capable of offering. Therefore, for the time being this is the way in which Mozambique can make use of the Maritime Satellite Communications System.

5.10.2 - The impact of the Satellite Communications on the Mozambican Maritime Infrastructures

The main feature of the INMARSAT-C system is that it can be used to transmit and receive text messages or data at anytime. The promulgation of Maritime Safety Information (MSI), through the INMARSAT-C EGC (see section 2.7.3) in its international SafetyNet capability, in combination with NAVTEX should make a great contribution to the gathering of meteorological and navigational information that might be used by INAHINA in the publication of its Notices to Mariners in Mozambique.

In the near future, the national fleet is expected to grow and make an appearance in the international shipping business. Hence shipping companies would be able to send messages to the ship regarding crew wages, as well as to programme their ships in order to meet the needs of a world-wide market. In addition, shipping agencies such as MANICA Freight Services, Empresa Moçambicana de Navegação Internacional (NAVINTER), Agencia Nacional de Frete e Navegação (ANFRENA) etc. could initiate calls to the ships anywhere, at anytime. If there is a doubt regarding the INMARSAT Mobile Number (IMN) for a certain ship, the INMARSAT "Help-lines" at the headquarters in London, UK (Country Code 51), should be accessed either by means of telex or PC with Modem combination to ask for help. As long as these shipping agencies have their telex equipment connected to the international telex networks they can access the Telex Help-line, by calling the telex number: (51) 920 327 INMHLP G.

Furthermore, personal computers (PC's), as long as they are connected to a telephone line via a Modem in Mozambique, as well as to the destination anywhere in the world can be used to handle electronic mail (E-mail) services via INMARSAT Satellites. For instance, large amounts of data regarding ship operations or other issues can quickly and easily be transmitted to the shipowner/operator. The E-mail provides certain advantages against fax and telex, in terms of cost of communication, because the transmission of E-mail (message in the PC) can be programmed to take place during "off-peak hours".

CHAPTER 6

Training and Certification of GMDSS radio personnel in Mozambique

6.1 - General

The technology applied in the GMDSS equipment is so sophisticated and so highly developed that only properly trained personnel can handle it in an effective and efficient manner. Therefore, training is required for those whose tasks are to operate the day-to-day GMDSS communications in Mozambique, either in the Maritime Administration radio stations or onboard Mozambican ships.

However, the training and certification of GMDSS radio personnel comprises the following certificates:

- the First - Class Radioelectronic Certificate;
- the Second - Class Radioelectronic Certificate;
- the General Operator's Certificate (GOC);
- the Restricted Operator's Certificate (ROC); and
- the Maintenance of GMDSS Installations onboard ships.

Nevertheless, for the purpose of this paper only the General Operator's Certificate (GOC) is discussed in more detail. However, apart from theoretical knowledge, the training requirements for this certificate comprise operational and procedural skills. The training is to be conducted where relevant equipment is available.

However, world-wide training of GMDSS radio personnel is conducted in simulators, because simulators provide certain advantages in comparison with the real-life equipment. Practical exercises on the various communication systems can easily be done in a simulator rather than in real-life equipment, specially for exercises on distress communications that if in real equipment would send a false alert to other terminals.

6.2 - GMDSS training simulators

The development of technology in terms of GMDSS training simulators enables the manufacturers to develop the product that can meet the needs of the users at any level of economic development. These simulators are classified as follows:

- Full mission GMDSS simulator for GOC and ROC training, and
- PC - based simulator for GOC and ROC training.

However, the number of manufacturers making GMDSS training simulators is increasing considerably all over the world.

6.2.1 - The Norcontrol Full mission GMDSS simulator

Among the leading developers of GMDSS training simulators, Norcontrol launched in August 1995 the first "Full mission GMDSS simulator for GOC and ROC training", a high quality simulator resembling the real-life equipment. The Norcontrol CPT 2000

Trainer contains all equipment which is found onboard a ship for distress and safety communications as well as for SAR communications.

The Norcontrol CPT 2000 Trainer comprises a computer network that enables the connection of an instructor console with up to 16 student consoles. The following is the GMDSS equipment simulated in the new Norcontrol CPT 2000 Trainer:

- MF/HF DSC
- VHF DSC, channel 70
- MF/HF radiotelephone transmitter and receiver
- VHF radiotelephone transmitter and receiver
- Narrow Band Direct Printing (NBDP) telegraphy
- NAVTEX receiver
- INMARSAT-C EGC capability
- INMARSAT-A/B SES
- INMARSAT-C SES
- 406 MHz COSPAS-SARSAT EPIRB
- 1.6 MHz INMARSAT-E EPIRB
- 9 GHz Search and rescue radar transponder (SART)

Cross, 1995, p 40.

However, the price of this full mission GMDSS simulator does not benefit at all the developing countries where budgetary problems prevail.

6.2.2 - Poseidon GMDSS simulator (PGS) for GOC training

The Poseidon GMDSS simulator (PGS) is a Personal Computer (PC)-based simulator, designed for training of GMDSS radio personnel, where 8 student workstations can be connected to the instructor's station. However, the number of student workstations can be increased up to 16, if two Audio Multiplexer Units (AMUs) are coupled together.

The Poseidon GMDSS simulator shows on the monitor of a computer the front panels of well known radio communications equipment such as SKANTI and ABB NERA, resembling all the functions and facilities provided in these radio communications.

The GMDSS equipment simulated in the PGS, either in the instructor station or in the student station is as follows:

- VHF Radiotelephone
- VHF DSC controller/receiver
- MF/HF Radiotelephone
- MF/HF Radio telex
- MF/HF DSC controller/receiver
- NAVTEX Receiver
- 2182 KHz Watch Receiver
- INMARSAT-A SES
- INMARSAT-C EGC facility.

However, in the PGS simulator the instructor has the possibilities of setting up training scenarios. In addition, this simulator enables the students to run all communication systems in the GMDSS, using mouse control instead of fingers, to hit the buttons of the radio panels on the screen. Moreover, the students are provided with a telephone headset in order to talk each other or with the instructor.

The Poseidon GMDSS simulator is an appropriate tool for training purposes, being capable of solving the problem of those whose budget is not enough to purchase the "Full mission GMDSS simulator".

6.3 - Training facilities in Mozambique

There are in Mozambique two centres with adequate facilities to handle the training of radio operators, namely: Escola Nàutica de Moçambique (ENM) and Instituto das Telecomunicações de Moçambique (TDM), both located in Maputo. However, the ENM seems to be the most convenient site for the training of GMDSS radio personnel. The reason behind it is that this Institution is devoted to Maritime Training and a number of facilities for this training are available, such as ordinary classrooms with blackboard; overhead projectors; language laboratory capable of accommodating more than 15 students one in each cabin incorporating a blackboard (white) and an overhead projector; a GMDSS Ship's Station (real-life equipment model SKANTI); and Computer Based System (CBS), with 8 students' workstations and one master station for the instructor.

The GMDSS Ship's Station at ENM comprises VHF 3000 (radiotelephone) with VHF DSC controller - receiver, HF SSB radio system, MF/HF DSC controller - receiver (DSC 9000). The maritime identification (MID) of this station is as follows:

- ENM call sign C 8 Z 4
- MMSI number 650 001 000
- DSC number 57 701
- INMARSAT-C number 465 000 110
- Maritex telex number 29 403
- Answer back: 57 701 C 8 Z 4

However, there is a need to purchase a GMDSS training simulator that can respond adequately to the reality of the situation in Mozambique. From a cost effective point of view, if the already existing Computer-based system at ENM is examined, the

Poseidon GMDSS simulator should be the best option. Of course there is the GMDSS Ship's Station at ENM, but as already mentioned the real-life equipment does not perform properly for training purposes. Hence this station can be used for demonstration purposes for the students after having conducted the practical exercises on the PC-based Poseidon GMDSS simulator.

6.3.1 - Present staff in the radio department

The ENM has in the radio department competent staff, with considerable experience in maritime radiocommunication, at least two of them being in possession of valid a General Operator's Certificate (GOC). Therefore, the department is well manned so that they can carry out the training of radio personnel to serve onboard ships as well as in the shorebased stations, as required in the Chapter IV of the revised STCW Convention, 1978.

6.3.2 - Training of personnel to handle maritime radiocommunications

As already mentioned in Chapter 4 of this paper, the radio operators in Maritime Administration radio stations do not fulfil the qualifications required in the GMDSS radiocommunications system. Likewise, personnel onboard Mozambican ships are not qualified for distress and safety radiocommunications. Nowadays, radiocommunication equipment based on the GMDSS system, can only be operated by properly qualified personnel in possession of a valid General Operator's Certificate (GOC). Hence in Chapter IV of the revised STCW Convention, 1978 all seafarers who are qualified deck officers or are studying for such qualification are obliged to undertake course leading to a General Operator's Certificate (GOC). Therefore, this course will be given at ENM to the Skippers of fishing vessels as well.

6.4 - Proposed Course Curriculum

In order to provide a reasonable response to the needs of GMDSS technology, ENM should adopt the subsequent unit of work for these students with the following title: **TRAINING COURSE FOR THE GENERAL OPERATOR'S CERTIFICATE (GOC) FOR THE GMDSS**. This course will run over 150 hours, i.e. 5 weeks of 30 hours each. Of course these hours are somewhat in excess of international standards but if it is recognised that the candidates have weak knowledge in maritime English language as well as lack of basic skills in computers, 150 hours is more suitable for this first course. However, for the subsequent courses it can be anticipated that the duration time will be reduced to meet recognised international standards, if the candidates have sufficient knowledge of the English language as well as certain skills in computers.

The AIM in this course is that students should understand the radiocommunication procedures in the GMDSS system. However, the course is designed to achieve certain objectives. A student successfully completing this course and passing the prescribed examination should be able to:

1- Recall the basic principles of electronics;
2- Define the basic concepts of the GMDSS system;
3- Identify the communication systems in the GMDSS;
4- Explain operational procedures for automated communications;
5- Classify the GMDSS carriage requirements;
6- Use the English language, both written and spoken, for the satisfactory exchange of communications relevant to the safety of life at sea;
7- Efficiently operate the GMDSS radio equipment and act as a dedicated communications operator in cases of distress;

8- Use personal computer (PC) for communication purposes;

9- Predict the consequences of false alert transmission.

The following table covering the GMDSS course outline shows how these objectives should be achieved. However, the alphabetical order in this table is to be used as guide in the timetable, to show the syllabus content.

Table 6 - GMDSS Course Outline

Specific Objectives	Knowledge and Understanding
Recall the basic principles of electronic	"A" Frequency, Wavelength and Propagation 1-Frequency [kilohertz (KHz), megahertz (MHz) GigaHertz (GHz)] 2- Wavelength (radio waves frequency bands) 3- Propagation (medium frequency bands, high frequency bands, very high frequency band)
Define the basic concept of the GMDSS	"B" Introduction to the new system 1.1- INMARSAT systems 1.1.1- The space segment 1.1.2- The ground segment 1.1.2.1- Coast Earth Stations (CESs) 1.1.2.2- Ship Earth Stations (SESs) 2- The old radiocommunications system 3- The new radiocommunication system
Identify the communication systems in the GMDSS	"C" Satellite communications 1.1- INMARSAT satellite communications 1.2- COSPAS-SARSAT satellite communications "D" Terrestrial communications 1.1- Long-range communications (HF) 1.2- Medium-range communications (MF) 1.3- Short-range communications (VHF)
Explain operational procedures	"E" Operational procedures for automated communications: 1.1- General principles of NBDP 1.2- Digital Selective Calling (DSC) 1.3- Enhanced Group Call (EGC) "F" Distress communications: 2.1- MF/HF/VHF bands - use of DSC facilities 2.2- INMARSAT SESs distress alerting 2.3- COSPAS-SARSAT EPIRBs 2.4- SAR operation

Classify the GMDSS carriage requirements	"G" Ship equipment carriage requirements * Sea area A1 * Sea area A2 * Sea area A3 * Sea area A4
Use the English language both written and spoken, for the satisfactory exchange of communications relevant to the safety of life at sea	"H" - IMO Standard Marine Vocabulary - International phonetic alphabet - Standard abbreviations and commonly used service codes
Efficiently operate the GMDSS equipment	"I" - Regulations and agreements governing the maritime communication services - Selection of appropriate communication methods in different situations: * radiotelephone * radiotelegram * traffic charges
Use of personal computers (PC) for communication purposes	"J" The student should be able to : 1- start the PC; 2- initiate the communication programs; 3- exit the communication program; and 4- turn off the PC
Predict the consequences of false alert transmission	"K" 1- Inadvertent or incorrect operation of the equipment has caused false alerts transmission 2- Measures to prevent false alerts 2.1- Actions to be taken by masters or skippers 2.2- Actions to be taken by manufacturers, installers and instructors.

6.4.1 - Assessment

The examination to be conducted by the end of this course is to be divided in two parts, namely theory (written) and practical demonstrations that should include an oral test. From the total hours in the timetable below, eight (8) hours should be reserved for the examinations, three (3) hours for written and five (5) for practical, each part carrying 50% of the total marks.

Table 6.1 - Course Timetable

ITEM	HOURS		
	Theory	Practical	Total
"A"	4	0	4
"B"	4	0	4
"C"	4	0	4
"D"	6	12	18
"E"	4	0	4
"F"	6	24	30*
"G"	4	0	4
"H"	6	24	30*
"I"	6	24	30*
"J"	4	14	18*
"K"	4	0	4
Total	52	98	150

* Relevant parts of the instruction to be conducted in English

6.4.2 - Teaching aids (resources)

This course is divided in two parts, theoretical and practical. Lecturing will cover a theoretical part where overhead transparencies, blackboard, video and pictures will be used. The GMDSS equipment available at ENM, among other facilities offers two personal computers. Therefore, during the practical sessions, groups of two students will make use of the facilities for exchange of communications, one hour being allocated for each group.

The following textbooks should be provided as a core supporting resource.

- A Textbook on Maritime Communications (Lars Brödje - INMARSAT, 1995)
- G.M.D.S.S. Handbook (IMO, 1992)
- Handbook For Marine Radiocommunications (G.DLees & W.G Williamson,1993)
- IMOSAR Manual (IMO, 1993)
- Inmarsat Maritime Communications Handbook (INMARSAT, 1995)
- NAVTEX Manual, 1994 Edition (IMO)
- SOLAS Consolidated Edition (IMO, 1992)
- Standard Maritime Navigational Vocabulary
- STCW Convention, 1978 as revised

CHAPTER 7

Conclusions and recommendations

7.1 - Conclusions

Nowadays the safety of life at sea has been improved by reliable maritime communications provided by IMO, through modern and sophisticated technology known as the GMDSS communications system. However, GMDSS is specially designed to handle both satellite communications and terrestrial communications. GMDSS employs those satellites provided by INMARSAT and COSPAS-SARSAT, for distress alerting and safety communications. In addition, Digital Selective Call (DSC) technology is used to upgrade terrestrial radio communications (VHF, MF and HF frequency bands) to a fully automated connection, as required in the GMDSS communications system. Therefore, Mozambique in order to benefit from this technology will declare the Mozambican waters as a sea area A2, providing its services in MF DSC frequency band, including NAVTEX NBDP and SAR operations, in all 6 radio stations to be installed in Maputo, Inhambane, Beira, Quelimane, Nacala and Pemba, will comply with the GMDSS requirements.

More often the COSPAS-SARSAT EPIRBs are not switched on before they are placed into their containers, although they are properly installed onboard ships. However, if there is a disaster at sea and the ship sinks they will be automatically released and float free but no distress signals will be transmitted. There is a need for ship surveyors to be made aware of this problem.

Although for the time being the country's economy does not justify the establishment of satellite communications, it is important to be aware that the technology is there to be exploited at any time. However, the reasonable step for Mozambique is to commence operations through routing arrangements with the Coast Earth Stations (CESs) that provide all INMARSAT systems in all four ocean regions covered by INMARSAT geostationary satellites. One way to approach this would be for the Government of Mozambique to make arrangements with the Coast Earth Station 12 in the Netherlands operated by PTT Telecom because for the time being it is the only one providing all INMARSAT services in all ocean regions. However, this Station does not yet provide INMARSAT-C for the Pacific Ocean Region (POR). Hence the Government could make further arrangement with the CES Perth in Australia for the INMARSAT-C services in the Pacific Ocean Region.

SAR Services

As mentioned earlier the establishment of search and rescue (SAR) services in Mozambique is a common concern among Civil Aviation and Maritime Authorities, as well as for all SADC member countries. Therefore, there is a need for strong co-operation between these entities leading to the development of an SAR centre.

Training of personnel

The training of personnel to handle radiocommunications under the GMDSS is extremely important. It has been shown that the use of a PC - based simulator provided by Poseidon, in addition to the real-life radio equipment available at ENM, would enable personnel to speedily meet new international communication requirements.

The students' knowledge with regard to the English language is very poor. However, they are required to use English for communication purposes, especially when they need to communicate with foreign ships. One way to overcome this weakness is to provide the majority of theoretical and practical training sessions using the English language. Questions and answers as well as comments should be also in the English language.

The use of personal computers for simulating communication exercises has been shown to be very effective, especially with regard to NBDP and DSC. Practical training sessions cannot yet cover INMARSAT satellites because the national maritime communication system is not yet party to the INMARSAT system, although Mozambique is member of this Organisation. Therefore, this training is devoted to terrestrial communications.

Written and oral tests are best conducted in a combination of Portuguese language and English language, but with more emphasis in English, in order to ensure the attainments of skills required from them.

In order to achieve better standards, certain requirements should be established for new admissions so that the candidate has completed at least ninth grade of the previous schooling system, with fluent knowledge of the English language (written and spoken) being a main requirement. The best solution is to require the candidates to hold the high-school leaving certificate, together with an agreed level of knowledge of the English language (written and spoken) in order to be admitted to a short course in GMDSS radiocommunications of at least two weeks duration.

7.2 - Recommendations

It is strongly recommended that:

1. The GOM makes contractual arrangements with CES 12 (Netherlands) and CES Perth for the provision of satellite communication services in the Pacific Ocean Region.

2. SADC member countries and relevant Mozambican authorities co-operate in establishing SAR services and related SAR centre in Mozambique.

3. A GMDSS Simulator, manufactured by POSEIDON, be purchased and installed at ENM by 1st January 1997 to allow for effective training of personnel before the 1st February 1999 deadline for full implementation of GMDSS.

4. Personal computers be made available to ENM for simulating communication exercises.

5. GMDSS theoretical and practical training programs at ENM be conducted in the English language.

6. Assessment of students be conducted using a combination of the Portuguese and English languages.

7. New admissions standards be established requiring candidates to hold high school leaving certificates and knowledge of the English language in order to be eligible for an intensive GMDSS - GOC start course program.

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APPENDICES

Appendix - A INMARSAT Coast Earth Stations Contacts and Services

Country	Operator	Telephone	Facsimile	CES	AOR-E	AOR-W	IOR	POR
Australia	Telstra	+61 2 311 1302	+61 2 311 3846	Perth			ABCM	ABCM
Brazil	EMBRATEL	+55 21 216 7738	+55 21 233 9032	Tangua	AC			
China	Beijing Marine	+86 1 421 3131	+86 1 421 3509	Beijing			AC	AC
Denmark	Telecom Denmark	+45 4252 9111	+45 4252 9341	Blaavand	C			
Egypt	National Telecom	+20 2 352 1220	+20 2 77 1306	Maadi	A			
France	France Telecom	+33 56 22 32 31	+33 56 83 13 05	Pleumeur-Boudou Aussaguel	A BCM	A	 BCM	
Germany	DeTeMobil	+49 228 936 7777	+49 228 936 9189	Raisting	ABCM		ABCM	
Greece	OTE SA	+30 1 611 8100	+30 1 806 3999	Thermopylae			AC	
Hong Kong	Hong Kong Telecom Int.	+852 888 2939	+852 566 8900	Cape D'Aguilar			BM	BM
India	Videsh Sanchar Nigam	+91 22 262 4020	+91 20 95 4321	Arvi			AC	
Iran	Telecom Co of Iran	+98 21 86 1022	+98 21 85 8566	Boumehen			AC	
Italy	Telecom Italia S.p.A.	+39 6 4069 3379	+39 6 4069 3624	Fucino	AC			
Japan	KDD	+81 3 3347 5016	+81 3 3347 6306	Yamaguchi	ABM	BM	ABCM	ABCM
Korea	KTA	+82 2 750 3745	+82 2 750 3749	Kumsan			AC	AC
Malaysia	Telekom Malaysia	+60 3 2087972	+60 3 7557316	Kuantan			BM	
Netherlands	PTT Telecom	+31 2550 62 440	+31 2550 62 424	Station 12	ABCM	ACBM	ABCM	ABM
Norway	Telenor International A/S	+47 22 77 7206	+47 22 77 7178	Eik	ABM	ABM	ABCM	
Poland	Polish Telecom	+48 22 20 3887	+48 22 26 3665	Psary	A		A	
Portugal	CP Radio Marconi	+351 1 720 7226	+351 1 795 5738	Sintra	C			
Russia	Far East Shipping Co	+7 095 274 0046		Nakhodka				A
Saudi Arabia	Ministry of PTT	+966 1 404 1515	+966 1 405 9008	Jeddah			A	
Singapore	Singapore Telecom	+65 331 6745	+65 334 6110	Sentosa			BCM	ABCM
Turkey	PTT Genel Mudurlugu	+90 312 366 553 +90 312 499 5153	+90 312 310 9141 +90 312 499 5115	Ata	AC		AC	
UK	British Telecom	+44 71 492 4996	+44 71 606 4640	Goonhilly	ABCM	ABCM		
Ukraine	MORCOM	+7 048 268 3932	+7 048 268 3932	Odessa	A		A	
UAE	ETISALAT	+971 6 822566	+971 6 823502	Towi Al Saman			BM	
USA	COMSAT Mobile Communications	+1 301 428 2400	+1 301 601 5953	Santa Paula Southbury Anatolia (Turkey) COMSAT Eurasia (Malaysia)	ABCM	ABCM	A BM	ABCM
USA	IDB Mobile Communications	+1 301 214 8700	+1 301 214 8701	Staten Island Niles Canyon Gnangara (Australia)	A	A	A	A

(Source: INMARSAT)

Appendix - B GMDSS carriage requirements

The IMO has specified the communications equipment to be carried in each of the ocean operating areas. All SOLAS Convention ships of 300 gross tonnage and above are required to carry a minimum set of communications equipment:

1. VHF installation capable of transmitting and receiving DSC on channel 70 and radiotelephony on channels 6, 13, and 16;
2. Equipment able to maintain continuous DSC watch on VHF channel 70;
3. Radar transponder operating in the 9 GHz band;
4. Receiver, capable of receiving international NAVTEX service broadcasts, if the ship operates in any area where NAVTEX is provided;
5. Facility for reception of maritime safety information by the Inmarsat enhanced group call system (International SafetyNET™ Service), if on voyages in areas of Inmarsat coverage where NAVTEX is not provided;
6. Satellite emergency position-indicating radiobeacon (EPIRB) capable of being manually activated and of floating-free and activating automatically (406 MHz Cospas-Sarsat or Inmarsat-E).

Additional Requirements for Sea Area A1

1. The VHF installation shall be capable of general radio communications using telephony;
2. (Optionally), a float-free EPIRB capable of transmitting a distress alert using DSC on VHF channel 70, in lieu of a satellite EPIRB;
3. Another approved installation capable of initiating the transmission of a distress alert from the navigating position, either by: 1) VHF using DSC; 2) manual activation of an EPIRB; 3) MF using DSC; 4) HF using DSC; or 5) an Inmarsat ship earth station.

Additional Requirements for Sea Areas A1 and A2

1. An MF installation capable of telephony on 2182 kHz and DSC on 2187.5 kHz;
2. Equipment capable of maintaining continuous DSC watch on 2187.5 kHz;
3. Equipment capable of general radio communications on working frequencies in the MF band 1605-4000 Khz; or an Inmarsat ship earth station;
4. Another approved means of initiating the transmission of distress alerts from the navigating position by radio service other than MF either by: 1) manual activation of a satellite EPIRB; 2) HF using DSC; or 3) an Inmarsat ship earth station.

Additional Requirements for Sea Areas A1, A2, and A3 (within Inmarsat coverage area)

1. MF installation capable of telephony on 2182 kHz and DSC on 2187.5 kHz;
2. Equipment capable of maintaining continuous DSC on 2187.5 kHz;
3. Inmarsat-A or Inmarsat-C (class 2) ship earth station, or an HF radio installation as required for Sea Area A4;
4. Facilities must include at least two of the following radio systems for transmitting the distress alert from the navigating position: 1) Inmarsat ship earth station (Inmarsat-A or Inmarsat-C); 2) Manual activation of a satellite EPIRB; or 3) HF radio installation.

Additional Requirements for Sea Area A4 (beyond Inmarsat coverage)

1. MF/HF radio installation capable of transmitting and receiving on all distress and safety frequencies in the band 1605-27500 kHz using DSC, telephony, and direct-printing. It shall also be capable of general communications using telephony or direct-printing in the band 1605-275000 kHz;
2. Equipment capable of selecting any of the distress and safety DSC frequencies in the band 4000-27500 kHz, and maintaining DSC watch simultaneously on 2187.5 kHz, 8414.5 kHz and at least one additional distress and safety DSC frequency in the band;
3. Capability to initiate a distress alert from the navigating position through the polar orbiting satellite system on 406 MHz (manual activation of 406 MHz satellite EPIRB).

(Source: INMARSAT)

Appendix - C How to send a Distress telex or telephone call using an INMARSAT-A SES

When you are in grave and imminent danger, you may use your Ship Earth Station (SES) to send a distress alert. The alert is routed automatically through a Coast Earth Station (CES) to a land-based Rescue Co-ordination Centre (RCC). The procedure for sending a distress alert is outlined below:

1. **Select telex or telephone** mode of operation.
2. **Select Distress Priority.**
3. **Select the required CES,** referring to table E-2 in Appendix E for the ID codes.
4. **Initiate the Request according** to the equipment manufacturers instructions.
5. If you do not receive any response within approximately 15 seconds, repeat the distress alert.
6. When contact has been established, **send your message** in the following format:

- MAYDAY MAYDAY MAYDAY
- THIS IS *[ship's name/callsign]* CALLING ON INMARSAT FROM POSITION *[latitude and longitude, or relative to a named point of land].*
- MY INMARSAT MOBILE NUMBER IS *[IMN for this channel of your SES].* USING THE *[Ocean Region]* SATELLITE.
- MY COURSE AND SPEED ARE *[course and speed].*

  You should then give:

  The NATURE OF YOUR DISTRESS, for example:

  - Fire/explosion
  - Flooding
  - Collision
  - Grounding
  - Listing
  - Sinking
  - Disabled and adrift
  - Abandoning ship
  - Attack by pirates
- ASSISTANCE REQUIRED
- OTHER INFORMATION to help rescue units

6. **Keep the telephone line clear** so that the RCC can call you back when necessary.

(Source: INMARSAT)

Appendix - D How to send an urgent or safety telex or telephone call usind an INMARSAT-A SES

You can obtain **MEDICAL ADVICE, MEDICAL ASSISTANCE,** and **MARITIME ASSISTANCE** from some CESs by using the 2-digit codes described below.

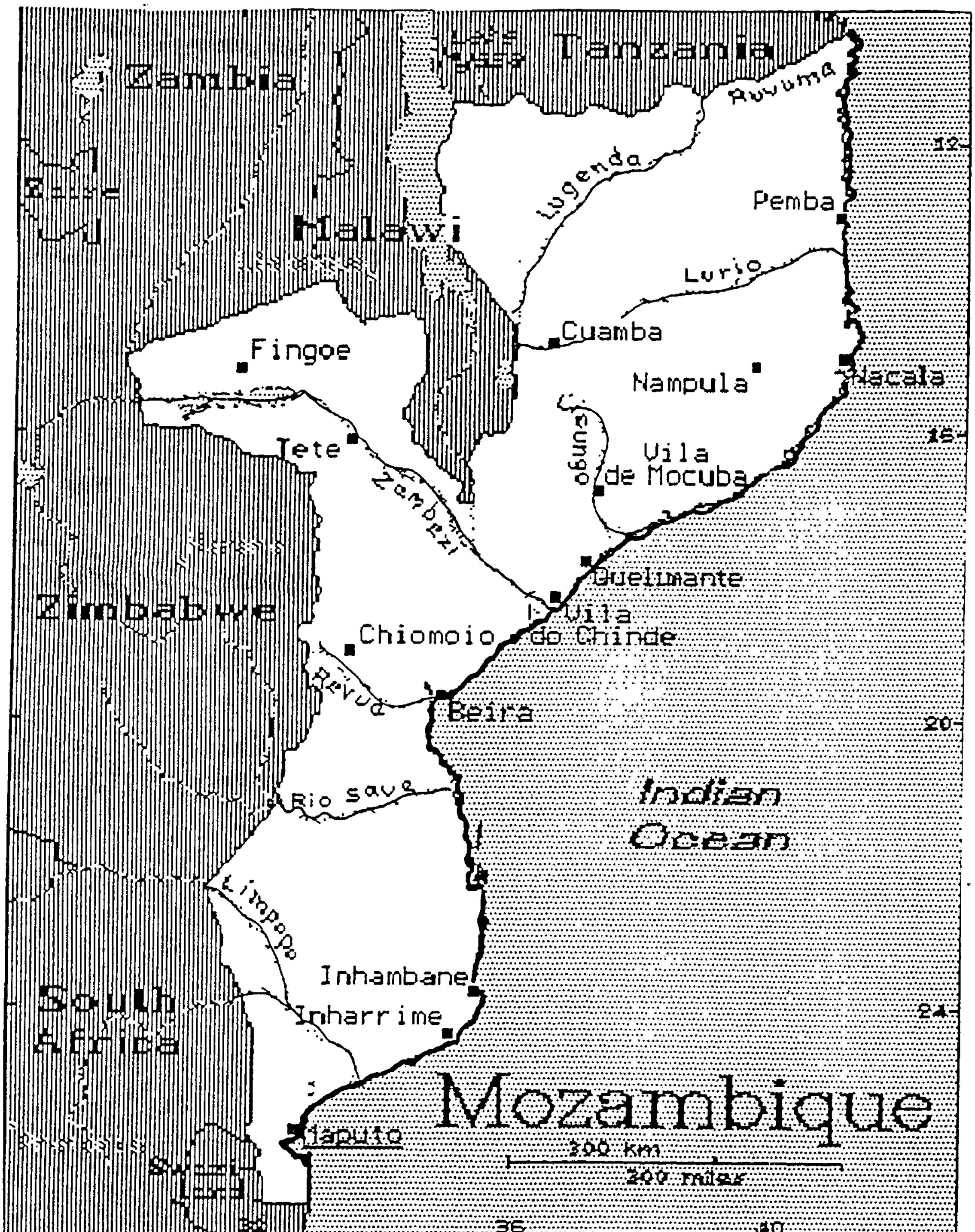
NOTE: If the CES you select does not support the 2-digit codes below, ask for advice from the CES, and/or select a different CES.

1. Follow the procedure on your SES to select telex or telephone mode of operation, as required.
2. Select **Routine Priority** (also known as **Priority 0**).
3. Select the required CES, referring to Table E-2 in Appendix E for the ID codes.
4. Call the CES selected, and on receipt of the **PTS** (Proceed to Select) tone, dial or key the appropriate 2-digit code listed below, *followed by #.*
5. When you establish communications, identify the call as **URGENCY** or **SAFETY**, as appropriate, and give the information listed below:

Service	2-digit code	Remarks	Information required
Medical Advice	32	Some CESs automatically connect all calls using this code direct to local hospitals, so that advice may be obtained quickly.	Give the word **MEDICO**, plus the following information: • Name of ship. • The ship's radio call-sign and identification number. • The ship's exact position (latitude/longitude). • The condition of the ill or injured person. • Any other relevant information.
Medical Assistance	38	Some CESs connect these calls directly to associated RCCs, so that they can be dealt with immediately. This code should only be used when immediate assistance such as medical evacuation of a patient is required.	Give the following information: • Name of ship. • The ship's radio call-sign and identification number. • The ship's exact position (latitude/longitude). • The condition of the ill or injured person. • Any other relevant information.
Maritime Assistance	39	Some CESs connect these calls directly to associated RCCs, so that they can be dealt with immediately. This code should only be used when immediate assistance is required from the relevant authorities in the event of, for example, man overboard, steering gear failure, or oil pollution. This code should also be used to send a request for towage.	Give the following information: • Name of ship. • The ship's radio call-sign and identification number. • The ship's exact position (latitude/longitude). • Particulars of the incidence. • Any other relevant information.

(Source: INMARSAT)

Appendix - E Land-locked countries which use the main Ports of Mozambique



(Source: Computer Program)