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Global Maritime Distress and Safety System (GMDSS) Infrastructure in Nigerian-Critical Evaluation and Assessment

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Abstract

The Global Maritime Distress and Safety System (GMDSS) is the technical, operational and administrative structure for maritime distress and safety communications worldwide. It was established in 1988 by the International Maritime Organization (IMO) which adopted a revised text of Chapter IV of the International Convention for the Safety of Life at Sea, 1974, (SOLAS) — dealing with Radio communications — and was implemented globally between 1992 and 1997. GMDSS establishes the radio communications equipment that ships are required to carry, how this equipment shall be maintained and how it is used, and provides the context within which governments should establish the appropriate shore-based facilities to support GMDSS communications. Nigeria, as a maritime nation and as a member of the IMO, has domesticated the SOLAS Convention; and therefore, should establish, like other maritime nations, a robust GMDSS system to enhance maritime safety and environmental protection. This paper evaluates GMDSS infrastructure and how effective they have been put into use to provide effective GMDSS services in Nigeria. The research revealed that Nigeria has only one operational INMARSAT LES (B) Coast Station, two planned/proposed NAVTEX MSI Broadcast Stations at Lagos and Oron, and two operational COSPAS-SARSAT MCC and LUT Stations located in NEMA headquarters in Abuja. The Antennas for the planned stations are to be positioned on 06º23'.99N, 003º22'.91E for the Lagos station and 04º48'.01N, 008º15'.34E for the Oron station. Both are expected to have a range of 250NM. This is in clear contrast to provisions of the SOLAS convention to which Nigeria is a signatory. The research, therefore, recommends that urgent and appropriate steps be taken to establish a robust GMDSS system in the country to stem the tide of maritime insecurity and environmental degradation in Nigeria's territorial waters and in the Gulf of Guinea; even as this could serve as a veritable revenue generation source to the country.

Keywords: evaluation, GMDSS System, implementation, recommendation, SOLAS Convention

1. Introduction

1.1 Background of the Study

Since the invention of radio at the end of the 19th century, ships at sea have relied on Morse code, invented by Samuel Morse and first used in 1844, for distress and safety telecommunications. The need for ship and coast radio stations to have and use radiotelegraph equipment, and to listen to a common radio frequency for Morse encoded distress calls, was recognized after the sinking of the liner RMS Titanic in the North Atlantic in 1912. The U.S. Congress enacted legislation soon after, requiring U.S. ships to use Morse code radiotelegraph

equipment for distress calls. The International Telecommunications Union (ITU), now a United Nations agency, followed suit for ships of all nations. Morse encoded distress calling has saved thousands of lives since its inception almost a century ago, but its use requires skilled radio operators spending many hours listening to the radio distress frequency. Its range on the medium frequency (MF) distress band (500 kHz) is limited, and the amount of traffic Morse signals can carry is also limited.

Not all ship-to-shore radio communications were short range. Some radio stations provided long-range radiotelephony services, such as radio telegrams and radio telex calls, on the HF bands (3-30 MHz) enabling worldwide communications with ships. For example, Portishead Radio, which was the world's busiest radiotelephony station, provided HF long-range services (John B., 1994). In 1974, it had 154 radio operators who handled over 20 million words per year. Such large radiotelephony stations employed large numbers of people and were expensive to operate. By the end of the 1980s, satellite services had started to take an increasingly large share of the market for ship-to-shore communications.

For these reasons, the International Maritime Organization (IMO), a United Nations agency specializing in safety of shipping and preventing ships from polluting the seas, began looking at ways of improving maritime distress and safety communications. In 1979, a group of experts drafted the International Convention on Maritime Search and Rescue, which called for development of a global search and rescue plan. This group also passed a resolution calling for development by IMO of a Global Maritime Distress and Safety System (GMDSS) to provide the communication support needed to implement the search and rescue plan. This new system, which the world's maritime nations are implementing, is based upon a combination of satellite and terrestrial radio services, and has changed international distress communications from being primarily ship-to-ship based to ship-to-shore (Rescue Coordination Center) based. It spelled the end of Morse code communications for all but a few users, such as amateur radio operators. The GMDSS provides for automatic distress alerting and locating in cases where a radio operator does not have time to send an SOS or MAYDAY call, and, for the first time, requires ships to receive broadcasts of maritime safety information which could prevent a disaster from happening in the first place. In 1988, IMO amended the Safety of Life at Sea (SOLAS) Convention, (SOLAS, 1974) requiring ships subject to it fit GMDSS equipment. Such ships were required to carry NAVTEX and satellite EPIRBs by August 1, 1993, and had to fit all other GMDSS equipment by February 1, 1999. US ships were allowed to fit GMDSS in lieu of Morse telegraphy equipment by the Telecommunications Act of 1996.

Safety of life at sea has been the focus of all maritime affairs since organized measures have been taken internationally. The "Titanic" disaster in 1912 was the first strong impetus in this regard. In 1914 the first international conference for the Safety of Life at Sea was held. The result of this conference was the adoption of a Convention on the Safety of Life at Sea (SOLAS). Chapter IV of this convention required, for ships carrying more than 50 passengers, a radiotelegraphy installation having a range of at least 100 nautical miles and continuous radio watch-keeping.

After the second, third and fourth versions of SOLAS in 1929, 1948, and 1960 the present version of SOLAS came into existence in 1974. Chapter IV of the 1974 SOLAS Convention mainly deals with facilities intended for distress and safety purposes. It does not specifically provide a requirement for equipment intended for public correspondence. The technical requirements of equipment intended for this purpose are covered by the Radio Regulations of the International Telecommunication Onion (ITU). The existing maritime distress and safety system relies on the capability of a ship in distress to alert another ship in the vicinity. Present regulations, in MHz for all passenger ships and ships of 300 gross tonnages and above which make international voyages. The Maximum required range of radiotelegraphy and radiotelephone equipment is only 100 to 150 nautical miles. A ship transmitting a distress message in mid-ocean therefore, knows that it may not be received on shore. In other words, the existing system is mainly a ship-to-ship service whose effectiveness depends on other ships being within range. Therefore, the present system has many limitations and disadvantages such as short range, manual distress alerting, aural watch-keeping and the limited number of frequencies being allocated for maritime communication.

From the time when the first world communication satellite (TELSTAR) was put into orbit (1962), IMO and especially the Maritime Safety Committee (MSC), took into consideration the possibility of a satellite communication system devoted to maritime purposes. The main reasons, inter alia, for considering such a system was to improve distress and safety communications, reliability, quality and speed of communications, to relieve the existing congestion in the medium frequency (MF) and high frequency (HF) bands and to expand geographical coverage and continuous availability of services.

In 1973, the IMO Assembly adopted resolution A.305 (VIII), to call a conference to establish an International maritime satellite system. Finally, after three sessions by that conference, in 1976 the convention on the Establishment of the International Maritime Satellite Organization (INMARSAT) was adopted and on 16 July 1979, INMARSAT as an organization came into being. There are three essential components of the INMARSAT

system, namely the space segment, the land or control segment and the user segment.

1.2 Statement of the Problem

The assumption underlying this research is that GMDSS operations and services in Nigeria is inadequate and suffers multiple limitations. The central issue discussed in this research is that these inadequacies have made the maritime telecommunications ineffective paving way for high level of insecurity and maritime incidents in Nigeria and in the Gulf of Guinea region.

The maritime domain according to the United States Department of Defence includes “all areas and the things on, under, relating to, adjacent to, or bordering on a sea, ocean or other navigable waterway including all maritime related activities, infrastructure, people, cargo and vessels and other conveyances”. On the other hand, MDA is defined by IMO as the “effective understanding of anything associated with the maritime domain that could impact the security, safety, economy, or environment” (IMO, 2010b).

The GMDSS is the culmination of more than 10 years work by the IMO, in particular its Maritime Safety Committee, in cooperation with a number of other bodies such as the International Telecommunication Union and “INMARSAT.” The GMDSS, by taking proper advantage of modern communications facilities, has achieved a long-needed modernization of maritime distress and safety procedures.

The GMDSS has been designed to ensure a combination of safety and efficiency. Consequently, it is a highly automated system and will require ships to carry a range of technically very sophisticated but user friendly equipment.

The GMDSS places emphasis on alerting shore based search and rescue authorities for coordinated assistance and rescue operations. The GMDSS equipment carriage requirements, which will enable ships to perform specified distress and safety communication functions, is mandatory for all SOLAS convention vessels. It means according to SOLAS regulations all passenger ships and all cargo vessels of 300GT and above are required to carry GMDSS equipment on international voyages.

The requirements of the GMDSS have been made mandatory from February 1999. During the 7 year transitional period, from 1992 to 1999, all of the administrations in different countries will require ships under their flag to comply with the GMDSS requirements or, until they are able to do so, with the present safety requirements. Carriage requirements will vary somewhat depending on the areas of operation for the applicable ships. For example, those ships which confine their operations exclusively to areas of recognized VHF and MF coverage will be required to have capabilities for medium and short range communication, and those navigating in high seas will be required to carry satellite communications or an HF radio installation which includes new automated communications capabilities.

Here underscores the question of the adequacy of this critical maritime infrastructure and its operations. This research undertakes to investigate and evaluate the GMDSS infrastructure in Nigeria and proposes a workable and implementable GMDSS master plan for Nigeria to enable her improve on the MDA and security.

This research shall strive therefore, to answer these questions:

1) What is the current status of Nigeria’s GMDSS infrastructure and programme;

2) How the rules of National GMDSS policy, GMDSS master plan, GMDSS Assets, competent and trained personnel, operational and administrative bureaucracies and poor coordination and implementation influence GMDSS services in Nigeria;

3) How to overcome the various challenges posed by the aforementioned in order to improve on GMDSS services with a feasibility study of an implementable GMDSS master plan for Nigeria.

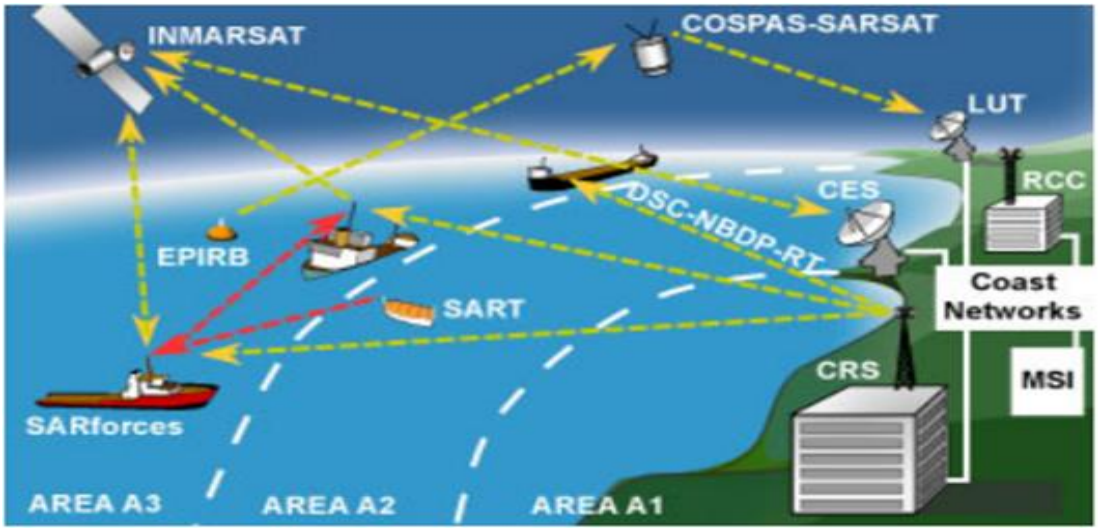


Figure 1. Functional requirements of the GDMSS System (Source: USCG-GMDSS-Guide-Booklet, 2019)

1.3 Aim and Objectives of the Study

The aim of this research is to evaluate GMDSS infrastructure in Nigeria so as to identify existing gaps, and proffer a feasibility plan for the implementation of a GDMSS master plan in line, and to the requirements of international regulations to which Nigeria has subscribed.

To achieve the above objective, the specific objectives are:

1) Map GMDSS infrastructure and services in Nigeria;

2) Examine GMDSS management and coordination in Nigeria;

3) To identify the challenges that inhibit the proper functioning of the GMDSS operations in Nigeria.

1.4 Significance of the Study

To improve efficiency of communication at sea, especially in cases of emergency, the IMO has established the GMDSS. GMDSS has been fully implemented worldwide since February 1999 as a part of the SOLAS (Safety of Life at Sea) convention, specifying the GMDSS communication equipment for marine vessels, and rescue procedures for vessels and humans at sea with the objective of maximizing safety at sea.

This GMDSS system provides methods and procedures of alerting by radio communication shore based RCCs (Rescue and Communication Centres) and ships in the vicinity of ships in distress. This Ship to Shore distress alerting enhances the likelihood of quick and efficient SAR (Search and Rescue) operations. All SAR activities are organized by RCC within specified navigational sea areas normally bordering their coastlines.

This topic was selected because of the dramatic increase in piracy in Nigeria since 2016. The study is important because it provides the needed intellectual input for understanding the difficulties faced by maritime operators and the law enforcement institutions at national and regional levels because of the lack of an effective ship-to-shore and shore-to-shore communication system as envisaged in the GMDSS, and how the difficulties limit their efforts to combat piracy and armed robbery at sea. The research also makes a unique contribution to the growing literature on maritime safety and law enforcement against piracy and incidents in Nigeria, and it lays a foundation for further research in this area.

1.5 Scope of the Research

The scope of this research shall be limited to the evaluation of GMDSS infrastructure and how effective they have been put into use to provide effective GMDSS services in Nigeria. Effort shall be made to compare Nigeria's status with some selected few African and other countries in the world. The research shall identify the inadequacies in Nigeria's GMDSS system and operations and proffer workable solutions thereof.

1.6 Geographical Area of Study

Nigeria is located in Western Africa on the Gulf of Guinea and has a total area of 923,768km^2. It's bothers span 4,047km, and it shares borders with Chad on the North-East (87km), by Cameroon on the East (1,690km), by the Atlantic Ocean (Gulf of Guinea) on the South (853km), by Benin (formerly Dahomey) on the West (773km), and by Niger on the North-West (1,497km). Nigeria lies between latitudes 4° and 14° N, and longitudes 2° and 15° E. Nigeria's southern borders have a coastline of 853km along the Gulf of Guinea in the Atlantic Ocean. Nigeria

has an estimated population of 210,367,591 million people spread across 36 states as at April 15, 2021, and it's estimated that the country's population would be about 401 million people by 2050 (World Population Review, 2020) making it the largest in Africa.

Figure 2. Map of Nigeria showing major rivers and the Gulf of Guinea (Source: mapsofworld.com)

Nigeria is endowed with about 8,575km of inland navigable waters consisting of Rivers and Creeks (CIA, 2013). The country is well linked with a network of rivers (significantly 2 major rivers — Niger and Benue), both running from the North and meeting at a confluence in Lokoja.

2. Literature Review

2.1 Introduction

The GMDSS is the technical, operational and administrative structure for maritime distress and safety communications worldwide. It was established in 1988 by the IMO which adopted a revised text of Chapter IV of the International Convention for the Safety of Life at Sea, 1974, (SOLAS) — dealing with Radio communications — and was implemented globally between 1992 and 1997. The GMDSS establishes the radio communications equipment that ships are required to carry, how this equipment shall be maintained and how it is used, and provides the context within which governments should establish the appropriate shore-based facilities to support GMDSS communications.

In the days since the very first radio equipment was used at sea, most famously in the sending of a distress message from the Titanic, vessels in distress relied almost exclusively on their ability to alert other ships in order to obtain assistance. The GMDSS, for the first time, changed this procedure and established a new fundamental principle that a ship in distress should send its alert to a shore, which would then accept the responsibility of coordinating the necessary rescue efforts. Thus, the GMDSS became inextricably linked with the parallel implementation of the International Search and Rescue Convention (SAR Convention) and the development of shore facilities within the structure of the World-Wide SAR Plan.

In addition to improving the capability of ships to declare their distress and receive assistance coordinated from the shore, the GMDSS also provided for the broadcast of essential safety-related information — Maritime Safety Information (MSI) — which could be received automatically on board ships at sea and would offer ships the chance to navigate more safely on a routine basis.

2.1.1 Functional Requirements

The GMDSS therefore, provides that every ship, while at sea, shall be able to perform the following nine basic communication functions:

1) Transmitting ship-to-shore distress alerts (by at least two separate and independent methods);

2) Transmitting and receiving ship-to-ship distress alerts;

3) Transmitting and receiving search and rescue coordinating communications;

4) Transmitting and receiving on-scene communications;

5) Transmitting signals for locating;

6) Transmitting and receiving maritime safety information;

7) Transmitting and receiving general communications; and

8) Transmitting and receiving bridge-to-bridge communications.

2.1.2 Ship Requirements — Areas of Operation Concept

The SOLAS Convention provides that "… every ship shall be provided with radio installations capable of complying with the functional requirements … throughout the intended voyage …" Thus, every ship has to carry a core installation of basic equipment that is applicable to all waters, supplemented by additional equipment that extends the ships communications capabilities according to the specific waters in which she will sail.

GMDSS sea areas serve two purposes — to describe areas where GMDSS services are available, and to define what radio equipment GMDSS ships must carry (carriage requirements). Prior to the GMDSS, the number and type of radio safety equipment ships had to carry depended upon its tonnage. With GMDSS, the number and type of radio safety equipment ships have to carry depends upon the GMDSS areas in which they travel. GMDSS sea areas are classified in the following four areas: A1, A2, A3 and A4 (IMO, 2001).

1) Sea Area A1 — An area within the radiotelephone coverage of at least one VHF coast station in which continuous digital selective calling (DSC) (Ch.70/156.525 MHz) alerting and radiotelephony services are available. Such an area could extend typically 30 to 40 nautical miles (56 to 74 km) from the Coast Station.

2) Sea area A2 — An area within a coverage of at least one coast station continuous listening on MF (2187.5 kHz) other than Area A1.

3) Sea Area A3 — An area, excluding sea areas A1 and A2, within the coverage of an INMARSAT geostationary satellite. This area lies between about latitude 76º North and South, but excludes A1 and/or A2 designated areas. INMARSAT guarantees their system will work between 70º South and 70º North though it will often work to 76º South or North.

4) Sea Area A4 — An area outside Sea Areas A1, A2 and A3 is called Sea Area A4. This is essentially the Polar Regions, north and south of about 76º of latitude, excluding any A1, A2 and A3 areas.

In addition to equipment listed, all GMDSS-regulated ships must carry a satellite EPIRB, a NAVTEX receiver (if they travel in any areas served by NAVTEX), an INMARSAT-C SafetyNET receiver (if they travel in any areas not served by NAVTEX), a DSC-equipped VHF radiotelephone, two (if between 300 and less than 500 GRT) or three VHF handhelds (if 500 GRT or more), and two 9 GHz search and rescue radar transponders (SART).

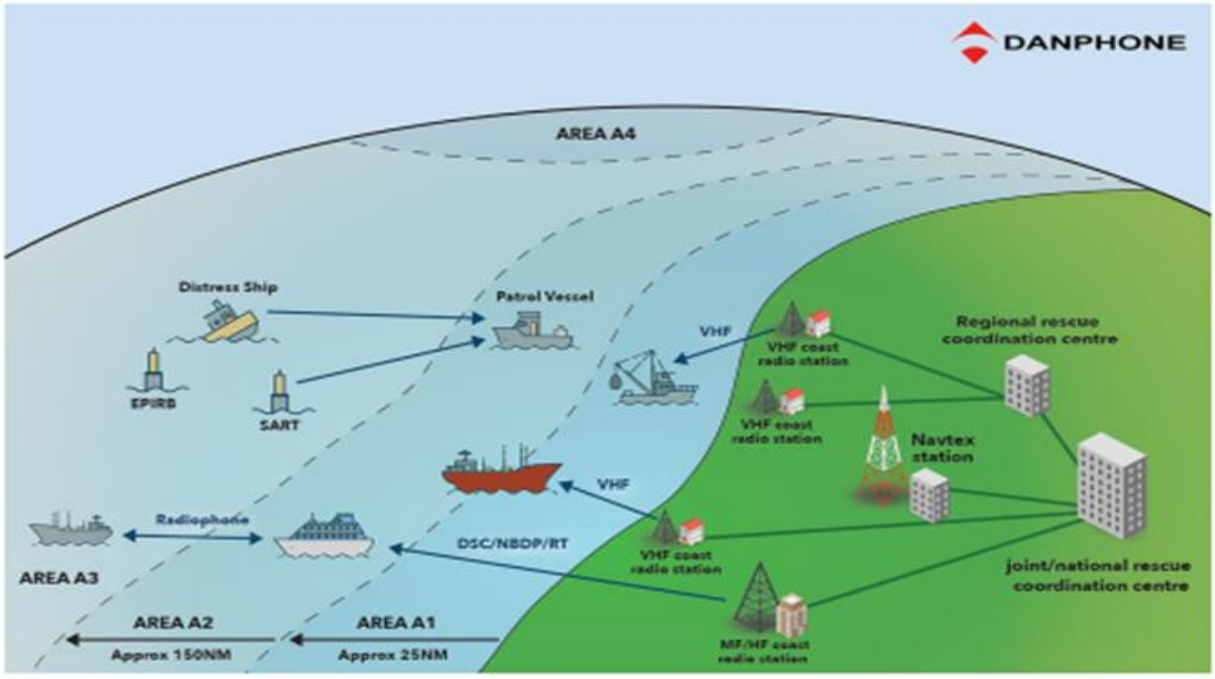


Figure 3. GMDSS Sea Areas (Source: Danphone.com)

In practical terms, this means that ships operating exclusively within about 35 miles from the shore may be able to carry only equipment for VHF-DSC communications; those which go beyond this distance, up to about 150 to 400 miles from shore, should carry both VHF-DSC and MF-DSC equipment; while those operating further from the shore but within the footprints of the INMARSAT satellites should additionally carry approved INMARSAT terminal(s).

Sea Area A4 cannot, by definition, be covered by the INMARSAT satellites and so ships operating in those waters — essentially the northern waters of the Arctic region — need to make provision for using HF communications.

In addition to the general communications equipment they are required to fit, ships also have to carry equipment for primary distress alerting — an Emergency Position Indicating Radio Beacon (EPIRB) and for the receipt of MSI. EPIRBs are small floating (some can automatically float free from a sinking ship) buoys and work through the COSPAS-SARSAT 406MHz satellite system. They can send a distress alert to the shore automatically to alert a Rescue Co-ordination Centre (RCC) that a ship is in distress in a particular location, but they cannot be used for two-way voice or data communications.

MSI is a broadcast of essential safety-related information (navigational warnings, meteorological warnings and forecasts, and other vital information) from the shore to all ships. The shore authorities co-operate to structure this broadcast in such a way that intelligent receivers can discriminate between information that is relevant to a particular ship and other information that is not, automatically discarding those messages that are not relevant to the ship in which the particular receiver is carried. NAVTEX is a terrestrial MF system used to make broadcasts up to around 450 miles from the transmitter. Broadcasts are coordinated in time, coverage and content so that ships can limit what they receive to only the specific information relevant to the waters in which they are operating. NAVTEX transmissions are provided for most of the highly populated coastal waters of the globe. SafetyNET is a satellite-based system that is used to broadcast MSI to all other waters of the globe, except Sea Area A4. SafetyNET is a service provided via the INMARSAT-C system, and is used to address MSI to the 23 NAV/MET Areas of the world. A ship's terminal will normally select automatically the area in which she is currently located, and the ship's staffs have the option to receive also information addressed to the area in which she is next heading. Information broadcast on NAVTEX is not normally also broadcast via SafetyNET.

The SOLAS Convention also places responsibilities on ships to maintain watches on specific frequencies for distress and safety communications, so some element of ship-to-ship alerting is retained in the new system; and specifies in general terms to means to be employed to preserve the operation of the radio equipment through reserve sources of electrical supply. It deals also with the IMO Performance Standards — IMO's series of operational criteria that each type of equipment must meet; plus how the equipment shall be maintained and the basic qualifications needed to operate the equipment safely and reliably.

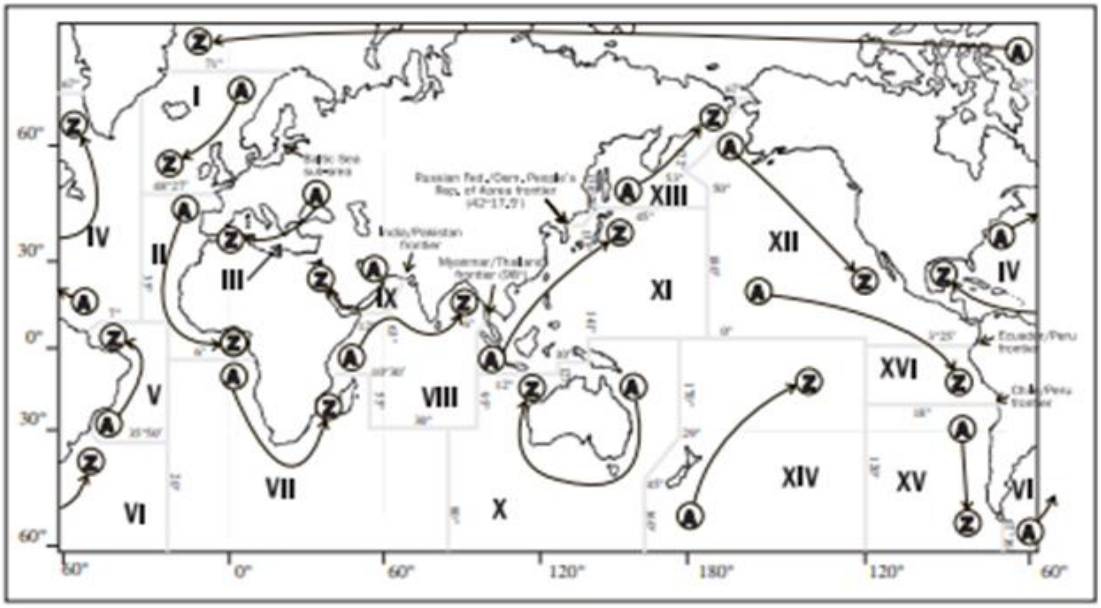


Figure 4. NAVAREAs of the World-Wide Navigational Warning Service, showing the basic scheme for allocation of transmitter identification (B1) characters by the Organization (Source: IMO GMDSS Handbook, 2001)

2.2 Undertakings by Government

While the requirements for ships are detailed and explicit, Governments cannot be held by international regulation to provide particular shore facilities in quite the same way. The GMDSS therefore, includes a provision whereby each government that chooses to sign the SOLAS Convention (called a Contracting Government) "*... undertakes to make available, as it deems practical and necessary either individually or in co-operation with other Contracting Governments, appropriate shore-based facilities for space and terrestrial communications ...*".

This undertaking establishes one of the really significant features of the GMDSS infrastructure: some communication systems will use facilities that are essentially international in nature and not under the control or supervision of any single government. It is this that gives rise directly to the need for the international community to establish special arrangements for the international supervision of satellite-based communication facilities for the GMDSS, which have been developed and are implemented by IMSO.

2.3 Applications of Gmdss

The GMDSS generally applies to all ships over 300 GT and upwards on international voyages. However, GMDSS systems are equally valuable for other vessels, including recreational and other "voluntary fit" vessels. GMDSS carriage requirements are also applied to some fishing vessels by national legislation.

2.4 Gmdss Equipment for All Ships

1) 406 EPIRP

- A 406 Satellite EPIRB is a requirement of GMDSS for the purpose of transmitting a distress alert signal ashore and for transmitting a locating signal. This EPIRB must be mounted in a float free location.

2) SART

- Cargo ships/MODUs above 300GT but less than 500GT are required to only carry one SART,
- Cargo ships greater than 500GT and all passenger ships are required to carry two SARTs, one on each side of the vessel, ready to be taken to survival craft,
- On ships carrying at least two SARTs and equipped with free-fall life boats one of the SARTs shall be stowed in a free-fall lifeboat and the other located in the immediate vicinity of the navigation bridge.

3) Survival Craft Radiotelephones**:**

- Emergency VHF transceivers that operate on VHF CH 16 and one other channel (VHF CH 06 is recommended),
- Cargo ships/MODUs greater than 500GT and all passenger ships are only required to carry two VHF transceivers,
- Cargo ships/MODUs greater 500GT and all passenger ships are required to carry three VHF transceivers,
- A transceiver permanently installed in a craft may count towards this requirement.

4) VHF Installation

- Capable of operating on VHF CHs 06, 13 and 16,
- Capable of maintaining continuous DSC monitoring on VHF CH 70,
- Capable of initiating digital selective calling distress alert transmission on CH 70.

5) NAVTEX

- One NAVTEX receiver required. Where NAVTEX service is not available, the vessel must have INMARSAT Enhanced Group Calling system, or HF direct printing telegraphy to receive MSI.

3. Research Methodology

3.1 Data Sources and Basis of Literature Review

Data for the study was collected in two main ways; primary and secondary. Primary data is an authentic or original data that may be collected from participants of a study. Currie (Currie, 2015) identifies primary data as "data that were previously unknown and which have been obtained directly by the researcher for a particular research project". According to the business dictionary, primary data is directly collected or observed from first-hand experience. It is normally collected straight from the respondents from the affected community. Some of the methods used to collect this kind of data include questionnaire, interview and participant observation.

Secondary data is the data that is already published in literature by other researchers. The business dictionary defines secondary data as “published data and the data collected in the past or by other parties”. Secondary data can be retrieved from books, published research, journal articles, media reports and academic writing. This specific type of data can be very essential to every research that involves the collection of primary data. It provides a reference point to begin any research. For the purpose of this research, secondary data provided a useful source of historical background to GMDSS.

Questionnaires were administered online to collect data about everyday operations of the various maritime stakeholders in Nigeria, and created the full picture of how they cooperate and adapt to changing operational conditions. Closed-ended as well as open-ended questions were posed to solicit ideas and information from respondents. The questionnaires were designed in such a way not to provide identification of a particular respondent but to ensure strict confidentiality. The questionnaires were divided into two (2) parts: the general part, which was intended to explore the general background of a respondent, and part two (2) which solicited answers to the research questions.

The general section of the questionnaire consisted of straight forward questions while part 2 was comprised of both closed ended and open ended questions. The questions were posed in such a way to seek genuine responses from individuals working with the maritime surveillance departments of various maritime agencies, especially the Nigerian Maritime Administration and Safety Agency (NIMASA) and who volunteered to take part in the study.

The secondary data complemented the responses from the questionnaire and interviews. It was very resourceful in interpreting the responses so that solutions to the existing GMDSS problems in Nigeria could be identified. Data from questionnaires that are in tandem with secondary data indicates the quality of the research data gathered, while contradictory data was analysed based on the weight of people responding in a similar manner i.e. the number of people, their background and experience.

3.2 Research Participants

In every research, the individuals that take part must be willing to provide vital information to the best of their knowledge, and their individual perspective and experiences to best help the study. Participants included in the research were managers or directors, supervisors and operators of maritime administration and management agencies in Nigeria. Primary data collection for this study was conducted within the various surveillance departments of the following maritime stakeholders in Nigeria:

3.2.1 Nigerian Maritime Administration and Safety Agency (NIMASA)

The Nigerian Maritime Administration and Safety Agency (NIMASA) is the apex regulatory and promotional maritime agency. The Agency was created from the merger of National Maritime Authority and Joint Maritime Labour Industrial Council on the 1st August 2006. The obligation of regulating the Maritime industry in Nigeria rests on the Agency through the relevant instruments.

The Agency was established primarily for the administration of Maritime Safety Seafarers Standards and Security, Maritime Labour, Shipping Regulation, Promotion of Commercial Shipping and Cabotage activities, Pollution Prevention and Control in the marine environment, the Agency also implements domesticated International Maritime Organization (IMO) and International Labour Organization (ILO) Conventions.

3.2.2 The NIgerian Navy (NN)

The Nigerian Navy (NN) is a branch of the Nigerian Armed Forces. It is among the largest navies on the African continent, consisting of several thousand personnel. The Navy’s core function is to ensure the protection of Nigeria’s sea lines of communication, which are vital to national survival. In that sense, it is for both defence and law enforcement at sea. The Nigerian Navy, one of the Gulf of Guinea (GoG) maritime forces, is expected to maintain and operate an efficient fleet, to meet the maritime challenges imposed on the sub region.

3.2.3 The Nigerian Ports Authority (NPA)

The Nigerian Ports Authority develop, own and operate ports and harbours, provide safe and navigable channels, offer cargo handling and storage services, maintain port facilities and equipment, ensure safety and security, and develop and own properties. This system hindered port development and curtailed operational efficiency. The ports became less competitive and a conduit to drain the meager national resources. In an attempt to change this trend, the activities of the Authority (NPA) were commercialized and offered greater autonomy in accordance with the recommendations of the Technical Committee on Privatization and Commercialization. However, this could not bring the expected improvement because of the public service bureaucracy and interference. It was later reversed to the initial status.

In an effort to reposition and enhance the national economy, the Federal Government embarked on various reform initiatives in the public sector, which includes the maritime sub-sector. This initiative was to foster an

economy that is responsive, robust, private sector oriented and in line with the international best practices.

3.2.4 National Emergency Mangement Agency (NEMA)

NEMA's mission is to coordinate resources towards efficient and effective disaster prevention, preparedness, mitigation and response in Nigeria. It acts in the following areas: coordination, disaster risk reduction, search and rescue; policy and strategy; geographic information system (GIS), advocacy, education, administration, finance and logistics; relief and rehabilitation; planning, research and forecasting.

3.2.5 The Nigerian Shipper's Council (NSC)

Transport is a critical determinant in the conduct of international trade and impacts on national economies. The availability, quality, cost, and efficiency of transport services influence the trading environment and the competitiveness of export goods on the international market as well as the cost of imported goods.

In this regard, the Nigerian Shippers' Council serves as an agent for economic development through interventions in cost moderation and cargo transport issues resulting in positive impact on inflationary trends in the country. The agency establishes the enabling environment for all stakeholders by instituting an efficient and effective economic regulatory system in the transport sector.

3.2.6 The Marine Police Unit of the Nigerian Police

The Marine Police was established in the year 1891 in Lagos, Nigeria and was then styled 'Night Water Patrol', with its initial personnel of twelve men headed by a sergeant. In those early days, improvised equipment such as locally carved wooden (hand pulled) canoes were used for surveillance and anti-crime patrols.

Though, the Marine Section had its peculiarities, it was regarded as part of the regular Police division. It is important to add that even in those days, the Marine Section was saddled with basic 'operational' duties such as anti-smuggling patrols, anti-piracy operations; enforcement of ports, harbours and Shipping Acts, guards, escorts duties, surveillance and general anti-crime duties.

The Marine Section generally conducts security combat and anti-crime operations on the Territorial Inland Waters, (measured from the inward limits of the coastal waterways from the fairway buoy), Ports, and Harbours. The section sometimes enjoys incursion extending into the Continental shelf and the Exclusive Economic Zone (E.E.Z) when it is conducting hot pursuit and chases. The basic and ancillary powers and authority of the section are from the Constitution of the Federal Republic, the Police Act, and various Acts and legislation.

3.3 Highlights of Issues with Gmdss in Nigeria

To achieve the objective of this research, an evaluation is made regarding the current GMDSS arrangements in Nigeria and in the Gulf of Guinea. The research studied the adequacy of GMDSS infrastructure in the countries ports and coastal area along with existing legal and institutional frameworks directed towards an effective GMDSS coverage. An analysis of the strengths and weaknesses of the system was done using survey reports from the IMO to determine the adequacy and extent of their effectiveness. The research provides a descriptive and logical analysis of secondary data, such as national and international organizational reports and records, journals, previous research, existing literature, newspapers, and online publications.

Also, surveys were done on vessels, VTS sites (including Port Control), Shore Radio Station (SRS) and Marine Rescue Coordination Centre (MRCC) that are involved in distress incident were visited and verbal interviews carried out with Radio Officers. The intentions of the interviews were to gather information about the GMDSS status and effectiveness in Nigerian ports. The following issues were highlighted:

1) Poor performance of INMARSAT-C,

2) Incontrollable and incessant Pirates attacking,

3) Non-GPS E3/E5 COSPAS Satellite EPIRB is incompetent for search and rescue operations,

4) The incorrect use of VHF hand held radios during fire fighting.

3.3.1 Poor Performance of Inmarsat

It was reported the terminal becomes too slow in transmission and likely freezing in dense traffic jam during distress communication. When the system gets freezing, it automatically reboots and takes long time to synchronise to the satellite. It was also highlighted that during heavy weather conditions, the system cannot find satellite due to ship rolling and elevation to the satellite.

3.3.2 Incessant Pirates Attacks

The trend of the rise of pirates attacking and armed robberies on board was debated as major problem GMDSS facing. It was evidenced that the current GMDSS infrastructure still does not cover all spheres of distress situations occurring at sea such as "Pirates attacking". Therefore, anti-pirate device solutions have to be

deployed on board and be part of GMDSS next generation.

3.3.3 Non-Gps E3/E5 Cospas Satellite Epirb Is Incompetent for Search and Rescue Operations

The MRCC rescue team found the deployment of the latest technology EPIRB with internal DGPS makes life much easier for rescue team operation to locate the vessel in distress. It is due to the DGPS information being added on to the coded identification programmed on the EPIRB.

Rescue team supported their statement as follows: although it is understood that GMDSS prescribes the EPIRB as last resort equipment to initiate a distress alert to MRCC, with the inclusion of GPS information it makes minimal time delay to find the vessel in distress.

3.3.4 The Incorrect Use of Vhf Hand Held Radios During Fire Fighting

IMO Radio Regulations (RR) requires all compulsory GMDSS compliant vessels to be fitted with at least 3 sets of VHF Hand held radios which shall be used during distress and rescue communication between the mother vessel and the lifesaving appliances, or between the lifesaving appliances. VHF Hand held radios shall be also used on-board communication between the controlling station and the slave stations, or between slave stations. It was raised and discussed that VHF Hand held radios were observed during distress operations; water penetrated and causes transmission limitation to the radio communication.

In addition, it was discussed and debated that during fire fighting situations on board, the vessel also uses the same radios for communication. However, it was revealed that these VHF radios are experiencing failure when used in fire fighting due to heat. Then the regulation has to be rectified and amended for the use of VHF Radios.

4. Results and Discussion

4.1 Current Situation of Gmdss Coverage in Nigeria

The SOLAS Convention requires member nations to establish COSPAS/SARSAT Local User Terminal (LUT) stations at strategic places especially ports and terminals for effective GMDSS coverage. Coast stations with GMDSS equipment such as digital selective calling (DSC), narrow band direct printing (NBDP) and navigation telex (NAVTEX) equipment are expected to be installed. So far, from our extensive investigations, these do not exist even as Nigeria is not only a signatory, but has domesticated the SOLAS Convention. The following sections below outline the status of Nigerian GMDSS outlay.

4.1.1 Status of Shore-Based Facilities for the Gmdss

Figure 5 show shore-based facilities for the GMDSS in Nigeria and few other selected African countries. It is instructive to note that Nigeria has only one operational Inmarsat LES (B) Coast station, planned NAVETEX MSI Broadcast service stations at Lagos and Oron, and two operational COSPAS-SARSAT MCC and LUT stations located in NEMA headquarters in Abuja. The Antennas for the planned stations are to be positioned on 06º23’.99N and 003º22’.91E for the Lagos station and 04º48’.01N and 008º15’.34E for Oron. Both are expected to have a range of 250NM. This is in clear contrast to other countries in Africa such as South Africa and Algeria (as highlighted) with operational Coast stations in almost all the areas.

Table 1. Status of Shore-Based Facilities for the GMDSS in Nigeria and Selected African Countries (Coastal Stations), (IMO, 2016e)

Country	**Coastal Stations**						**SES for RCC**
	DSC			**Inmarsat LES**			
	A1	A2	**A3 & A4**	**B**	**C**	**Inmarsat Fleet F77**	
Algeria	o	o		o			o
Angola	P	P	P				P
Benin	o	o					
Cameroon	p	p					
Congo	p	p	p				
Cote d’Ivoire	o	o	o				
Democratic Republic of Congo	p	p					
Djibouti	p	p					
Egypt	o	o	o				o

Equatorial Guinea	p						
Gambia	p						
Ghana	o	p	p				
Guinea	p	p					
Guinea-Bissau	p	p					
Kenya		p	p				
Liberia	p	p	P				
Libya							P
Madagascar	p	P					
Mozambique	p	P	P				
Namibia							
Nigeria				o			
Senegal	o & p	O					
Sierra Leone	p	p	P				
South Africa			o				
Sudan	p	p	p				
Togo	p						
Tunisia							

Key: O = Operational, T = Under trial, P = Planned or to be decided.

Table 2. Status of Shore-Based Facilities for the GMDSS in Nigeria and Selected African Countries (MSI Broadcast Service/Cospas-Sarsat), (IMO, 2016e)

Country	**MSI Broadcast Service**					**COSPAS-SARSAT**	
	NAVTEX	**Safetynet**			**HF NBDP**	**MCC**	**LUT**
		NAV	**MET**	**SAR**			
Algeria	o	o	o	o		o	o
Angola	p	p	p	p	p	p	p
Benin							
Cameroon	p						
Congo							
Cote d'Ivoire	p						
Democratic Republic of Congo							
Djibouti							
Egypt	o				p		
Equatorial Guinea							
Gambia							
Ghana							
Guinea							
Guinea-Bissau							
Kenya							
Liberia							
Libya							
Madagascar							

Mozambique							
Namibia	o						
Nigeria	p					o	o
Senegal	p						
Sierra Leone							
South Africa	o	o	o	o		o	o
Sudan							
Togo							
Tunisia	p						

Key: O = Operational, T = Under trial, P = Planned or to be decided.

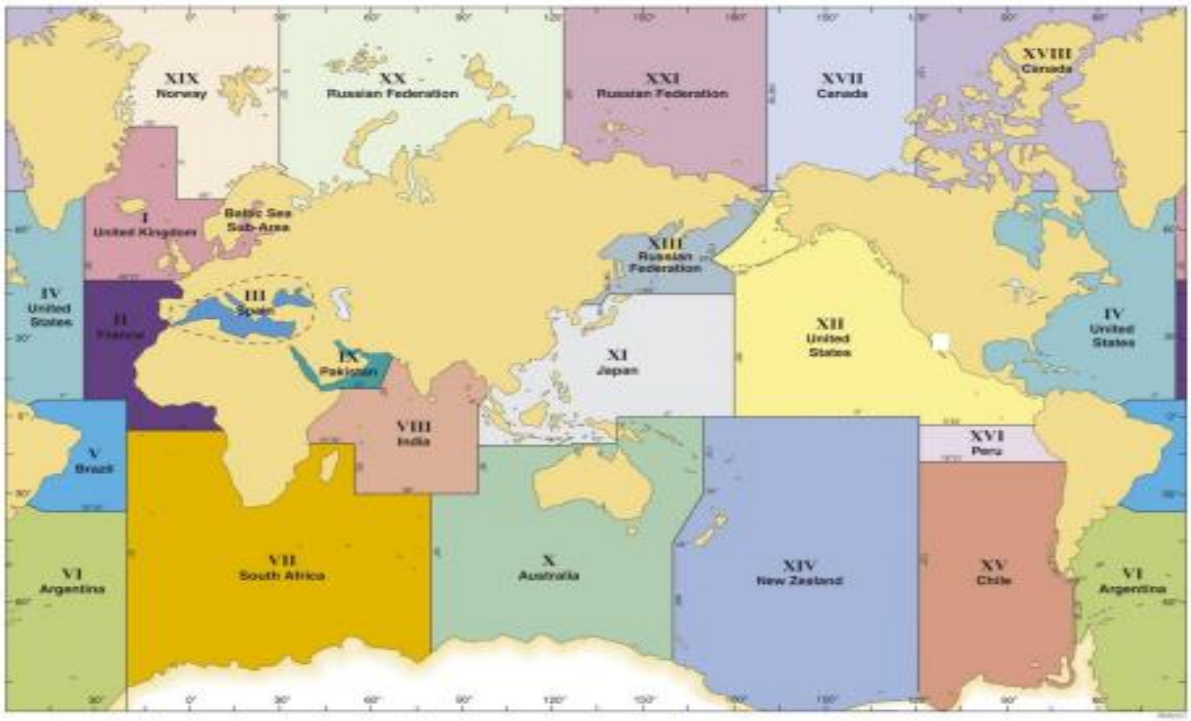


Figure 5. Geographical Areas for Coordinating and Promulgating Radio-Navigational Warnings (Source: Researchgate.net)

4.1.2 VHF DSC Coast Stations for Sea Area A1

There are no VHF DSC Coast stations for Sea Area A1 in Nigeria where as in other countries in Africa, Algeria has eleven (11) main and minor operational stations; Egypt has fifteen (15) main and minor stations; Ghana has nine (9), Cote d'Ivoire has seven (7), and Senegal six (6) (IMO, 2016e).

4.1.3 MF DSC Coast Stations for Sea Area A2

Nigeria does not have MF DSC Coast Station for Sea Area A2 while in Africa, Cote d'Ivoire has seven (7) operational main and monitor stations in NAV/MET Area II, Algeria has three (3) operational main stations in NAV/MET Area III, Egypt has three (3) main stations in NAV/MET Area III and Mozambique has one (1) main station in NAV/MET Area VII (IMO, 2016e).

4.1.4 HF DSC Coast Stations for Sea Areas A3 and A4

Nigeria again, has no HF DSC Coast Station for Sea Areas A3 and A4 while in Africa, Cote d'Ivoire has one (1) operational station in NAV/MET Area II, Egypt has one (1) operational station in NAV/MET Area III and South Africa with one (1) operational station in NAV/MET Area VII (IMO, 2016e).

4.1.5 Inmarsat Land Earth Stations (LESs)

There are no INMARSAT Land Earth Stations (LESs) in Nigeria. Neither is there any in the whole of Africa.

4.1.6 Rescue Co-Ordination Centres (RCCs) Using Ship Earth Stations (SESs)

There are no Rescue Co-ordination Centres using Ship Earth Stations (SESs) in Nigeria while in Africa, only Egypt has five stations viz. JRCC Cairo Authority (Operational), El-Adabeya VTC (Operational), False Ras Gareb VTC (Operational), Sharm El Sheikh VTC (Operational), and Safaga VTC (operational) in NAV?MET Area IX.

4.1.7 Navtex Service (International 518 KHz NAVTEX)

There are two (planned/proposed) Navtex Service (International 518 KHz Navtex) stations in Lagos and Oron in Akwa Ibom State. As at today, these are yet to be implemented. In Africa, Senegal has one (1) in Darka in NAV/MET Area II (non-operational); Algeria has one (1) at Ain Taya in NAV/MET III (operational); Egypt has one station in Alexandria in NAV/MET Area III and two (2) stations at Serapeum (Ismailla) and Kosseir in NAV/MET Area IX (operational); and South Africa having four (4) stations in Cape Town (operational), Durban (operational), and Cape Columbine (planed) all in NAV/MET Area VII.

4.2 Necessity for Gmdss Development, Expansion and Improvement in Nigeria

From the foregoing, it is clear that Nigeria currently does not have a functional NAVTEX station. There is therefore, the urgent necessity to develop, expand and improve on a robust GDMSS programme.

GMDSS was developed by IMO, and put into service in February 1992 and fully implemented in February 1999. As for shore-based facilities, Amendments to the 1974 SOLAS Convention concerning GMDSS, Chapter IV (Radio Communications), Part B (Undertaking by Contracting Governments), Regulation 5 (Provision of Radio Communication Service) stipulates that;

"*Each Contracting Government undertakes to make available, as it deems practical and necessary either individual or in cooperation with other Contracting Government, appropriate shore-based facilities for space and terrestrial radio communication services having due regard to the recommendations of the organization*".

Accordingly, two of such stations were planned for Lagos and Oron but the implementation is yet to begin. Still, there still remain many blind zones for Sea Area A3, Sea Area A2 and Sea Area A1, and National NAVTEX service that have to be established in the Nigerian coastal waters and the Gulf of Guinea to enhance maritime security.

Nigeria, as a big maritime state in the world, has a vital responsibility for the establishment of maritime distress and safety telecommunication system in accordance with the SOLAS Convention and related international regulations.

A lot of human lives have been lost every year in the Nigerian waters by serious marine accidents. Recent maritime incidents in and around the coastal area of Nigeria in 2020 alone as outlined below justify the need for a robust GMDSS programme (CEMLAWS, 2020):

1) IRENES RESOLVE, 21 February 2020: attack on the Liberia-flagged container ship about 160nm south-west off Bayelsa State, Nigeria.

2) CAP DIAMANT, 25 March 2020: suspicious approach on the Liberia-flagged crude oil tanker about 155nm south-west off Brass, Nigeria.

3) BW TAGUS, 14 June 2020: suspicious approach on the Singapore-flagged product tanker about 250nm off the Nigerian coast.

4) MV KOTA BUDI, 2 July 2020: attack and kidnapping on the Singapore-flagged general cargo vessel about 150nm off Cotonou, Benin.

5) CURACAO TRADER, 17 July 2020: attack and kidnapping on the Liberia-flagged product tanker about 224nm south of Cotonou, Benin.

6) VALLEY OAK, 11 November 2020: suspicious approach on the Marshall Island-flagged chemical tanker about 198nm south off Cotonou, Benin.

7) MINERVA EVROPI, 4 December 2020: fired upon incident on the Greece-flagged crude oil tanker about 230nm south off Cotonou, Benin.

8) MT VERRAZANE, 5 December 2020: attempted incident on the France-flagged product tanker about 210nm south off Lagos, Nigeria.

9) MT NEW RANGER, 5 December 2020: attack on the Malta-flagged product tanker about 200nm south off Lagos, Nigeria.

These maritime incidents clearly point to the fact that there is a dare need for a robust maritime

telecommunication system. The probability of lives to be rescued becomes much higher if GMDSS stations are established.

Today, the countermeasures against piracy and armed robbery are urgent issues for the coastal waters of Nigeria. It is pointed out that one of the reasons the measures against piracy and armed robbery do not work effectively is the delay in information transmission.

IMO recommends all ship Masters to report piracy and armed robbery cases in the sea to the nearest Rescue Coordination Centre (RCC) or coast station. GMDSS is an effective means in piracy report from ship's master to nearby RCC or coast station.

A lot of domestic and international vessels are engaging in transportations and fishing activities in Nigerian waters. An effective GMDSS programme will highly impact on the social and economic activities; as well enhance security, maritime safety and protection of the marine environment as follows:

1) As for International Responsibilities as a Maritime State
   - Rescue and Ensuring Safety of Life
   - Rescue and Preservation of Ships and Property
   - Marine Environment Protection Safety of sea lanes
2) As for Promotion of Economic Activities (Direct)
   - Maritime Transportation
   - Fishery Activities
3) Exploitation of Ocean Resources (Indirect)
   - Development of National Economy by Efficient Maritime Traffic
   - Promotion of Local Industries
   - Exploitation of Sea-bed Mines
   - Promotion of Shipping Industries

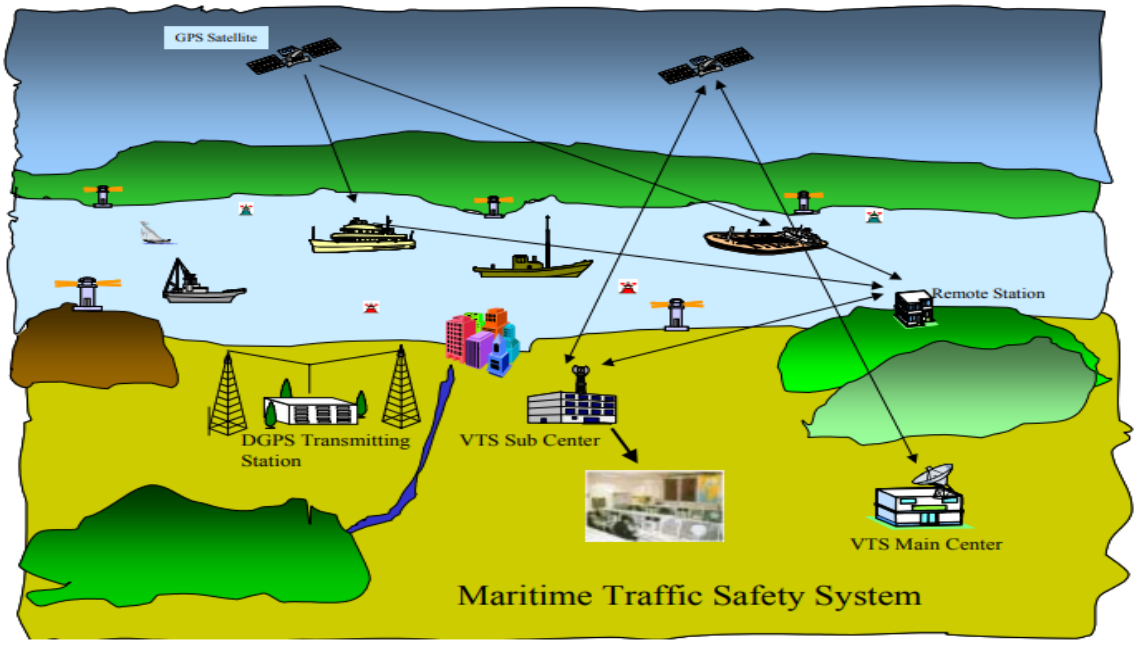
GMDSS was developed with the aim that a distress vessel in any sea area can make a quick and secure request for rescue to maritime SAR authorities. Therefore, in principle, the whole Nigerian waters should be covered by GMDSS. However, as Nigeria should hasten to establish GMDSS shore-based facilities and notify the Coast stations list of GMDSS to IMO, the following GMDSS development, expansion and improvement should be implemented as an urgent project:

1) To cover major blind waters by MF DSC,
2) To cover waters in and around main ports and important navigation waters by VHF DSC,
3) To commence National NAVTEX service using frequency and transmitters for International NAVTEX,
4) To expedite the implementation of the proposed/planned coast stations in Lagos and Oron.

4.3 Concept of GMDSS Development, Expansion and Improvement

The concept of GMDSS expansion and improvement that should be executed as an urgent national project is as outlined below:

1) Concept development;
2) Development and Expansion of GMDSS Coverage;
   - To cover major blind waters by MF DSC for Sea Area A2
   - To cover waters in and around main ports and important navigation waters by VHF DSC for Sea Area A1
3) Commencement of National NAVTEX service;
   - To introduce and commence National NAVTEX service in Nigeria using the English language and a frequency and transmitters for existing International NAVTEX
4) Development and improvement of coast stations to cover GMDSS;
5) Separation of transmitting and receiving stations at designated locations;
6) Development and improvement of environment for coast stations and VHF coverage;
7) Development/deployment of Generators to stations and installation of more Antennas.



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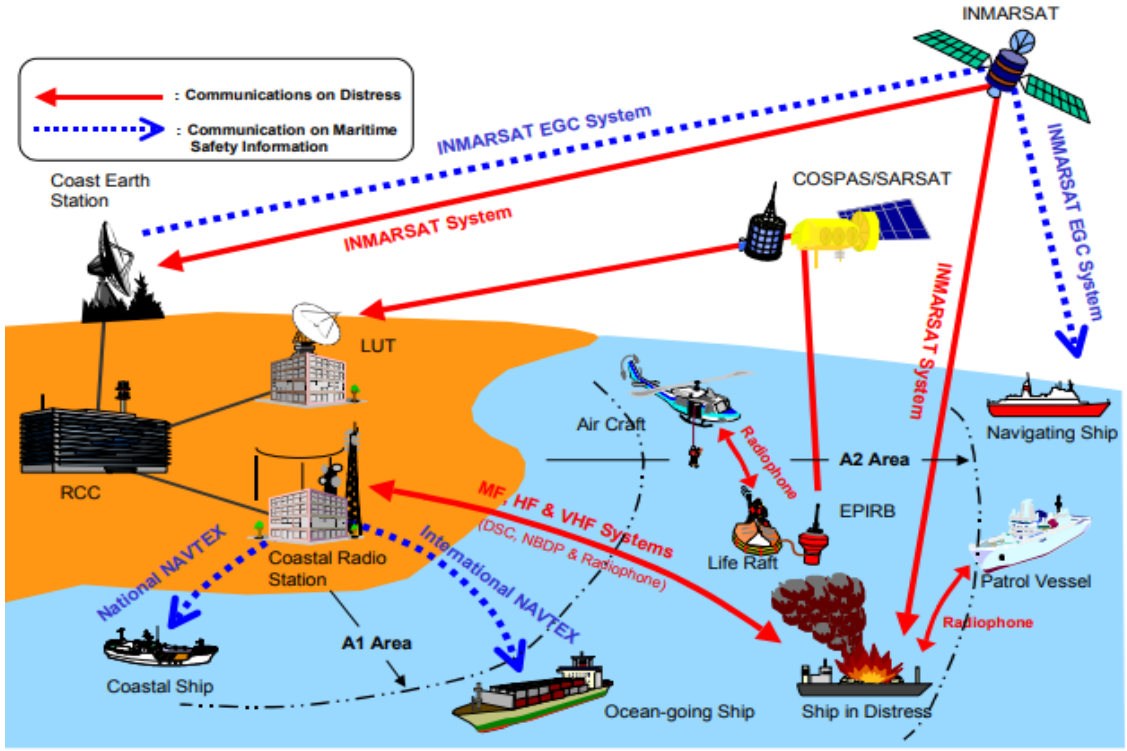


(b)

Figure 6 (a & b). Concept of the Maritime Traffic Safety System Development Plan in Nigeria

4.4 Contents of the Project

4.4.1 Development and Expansion of GMDSS Coverage

1) Installation of MF DSC for Sea Area A2 — The following stations should be installed with MF DSC equipment to cover major blind waters for Sea Area A2:

- 1st Class Stations: 3 stations in Lagos Ports, Tin – Can Port, Rivers Ports (Port Harcourt) and Oron

- 2nd Class Stations: 3 stations in Onne Port, Delta Port (Warri) and Calabar Ports
- 3rd Class Stations: 4 stations in Brass, Lokoja, Bonny and Burutu

2) Installation of VHF DSC for Sea Area A1- The following existing stations should be installed with VHF DSC equipment to cover waters in and around main ports and important navigation waters for Sea Area A1:

- 1st Class Stations: 3 stations in Lagos Ports, Rivers Ports (Port Harcourt) and Oron
- 2nd Class Stations: 3 stations in Onne Port, Delta Ports (Warri) and Calabar Ports
- 3rd Class Stations: 4 stations in Brass, Lokoja, Bonny and Burutu

4.4.2 Commencement of National Navtex

A frequency for International NAVTEX, 518 kHz, will be utilized for National NAVTEX service. The use of this frequency is limited to the message only in the "VITAL" or "IMPORTANT" categories. However, message can be received by the receivers of International NAVTEX without any modification, as the Nigerian alphabet is the same as that of English.

Figure 7. Map showing the major Rivers of Nigeria (Source: Wikipedia.com)

4.4.3 Establishment of Comprehensive Maintenance Function

In order to cope with the increase of sophisticated equipment, comprehensive maintenance function should be established in all the proposed stations in order to reinforce practical and effective maintenance system for maritime telecommunication system with fully prepared spare parts, maintenance goods, personal computer (PC) networks with 1st/2nd coast stations, etc and high-level trained staffs.

4.4.4 Enforcement of Training Function

After the establishment of the GMDSS stations, well-trained would have to be deployed to man them. This informed the necessity for the establishment for a comprehensive practical training function, introducing all-round equipment, instruction materials, simulators, etc on operation and maintenance for the staff to be deployed to the different types of equipment for GMDSS, and for communication purposes.

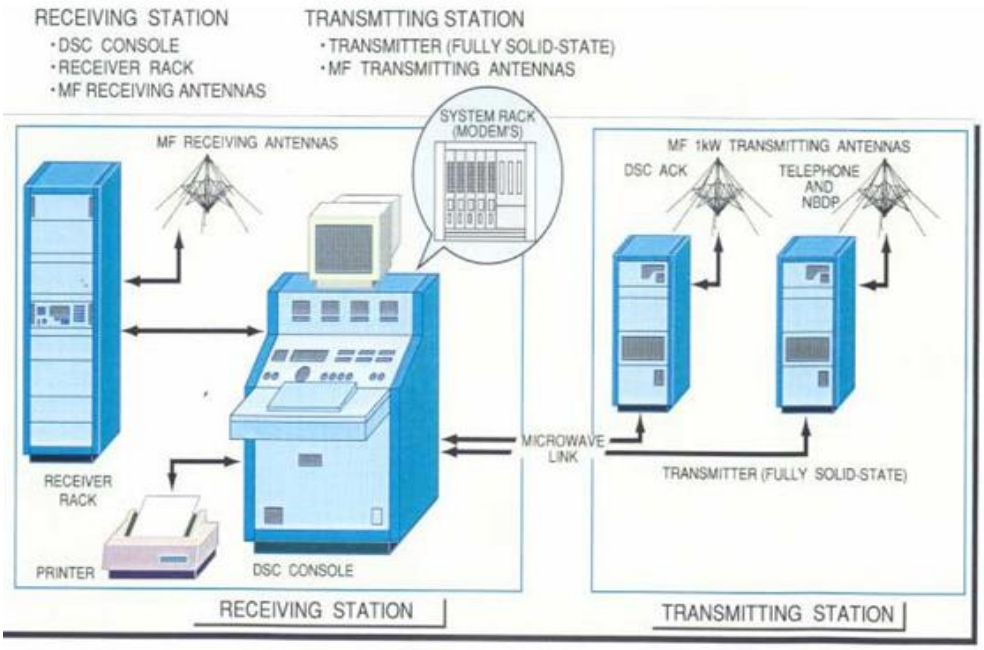
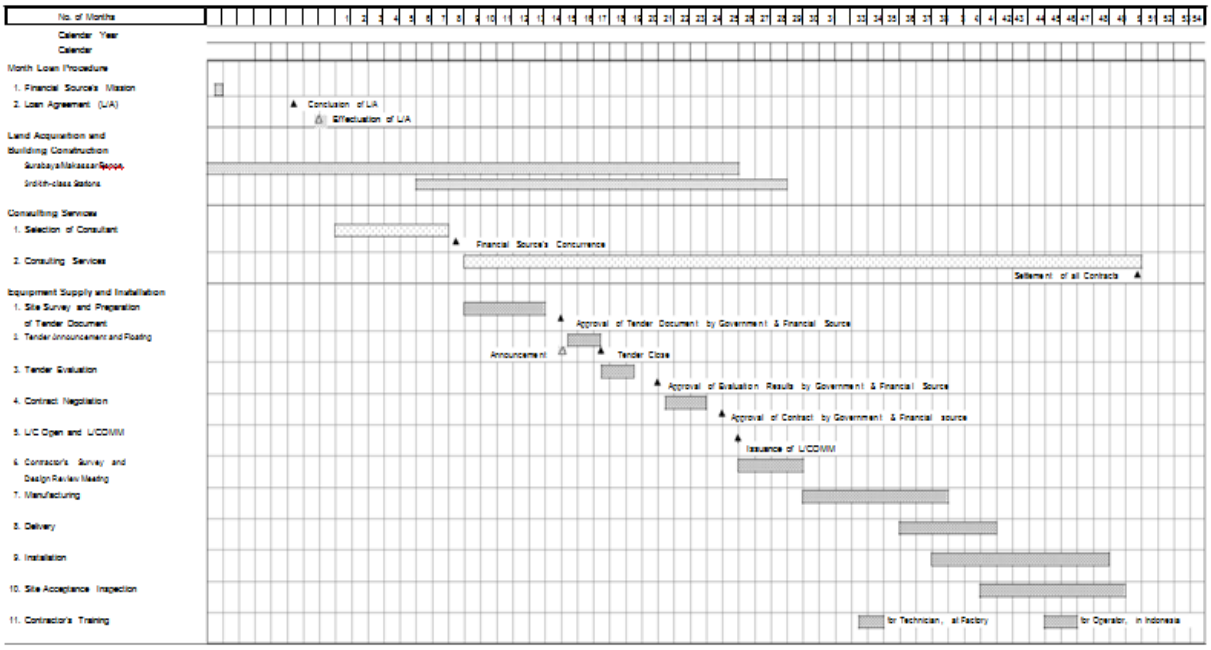


Figure 8. Radio Equipment for GMDSS (Area A2)

4.4.5 Implementation Schedule

Implementation time of this Project is estimated for 50 months and the schedule is shown in Table 3.

Table 3. Implementation Time Schedule for GMDSS



5. Conclusion and Recommendations

5.1 Conclusion

Global Maritime Distress and Safety System (GMDSS) is the internationally agreed-upon set of safety procedures, types of equipment and communication protocols used to increase safety and make it easier to rescue all distressed ships, boats and aircrafts.

According to IMO (1999) the GMDSS represents a worldwide network of automated emergency

communications for ships at sea. SOLAS convention Chapter IV states that all ocean-going passenger ships and cargo ships of 300 gross tonnage and upwards are required to carry radio equipment that conforms to international standards.

The main purpose of GMDSS is to prevent unanswered distress calls and delay in Search and Rescue actions when distress situations occur. GMDSS assures "*... that any emergency at sea will result in a distress call and the response to that call will be immediate and effective*" (IMO, 1999e).

The SOLAS convention Chapter IV Radio communication, Regulation 7 Radio equipment: General lists all radio equipment required onboard the vessels.

GMDSS consists of:

1) A Digital selective calling (DSC) — a standard for sending pre-defined digital messages from ship to ship, ship to shore and shore to ship based on VHF, MF and HF Maritime radio communication;

2) An Emergency position indicator radio beacon (EPIRB) — automated identification and locator device for Search and Rescue operations;

3) Search and Rescue locating equipment — automatically leading Search and Rescue units to the position of distress by signalling search and rescue radar transponders;

4) Search and Rescue locating equipment — automatically leading Search and Rescue units to the position of distress by signalling search and rescue radar transponders;

5) INMARSAT — a global mobile satellite communication system providing two-way data and messaging.

The original concept of the GMDSS is that search and rescue authorities ashore, as well as shipping in the immediate vicinity of the ship in distress, will be rapidly alerted to a distress incident so they can assist in a coordinated search and rescue operation with the minimum delay. The system also provides for urgency and safety communications and the promulgation of maritime safety information (MSI). The GMDSS Regulations requires every vessel compliant shall whilst at sea, be able to perform the below functions:

1) Transmit ship-to-ship distress alerts by at least two independent and separate means, each using a different communication service.

2) Receive shore-to-ship distress alerts by using terrestrial and satellite communication.

3) Transmit and receive ship-to-ship distress alert by using VHF DSC, 121,5 MHz EPIRB Homing frequency, text message exchange using satellite and MF/HF DSC using terrestrial communication.

4) Transmit and receive search and rescue (SAR) co-ordination communication. Transmit and receive on-scene communication using satellite and terrestrial communication.

5) Transmit and receive Maritime safety information (MSI) by using Enhanced Group Calling (EGC) system if the vessel is engaged on voyages within coverage of the satellite but beyond NAVTEX service.

6) Transmit and receive locating signals using Automatic Identification System (AIS) and Long-Range Identification and Tracking (LRIT).

7) Transmit and receive general radio communication to and from shore-based radio system or network.

8) Transmit and receive bridge to bridge communication (Routine communication).

9) Receive Navigational Warnings using NAVITEX receiver if the vessel is engaged on voyages within the coverage of coastal NAVTEX service station.

10) All compliant vessels must carry primary and secondary means of distress alerting in accordance of the Sea Areas in which the vessel is operating.

11) Transmit alert to ship owners, flag and suitable authorities when the security of the ship is under threat by using satellite.

By the advancement of technology and employment of high tech equipment on board ships, the following developments are expected to take place;

1) The reduction of crew to a minimum level; and

2) The increase of safety of navigation and protection of the maritime environment at a very high level.

In this process, the role of communication on board is very important and it is entrusted to high technology systems such as satellite communication, terrestrial DSC and NBDP.

Therefore, it is very essential for the maritime administrations to have a future plan ready for meeting these new trends of automation in every aspect.

The GMDSS, adopted by IMO in 1986, is a dramatic change in the regulations for maritime communication. The participation of coastal states in these new requirements is much more than before. The Morse code will be phased out and a new digital system will take over. The conventional radio officer is no longer necessary on board. Equipment redundancy and increasing.

MTBF will enhance the availability of equipment enormously. Satellite communications will have a major role in maritime communication.

The shores of many countries will be equipped with radio and satellite stations. SAR activity will become more sophisticated and RCC's will be installed in strategic positions.

Maritime Safety Information will be sent from the coast to ships by special procedures. The investments, both aboard ships and ashore will be high, but if the management of the amortization is properly adjusted then the result will be very effective and unnecessary expenditures can be avoided. The cooperation among neighbouring countries is also very crucial in budgeting for the new requirements.

Nigeria as a maritime state need to do a lot of work to establish a comprehensive and robust GMDSS system to tame the high trend of maritime insecurity in her maritime waters as well in the Gulf of Guinea. Nigeria has to also, work to establish the new requirements of GMDSS. The maritime administration in Nigeria has to give priority to the aspects of safety of navigation in allocating the budget as to:

1) The division of coastal water according to the requirements of GMDSS (A1, A2, ...).

2) The establishment of CRSs along the Nigerian coastal waters and the Gulf of Guinea.

3) The establishment of a Coast Earth Station (CES) in defined and strategic ports and coastal areas.

4) Co-operate with the Local User Terminal (LUT) in South Africa and other Africa countries having such facilities.

5) The establishment of NAVTEX stations for sending Maritime Safety Information in Nigerian coast and in the Gulf of Guinea.

6) The establishment of a Repair and Maintenance Centre in Lagos and Port Harcourt ports and branches in other ports.

7) The training of qualified personnel for ships and the Repair and Maintenance Centre.

8) The establishment of RCCs.

5.2 Recommendations

The following recommendations should be very helpful to the Maritime Administration especially NIMASA for maritime safety communication and administration in Nigeria:

1) The immediate implementation of the planned/proposed GMDSS stations in Lagos and Oron, and the establishment of other stations across the coastal waters of the country.

2) The use of a shore-based repair and maintenance centre as a replacement for the radio electronic officer. This is available when the centre can be fully operational and well manned. So, it can carry out all the repairs and maintenance of ship equipment. This program is already implemented by some developed countries such as the Netherlands.

3) Use of VHF Direction Finders for determination of positions of ships in the coastal area (VHF D.F.). Every small craft or vessel should have VHF on board. Then in case of an emergency as soon as a VHF contact is made the RCC, SRCCs and CRS can find the position of the vessel.

4) The organization of a repair and maintenance centre and its legal entity. There could be a preparatory committee for the establishment of this centre which could consist of a few experts from PSO and the satellite section of the information and telecommunications ministry. The agenda of this committee could be:

- Legal entity of the centre (Governmental or Private),
- Primary investment,
- Organizational structure,
- Training, for qualified personnel,
- Operational structure.

5) The establishment of more RCCs and SRCCs.

6) Co-operation with neighbouring countries in terms of using available resources in the region to the benefit of maritime safety. There is a possibility to establish an MRCC (Master RCC) for the whole region

and RCC in each country around the Gulf of Guinea. In this case the management of the search and rescue operation should be international, comprising of experts and equipment from all countries in the Gulf of Guinea. In this way the area can be divided for each area co-ordinator and all efforts can be controlled through a MRCC.

A control centre for every incoming and outgoing ship for the benefit of safety of navigation and protection of the marine environment. This should contain a reporting system especially for those ships carrying dangerous cargoes.

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