

SUB-COMMITTEE ON NAVIGATION,
COMMUNICATIONS AND SEARCH AND
RESCUE
7th session
Agenda item 14

NCSR 7/14
15 October 2019
Original: ENGLISH
Pre-session public release:

DEVELOPMENTS IN GMDSS SATELLITE SERVICES

Recognition of BeiDou Message Service System as a GMDSS Service provider

Submitted by China

SUMMARY

Executive summary: This document presents, in the annex, information on pre-assessment of the BeiDou Message Service System (BDMSS) in relation to the criteria established by resolution A.1001(25), for consideration by the Sub-Committee in its evaluation and recognition of BDMSS as a Global Maritime Distress and Safety System (GMDSS) service provider

*Strategic direction,
if applicable:* 6

Output: 6.2

Action to be taken: Paragraph 6

Related documents: MSC 99/12/1, MSC 99/22; NCSR 6/14/3, NCSR 6/23; resolutions A.707(17), A.887(21) and A.1001(25); MSC.1/Circ.1414 and SN.1/Circ.329

Background

1 The BeiDou Navigation Satellite System (BDS), as a part of the World-Wide Radio Navigation System (WWRNS), provides positioning, navigation, timing and messaging services. As a functional component operating through the BDS network, the BeiDou Message Service System (BDMSS) is capable of providing messaging and broadcast services for Asia and Western Pacific region with overlapping coverage on a 24/7 basis, with a view to contributing to the improvement of maritime safety communications and search and rescue at sea.

2 The Maritime Safety Committee, at its ninety-ninth session, considered document MSC 99/12/1 (China), forwarding an application for the recognition of BDMSS and use in GMDSS, and consequently referred the application to the NCSR Sub-Committee for evaluation

of the detailed information to be provided in due course and authorized the Sub-Committee to invite IMSO to conduct the technical and operational assessment, as appropriate (MSC 99/22, paragraphs 12.32 and 12.33).

3 The Sub-Committee, at its sixth session, having noted the information provided by China (NCSR 6/14/3) related to BDMSS, including its status, functional capabilities and development plan, invited China to provide all the necessary information to the Sub-Committee in due course for evaluation of the satellite system in relation to the criteria set out in resolution A.1001(25), taking into account the Guidance to prospective GMDSS satellite service providers (MSC.1/Circ.1414) (NCSR 6/23, paragraph 14.3).

Pre-assessment by CTTIC

4 China Transport Telecommunication and Information Group Co., Ltd (CTTIC) is the service provider of BDMSS, responsible for its marketing activities and business operations. As required, CTTIC undertook pre-assessment of the service capabilities and performance of BDMSS against the criteria specified in resolution A.1001(25), taking into account the guidance provided in MSC.1/Circ.1414 and submitted the information, as contained in the annex, for verification and evaluation by the Sub-Committee.

Discussion

5 The information on pre-assessment, as set out in the annex, for BDMSS to be considered for recognition and use in GMDSS provides evidence to show that:

- .1 BDMSS conforms with applicable criteria specified in resolution A.1001(25);
- .2 CTTIC will comply with the charging policies and provisions of resolution A.707(17), as amended;
- .3 CTTIC is committed to provide continuous, stable and reliable services for users of BDMSS with its sound financial standing and long-term service experience in satellite communications, and will continue to do so in the foreseeable future; and
- .4 CTTIC stands ready to submit any recognized services to oversight by IMSO and sign the required Public Services Agreement (PSA).

Action requested of the Sub-Committee

- 6 The Sub-Committee is invited to:
- .1 consider the information on pre-assessment of BDMSS contained in the annex;
 - .2 verify and evaluate the information contained in the annex; and
 - .3 invite IHO, WMO and other interested Member States and international organizations to review and provide advice, as appropriate.

ANNEX



Information on Pre-assessment for Recognition of BeiDou Message Service System as a GMDSS Service Provider

EXECUTIVE SUMMARY

1 The pre-assessment is conducted by China Transport Telecommunication and Information Group Co. Ltd (CTTIC) and relevant information is submitted to the International Maritime Organization (IMO) for the recognition and use of BeiDou Message Service System (BDMSS) in the Global Maritime Distress and Safety System (GMDSS). BDMSS services and capabilities are submitted in accordance with resolution A.1001(25) with evidence indicating that BDMSS complies with applicable criteria and requirements to be recognized as GMDSS service provider.

2 In addition, CTTIC will provide services to maritime users in compliance with the charging policies and provisions specified in resolution A.707(17), as amended. CTTIC is also ready to submit the recognized services to oversight by the International Mobile Satellite Organization (IMSO) and sign the required Public Services Agreement (PSA) with IMSO.

CTTIC

3 CTTIC was established in 1979 and affiliates with the China Transport Telecommunications and Information Center (CTTIC) of the Ministry of Transport of the People's Republic of China. Being committed in long term to the development and application of information technology in the transport industry in China, CTTIC undertakes responsibilities to provide emergency safety communication services and monitors the operation of distress and safety communications provided by Cospas-Sarsat, Inmarsat and VSAT in China.

BDMSS maritime services

4 Since the introduction of Regional Short Message Communication (RSMC) Service in 2003, BDMSS has been providing stable and reliable messaging, position-reporting and broadcast services for the Asia-Pacific region. Currently, there are more than 500,000 subscribers, of which more than 100,000 are maritime subscribers. BDMSS delivers over 136,000 messages and position reports per day on average to maritime subscribers in China and its adjacent areas. BDMSS has an estimated average of over 8,000 active maritime subscribers every day and assisted 26 maritime search and rescue (SAR) operations in 2017.

BDMSS network architecture

5 BDMSS is comprised of three major components: space segment, ground segment and user terminals.

6 At present, the satellite constellation consists of five geostationary earth orbit (GEO) satellites, which are deployed with short message communication service payloads and positioned at longitudes 58.75°E, 80°E, 110.5°E, 140°E and 160°E, providing short message communication services in Asia and Western Pacific Ocean regions. Three of the five satellites are operational and two are in-orbit spares. In the event of a total failure of one operational satellite, a spare satellite will be used to restore the service.

7 BDMSS abides by the frequency allocations, and performs declaration, coordination, notification and registration of satellite network files following the procedures specified in *Radio Regulations* of the International Telecommunications Union (ITU). The feeder links connection between the satellites and the Master Control Stations (MCS) uses the frequencies in the C-band allocated to Fixed Satellite Service (FSS). The system operates in the frequency bands 1 610.0 - 1 626.5 MHz (user terminal to satellite) and 2 483.5 – 2 500 MHz (satellite to user terminal) for Mobile Satellite Service (MSS) between BDMSS maritime mobile terminals and the satellites. In conformity with footnotes No.5.364 and 5.402, these frequency bands

have been coordinated under No.9.11A and registered in the Master International Frequency Register (MIFR) under No.11.41.

8 The ground segment is designed to comprise one operational and one backup MCS, one Mission Control Centre (MCC) and terrestrial communication links. Both the operational MCS and MCC are located in Beijing, and the backup MCS is under construction. Backup arrangements are in place to provide connection redundancy and real time services. MCC is connected to MCS via dedicated circuits and public switched networks and is connected to Maritime safety information (MSI) providers and Rescue Coordination Centers (RCCs) via dedicated circuits and public switched networks. A selection of communication links is available based on message priority and traffic volume.

9 User terminals are BDMSS-based, GMDSS-compliant maritime mobile terminals which are capable of transferring communications to and from the satellites, transmitting distress alerts and messages, and SAR coordinating communications.

Coverage Area

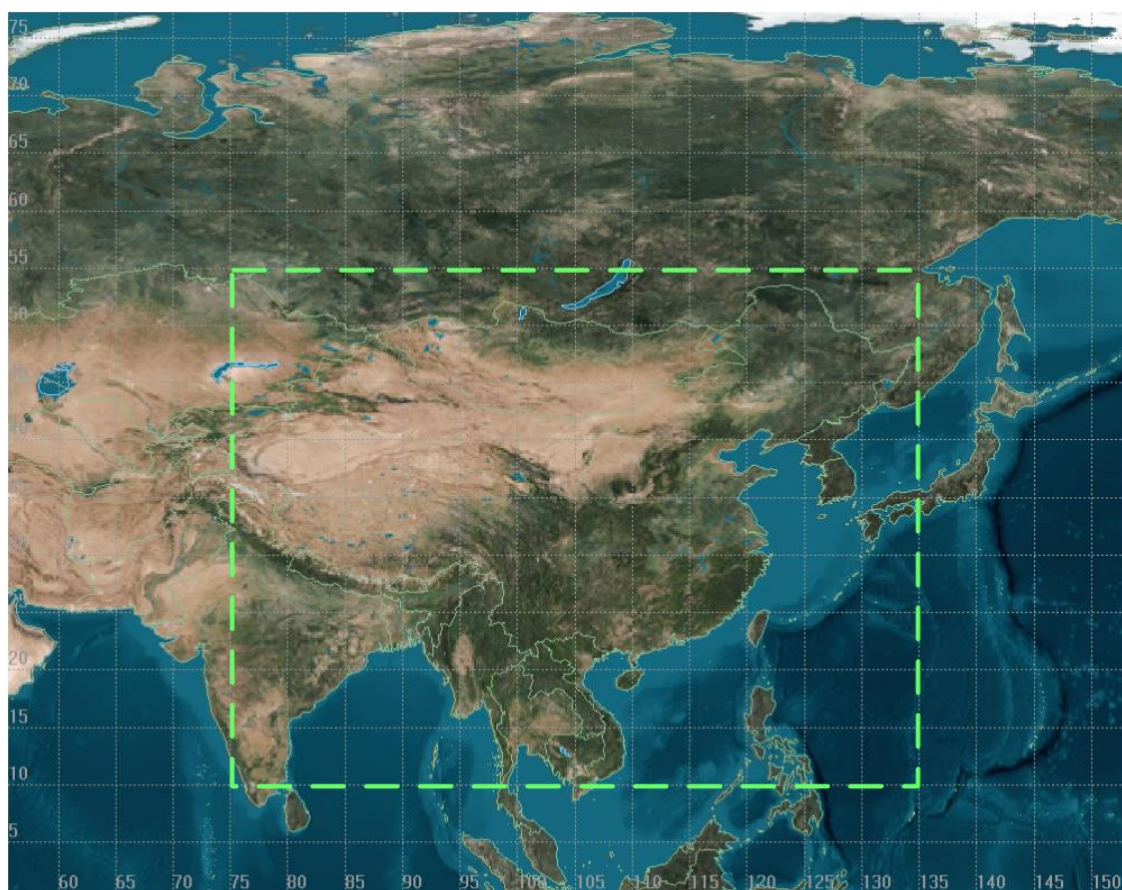


Figure 1: Service coverage area

10 The BDMSS service covers Asia and Western Pacific Ocean region and is capable of providing reliable satellite messaging and continuous alerting in areas of 75°E to 135°E longitude and 10°N to 55°N latitude (shown in figure 1).

Network availability

11 Since its introduction in 2003, BDMSS has been continuously providing messaging and broadcast services on a 24/7 basis. The system and service performance are under continuous monitoring. Supported by a robust and redundant satellite network and a continuously stable and reliable ground system, the system availability has consistently fulfilled the requirement of "at least 99.9% availability" set in resolution A.1001(25). In 2017 and 2018, its availability has been kept at 100%.

Service restoration

12 The BDMSS satellite constellation architecture ensures high reliability and low latency data communication services. In the event of a satellite failure, services will be fully restored within 10 seconds for users in the overlapping coverage of satellite beams by switching to another available satellite beam from another satellite, and within an hour for a small number of users in the coverage of a single beam by adjusting an in-orbit spare satellite.

Network functional capabilities

13 BDMSS will comply with all the applicable criteria and requirements as prescribed in resolution A.1001(25) for the provision of data communication and broadcast services in the GMDSS.

14 BDMSS will provide capabilities for the six maritime distress and safety communications as defined in section 3.1 of resolution A.1001(25) and is designed to support four levels of prioritization to ensure immediate transmission of distress, urgency and safety communications.

15 BDMSS also supports shore-to-ship broadcasting of MSI. Same as the short message communication service, the broadcast service has been designed to provide four levels of priority. Further details on the broadcast service functionality can be found in sections 3.1.5 and 4.9 below.

System development plan

16 BDMSS is implementing a programme to upgrade its satellite constellation to consist of three operational and one in-orbit spare GEO satellites. The upgraded service is expected to be available by 2020 with better system and service performance. Satellites to be launched will be completely compatible with current services and terminals, enabling a stable and seamless transition for its user terminals and services. The current five satellites will continue to serve as spare satellites or be decommissioned depending on their respective service life spans and conditions.

17 With the ongoing upgrading of the satellite constellation and deployment of the global system, BDMSS is envisaged to provide Global Short Message Communication (GSMC) Service as well as improving the existing RSMC service.

Unique features

18 BDMSS operates through the BDS network to provide GMDSS services in conformity with the provisions set out in resolution A.1001(25). BDS integrates navigation and messaging communication into one system and therefore allows BDMSS to possess unique features different from traditional satellite communication systems as follows:

- .1 **Overlapping coverage:** user terminals are under the coverage of more than one satellite, which reduces the need to maintain a link with a single satellite beam during sea voyages and enables stable connection with any one satellite beam in severe weather conditions. All BDMSS maritime mobile terminals use omnidirectional antennas, which require less automatic tracking of antennas and less equipment installation than those required by traditional ones.
- .2 **High integration:** BDMSS maritime mobile terminal integrates high accuracy positioning, navigation and timing (PNT), data communication and alerting services, which brings convenience to maritime users.
- .3 **Low latency and high efficiency:** immediate channel access is provided for communication originating from user terminals based on the Short Burst Data (SBD) service, saving time and resources for channel request, assignment or link establishment.
- .4 **Beneficial return links:** BDMSS is designed such that the receipt of acknowledgement of the distress alert will be sent to user terminals within 2 seconds upon initiating the distress alert. This would greatly reduce false alerts and boost the confidence of person in distress. In addition, wireless control over BDMSS maritime mobile terminals is carried out through return links, including remote shutdown, change of work mode and service access control.
- .5 **Low power consumption and compact in size:** BDMSS is designed with optimal uplink and high gain satellite payload, which allows mobile terminals to be compact in size and low in power consumption. With these features, BDMSS mobile terminals are not limited to be installed only at a fixed position in vessels, they are portable (such as Personal Locator Beacons (PLBs)), a feature that brings a broader range of maritime safety and security applications.
- .6 **Group communication:** similar to instant messaging applications on smart phones, BDMSS provides group communication service, and is capable of group communication and position sharing and SAR coordination communications among a group of maritime users within a specified geographic area.
- .7 **Various supplementary information:** in addition to ship position, velocity and course information, the distress messages sent through BDMSS also include information about the vital signs of the person(s) in distress, contributing to the effectiveness and efficiency of SAR operations.

Future work

19 CTTIC is ready to communicate with IMSO regarding the terms of PSA. Upon recognition by IMO for use in GMDSS, CTTIC intends to sign the mutually agreed PSA with IMSO.

20 CTTIC will also continue to progress work with RCCs and MSI providers to deploy interconnections with BDMSS to support message and broadcast services. CTTIC is prepared to provide the proposed services on a trial basis and sign memorandum of understandings

(MOUs) with each RCC and MSI provider when full services are available. Upon a formal recognition by IMO, BDMSS will start providing such services from a designated date.

21 CTTIC plans to cooperate with maritime mobile terminal manufacturers and the International Electrotechnical Commission (IEC) to develop standards and testing criteria for BDMSS maritime mobile terminals. CTTIC has been engaged in technical cooperation with multiple experienced maritime mobile terminal manufactures for the development and manufacture of BDMSS maritime mobile terminals compliant with resolution MSC.434(98) and IEC 61097-16, as well as the integration with other shipborne systems.

22 CTTIC looks forward to contributing to enhancing maritime safety by providing communication services through BDMSS. CTTIC will make its best efforts to work with IMSO, RCCs and MSI providers and undertake all necessary administrative and technical activities to ensure the system with full-service capability in place, so as to provide GMDSS-compliant services as soon as possible.

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1 DEFINITION

1.1 Mobile Satellite Communication System

The concerned mobile satellite communication system refers to BeiDou Message Service System (BDMSS), including or interfacing with the following elements:

- **Earth station:** BDMSS land earth station, consisting of BDMSS Master Control Stations (MCS) and Mission Control Centre (MCC);
- **Maritime mobile terminal:** BDMSS maritime mobile terminal;
- **Space segment:** BDMSS satellite constellation and communication links with the earth;
- **Terrestrial network:** terrestrial communication networks supporting BDMSS services.

1.2 Mobile Satellite Communication Service

Mobile satellite communication service refers to services provided by BDMSS to be recognized for use in the GMDSS.

1.3 Coverage area

Coverage area is the geographical area within which BDMSS provides GMDSS-compliant services.

1.4 Availability

Availability is defined as the percentage of time in which BDMSS as a whole is available for access and communication, calculated according to the following formula:

$$Availability = \frac{Scheduled\ operating\ time - downtime}{Scheduled\ operating\ time} \times 100\%$$

2 RECOGNITION OF MOBILE SATELLITE COMMUNICATIONS SYSTEMS FOR USE IN THE GMDSS

2.1 The evaluation and recognition of satellite systems participating or wishing to participate in the GMDSS are undertaken by the Organization

BDMSS will follow the procedures and abide by the provisions established by the Organization and provide necessary assistance in the evaluation and recognition of BDMSS as a GMDSS service provider.

2.2 Application for recognition

In May 2018, the Maritime Safety Committee (MSC), at its ninety-ninth session, considered the application by China (MSC 99/12/1) for the recognition and use of BDMSS in GMDSS. With no objections to the application, the Committee referred the application to the Sub-Committee on Navigation, Communications and Search and Rescue (NCSR) for

evaluation of the detailed information and authorized the Sub-Committee to invite IMSO to conduct the technical and operational assessment.

The pre-assessment is conducted by the BDMSS service provider CTTIC and relevant information is submitted through the People's Republic of China to IMO for review and evaluation.

Detailed information is provided to show that:

- BDMSS conforms with applicable criteria specified in resolution A.1001(25).
- BDMSS service provider will comply with the charging policies and provisions of resolution A.707(17), as amended.
- As the authorized service provider, once BDMSS is recognized for use in GMDSS, CTTIC will abide by the charging policies specified in resolution A.707(17), as amended, on *Charges for distress, urgency and safety messages through the Inmarsat system*, to provide service packages to maritime users through BDMSS.
- For ship-to-shore and shore-to-ship distress communications and alerts, urgent navigational and meteorological warnings and communications for medical assistance for persons in danger, CTTIC will provide such services at no charge to the originator or addressee. In addition, CTTIC will provide shore-to-ship SAR-related information broadcasting at no charge, including distress alerts relay originated from RCCs. Meteorological reports and forecasts, position reports and regular medical consulting and assistance will be charged to the originator. For non-distress shore-to-ship MSI broadcasting, the originators will be charged. For the delivery of MSI broadcast messages, CTTIC will sign annual contracts of fixed prices with each MSI provider to cover their broadcasting services in concerned service areas.
- The Government of China is committed that BDS, including BDMSS, will provide continuous, stable and reliable services for users. Considering the sound financial standing and long-term service experience in satellite communications, there are good reasons to believe that CTTIC is capable of providing stable and reliable services and will continue to do so in the foreseeable future.
- While providing informatization services and emergency communications for the transport industry, CTTIC has also been operating mobile satellite communication business in Asia-Pacific regions for decades, covering maritime, land and aviation fields. In addition to terminals and services, CTTIC has established an integrated service system with well-organized sales services, subscription and registration, billing and accounting, customer services, technology research and development and so on, providing service subscription, online support, after-sale services and value-added services. CTTIC is the first operator in China to be recognized by the Ministry of Information and Industry as a basic telecommunication operator in mobile satellite communication field. Interconnections have been established between CTTIC and other basic telecommunication operators, e.g. China Telecom, China Mobile and China Unicom.

- BDMSS service provider is ready to submit any recognized services to oversight by IMSO and sign the required Public Services Agreement (PSA) with that organization.
- CTTIC is ready to sign the PSA with IMSO and submit the recognized service to oversight by IMSO once BDMSS is recognized for use in GMDSS by IMO. As a member of the Chinese delegation, CTTIC has been participating in the activities of IMSO regarding the revision of Reference PSA and maintained cooperative in IMSO's oversight and audit on Inmarsat GMDSS services. CTTIC will be well prepared for the future activities between BDMSS and IMSO, such as PSA signing and BDMSS service oversight and audit.

2.3 Verification and evaluation

Detailed information of BDMSS is contained in this pre-assessment and submitted to the NCSR Sub-Committee by BDMSS service provider through the Government of China for further verification and evaluation. CTTIC will make clarifications and provide additional information when required by the Organization.

If it is concluded that BDMSS satisfies all the requirements as defined in resolution A.1001(25) and is qualified to be recognized and included in the GMDSS after evaluation, an MSC resolution will be consequently developed as a statement of recognition to officially announce the decision. A copy of the statement of recognition will be provided to IMSO.

If IMO is unable to recognize BDMSS as a GMDSS service provider after evaluation and consideration, CTTIC will kindly invite IMO to notify this decision in a formal notice, setting out reasons for the decision and future possible actions that CTTIC and BDMSS may take to achieve recognition.

2.4 The Public Services Agreement

Upon recognition of BDMSS as a GMDSS service provider, BDMSS service provider will sign the PSA with IMSO based on consensus on the terms and arrangements and assist IMSO in the oversight of recognized GMDSS service. Arrangements and methods for the oversight by IMSO on the GMDSS communications provided by BDMSS will be described in the PSA, including the implementation and financial issues.

2.5 Reports

After the recognition of BDMSS as a GMDSS service provider, the BDMSS service provider will provide necessary information, including data and tools, upon request to assist IMSO in developing the annual report on the availability, performance and other relevant aspects of BDMSS.

3 CRITERIA AND REQUIREMENTS FOR THE RECOGNIZED MOBILE SATELLITE COMMUNICATION SYSTEM

3.1 Functional requirements

BDMSS provides capabilities for the following maritime distress and safety communications.

Ship-to-shore distress alerts: BDMSS supports ship-to-shore distress alerts using the short message communication service. Ship-to-shore distress alerts are initiated by the BDMSS maritime mobile terminal installed on board the ship and are then routed through the link

between the maritime mobile terminal and the satellite to MCS. From MCS the distress alerts are routed to MCC and then terminated into the responsible RCC. If distress alerts are not delivered to, or answered by the responsible RCC, the operators on duty in the BDMSS land earth stations will receive a visual and audible alarm. Network latency for the delivery of a ship-to-shore distress alert is less than 10 seconds. A diagram for a ship-to-shore distress alert is provided in figure 2.

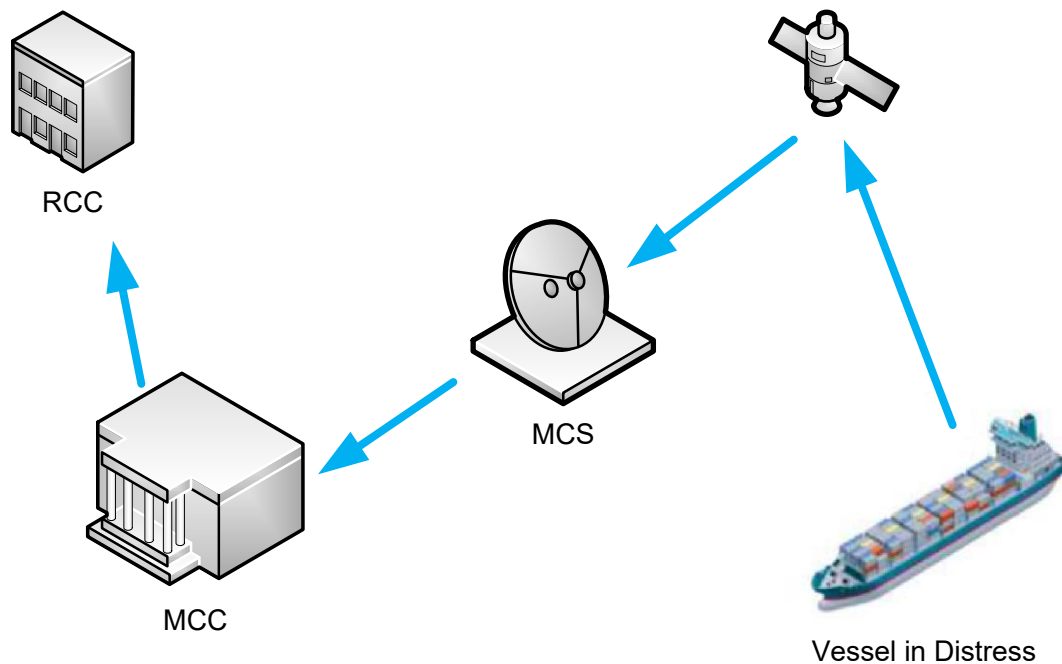


Figure 2: Ship-to-shore distress alert

Shore-to-ship distress relay alerts: BDMSS supports shore-to-ship distress relay alerts. Upon connection, the shore-to-ship distress relay alerts are immediately processed for delivery to the BDMSS maritime mobile terminals.

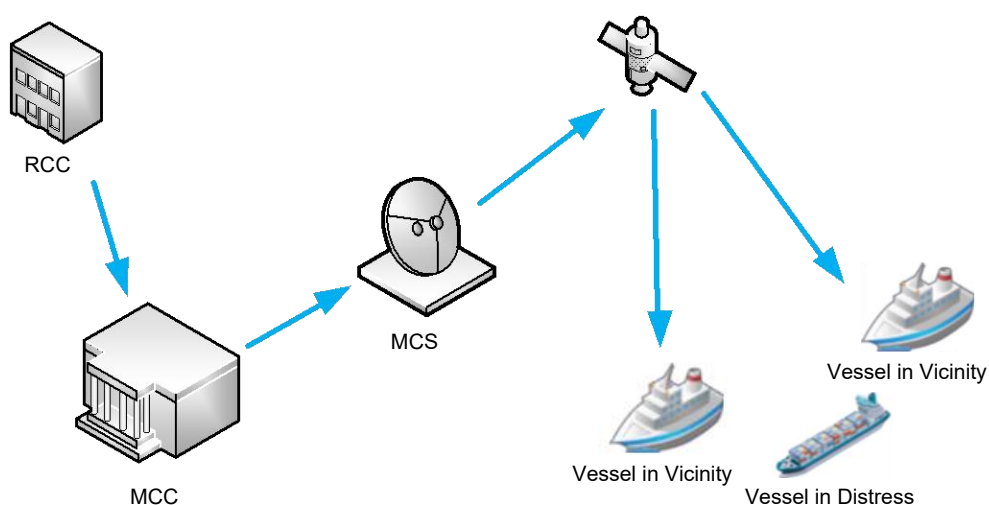


Figure 3: Shore-to-ship distress relay alert

Shore-to-ship distress relay alerts are initiated by an RCC or other appropriate party. The distress relay alerts are routed to MCC via dedicated circuits. MCC then transmits the distress relay alert to MCS. MCS would then deliver the distress relay alert through satellite downlink to the BDMSS maritime mobile terminals installed on the ships navigating in the vicinity of the distressed ship. A diagram for a shore-to-ship distress relay alert is provided in figure 3.

Ship-to-shore, shore-to-ship and ship-to-ship search and rescue coordinating communications: BDMSS supports ship-to-shore, shore-to-ship and ship-to-ship SAR coordinating communications. Priority is given to such communications between parties to ensure that SAR communications can be transmitted without interruption.

Ship-to-shore and shore-to-ship SAR coordinating communications will be routed in the same manner as described in sections 3.1.1 and 3.1.2. RCCs will serve as the focal point for SAR coordinating communications and act as the originator or addressee for all SAR coordination messages.

Ship-to-ship SAR coordinating communications will be initiated on board the ship and routed to the BDMSS maritime mobile terminals or to ships navigating in the vicinity of the distressed ship via group communication. A diagram for ship-to-shore, shore-to-ship and ship-to-ship SAR coordinating communications is provided in figure 4.

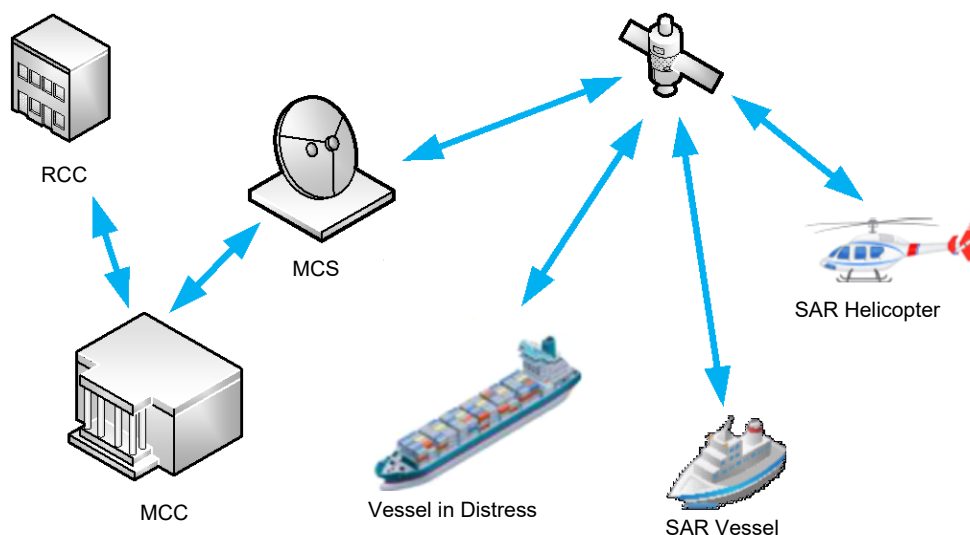


Figure 4: SAR coordinating communications

Ship-to-shore transmissions of MSI: BDMSS supports ship-to-shore transmissions of MSI. MSI generated on board a ship will be transmitted to the satellite through uplink. The message is then routed to MCS, then MCC, and terminated into appropriate MSI providers. A diagram for ship-to-shore transmissions of MSI is provided in figure 5.

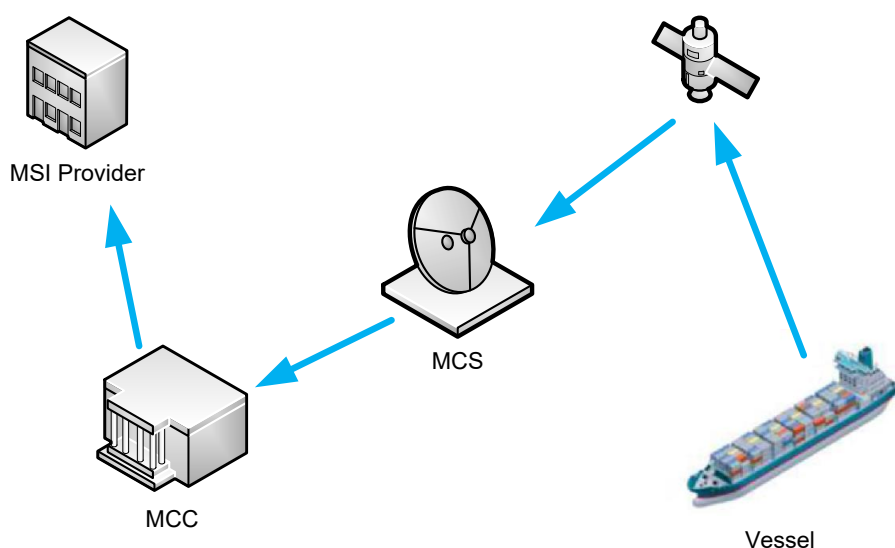


Figure 5: Ship-to-shore transmissions of MSI

Shore-to-ship broadcasting of MSI: BDMSS supports the shore-to-ship broadcasting of MSI. MSI providers may choose to use a Virtual Private Network (VPN) or dedicated circuits for direct connection to the BDMSS network. The MSI providers can specify the parameters for each broadcast message, including priority, delivery area and frequency and time of distribution.

Each broadcast message will be processed by MCC based on the message parameters and then routed as a whole to MCS. The broadcast message is then queued for delivery based on the message parameters and distributed through one or more satellite beam(s) depending on the specified geographical region. BDMSS will perform the retransmission at specified time intervals as requested by the MSI provider. A diagram for the shore-to-ship broadcasting of MSI is provided in figure 6.

Each NAVAREA and METAREA will be defined as a geographical area assigned with a unique identification number. The distribution area for the broadcast messages is defined by a set of GNSS coordinates. BDMSS is capable of broadcasting MSI to the following two types of areas:

- a user-defined area, either rectangular (by a set of coordinates) or circular (centre point plus radius); and
- NAVAREA(s) and METAREA(s) within the service coverage of BDMSS.

BDMSS maritime mobile terminals will be interconnected with display, printer, alarm panel and so on, to achieve MSI displaying, printing and alarming. BDMSS maritime mobile terminals will transfer the content and priority of the received MSI to other connected shipborne equipment.

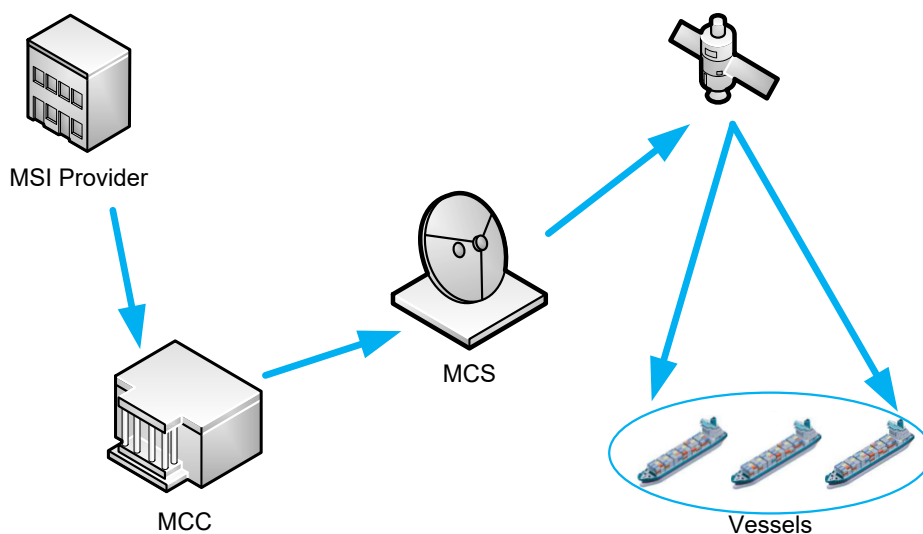


Figure 6: Shore-to-ship broadcasting of MSI

Ship-to-shore, shore-to-ship, and ship-to-ship general communications: BDMSS supports ship-to-shore, shore-to-ship and ship-to-ship general short message communications and group communications in addition to distress, urgency and safety communications. The maritime mobile terminals used to support ship-to-shore and shore-to-ship distress alerts, ship-to-shore, shore-to-ship and ship-to-ship SAR coordinating communications, ship-to-shore transmissions of MSI and shore-to-ship broadcast of MSI are all capable of general communications. The same terrestrial network and space segment infrastructure are used for these communications.

3.2 Capacity

BDMSS is designed to provide maritime distress, urgency, safety and general communication services for subscribers at the rate of 10 million messages per hour, with the availability stated in section 3.5. At present, there are over 500,000 subscribers with over 0.83 million messages transmitted on average an hour. Considering that 48 and 59 distress alerts were received in 2017 and 2018 respectively in the Asia Pacific region by the Beijing Inmarsat earth station, it is fully convinced that the GMDSS traffic expected to increase will have little impact on BDMSS regarding its service capacity and quality.

3.3 Priority access

BDMSS is capable of processing messages of the following four priorities as defined by the ITU *Radio Regulations*:

- distress;
- urgency;
- safety; and
- routine (general communications).

Message priorities will be dynamically assigned based on message destination information in the ship-to-shore direction or be specified by the message originator in the shore-to-ship direction, for BDMSS distress, urgency and safety communications. For routine

communications, the message originator will specify the message priority for shore-to-ship communications, and message priority will be routine by default for ship-to-shore communications, unless otherwise specified.

A unique priority will be assigned to each of the four levels of priority, with priority one (1) to distress communications, priority two (2) to urgency communications, priority three (3) to safety communications and priority four (4) to routine communications. Messages are immediately scheduled for delivery but will be queued after any higher priority messages or broadcasts scheduled for delivery. BDMSS will preempt lower priority messages for higher priority messages in the order of priority one (1), priority two (2), priority three (3) and priority four (4).

The BDMSS network utilized for GMDSS communications supports both maritime and non-maritime subscribers. BDMSS will automatically recognize and transfer messages from maritime subscribers in the order specified in section 3.3.3. The BDMSS message format is defined to automatically convey the priority and end destination of the message to the BDMSS network. The message priority will be preserved and transferred through the whole process.

Maritime search and rescue centres, hydrographic offices, meteorological offices and medical centres, registered with the BDMSS land earth station and recognized as safety-critical entities, will be assigned with a unique access code or address. BDMSS is capable of automatically recognizing the above-mentioned entities and assigning priority for communications from those entities.

The BDMSS network will automatically recognize and route distress alert messages to the responsible RCC. Each maritime mobile terminal will have an integrated BDS receiver. When a distress alert is initiated in the ship-to-shore direction, the maritime mobile terminal will cross reference the current vessel position information with a database stored in the maritime mobile terminal and automatically route the distress alert to the responsible RCC. If the BDMSS network is not directly connected to the responsible RCC, the distress alerts for that RCC will be routed to an associated RCC in the same geographic region, which will then forward the distress alert onto the responsible RCC.

The BDMSS maritime mobile terminals will be designed with the Application programme interface (API). This API enables selection and use of message or access priority, which are restricted to urgency and safety messages initiated from maritime mobile terminals to recognized and registered safety-related entities. Such messages are automatically routed through the BDMSS network to its final destination.

3.4 Coverage area

The service coverage of BDMSS is Asia and west Pacific Ocean region, an area closed by 75°E longitude, 10°N latitude and 135° E longitude, 55° N latitude as provided in figure 1, where stable and reliable messaging and continuous alerting services are available in compliance with the criteria in section 3.5 of resolution A.1001(25). Ship-to-shore, shore-to-ship and ship-to-ship communications are provided by a constellation of geostationary satellites with overlapping coverage in most areas.

Within the coverage area of BDMSS, services are available in sea areas of A1, A2 and A3, as defined in SOLAS regulation IV/2.

The information of coverage area will be included in the GMDSS Master Plan and consequently published, upon recognition by IMO for BDMSS to provide GMDSS communications.

3.5 Availability

BDMSS provides maritime distress and safety communications in all directions with continuous availability on a 24x7 basis within its coverage area as described in section 3.4.1.

After recognition of BDMSS as a GMDSS satellite service provider by IMO, CTTIC will thereafter cooperate with IMSO and provide necessary information as requested.

As the service provider of BDMSS, CTTIC will make arrangements for planned service outage and provide related information, including the scheduled downtime, affected services and areas, to associated RCCs, IMSO, MSI providers and ships at least 24 hours in advance. CTTIC will also notify the above-mentioned parties via telephone, facsimile or email, as soon as possible when an unplanned service outage is detected, and when the services are restored. All necessary actions will be taken to restore affected services. The notification to IMSO will be sent within one hour upon confirmation of service interruptions by email, followed up with a phone call to a designated IMSO representative.

BDMSS is designed and constructed with redundancy, including the ground segment, space segment and their hardware and software, to ensure reliable and continuous communications for users within its coverage area. With such redundant architecture and arrangements in place, BDMSS is able to achieve the minimum availability of 99.9%.

In 2017 and 2018, BDMSS services experienced no outage, achieving 100% service availability.

3.6 Restoration and spare satellites

Most BDMSS coverage areas are under dual satellite beams to ensure high reliability and low latency of the BDMSS communication service. The architecture and operating mechanism of the BDMSS constellation ensure that a single satellite failure would not cause regional service interruption. When a partial or total satellite failure results in service outage in corresponding area, user terminals in areas under dual satellite beams will automatically search for other available beams to restore the service after a short period of service outage (about 10 seconds). For user terminals in areas under single satellite beam, the service will be restored within one hour by adjusting the gesture or beam pointing direction of the spare satellite.

The BDMSS service provider will provide IMSO with its restoration plan for BDMSS communication service outage in the event of a satellite failure. The BDMSS service provider and BDMSS will arrange for periodic exercises together with IMSO to verify the efficiency and effectiveness of the restoration plan. The frequency and method for carrying out such exercises are subject to agreement among the BDMSS service provider, BDMSS and IMSO.

3.7 Identification

BDMSS assigns a unique identity for each BDMSS maritime mobile terminal, corresponding to the ship's Maritime mobile service identity (MMSI). BDMSS establishes and updates a database for BDMSS maritime mobile terminals. Based on specific message format, the BDMSS network will automatically recognize the maritime mobile terminal and transmit its identity to the addressee.

3.8 Information to be made available to SAR authorities

For all distress, urgency and safety communications, the MMSI and BDMSS maritime mobile terminal identity are designed as a part of a distress alert and will be routed to RCC together with the distress alert. If additional information is provided by the subscriber during registration, all information related to SAR operations (e.g. shipowner and other static information) will be provided to the proper SAR authority or RCC as required.

3.9 Reception of distress alerts

The BDMSS network supports the sending of distress alerts to a specified RCC. BDMSS will assign a unique identity to each RCC so that the ship's operator can specify RCC to receive the distress alert. The distress alert will be automatically routed to the responsible RCC based on ship position.

If a particular RCC or MRCC is not connected to the BDMSS network, it still can deliver the distress alert to the specified RCC with the assistance of other RCCs. The BDMSS maritime mobile terminal identity or other unique ship identities (e.g. MMSI) and position information will be transferred along with the distress alert. RCC will then relay the distress alert to RCC specified by the alert or message originator.

BDMSS provides a service platform to RCCs to receive distress alerts from BDMSS maritime mobile terminals. This is a free service platform that does not require any additional equipment but only access to the Internet, by which the RCC concerned can easily identify the BDMSS maritime mobile terminals and establish shore-to-ship communications with the ship concerned.

3.10 Control of maritime mobile terminals

BDMSS has a user management module in place to exercise control over access by maritime mobile terminals to the system, including giving or temporarily denying the access. However, in any cases, BDMSS maritime mobile terminals are allowed to transmit maritime distress alerts and messages using the BDMSS services.

3.11 Test facilities

BDMSS supports ship-to-shore distress capability test using BDMSS maritime mobile terminals without initiating a distress alert. BDMSS will define the format and content for test distress alerts. Test distress alerts from BDMSS maritime mobile terminals will be routed through the BDMSS network, which will arrange communication channels for its delivery with the highest message priority to the appropriate RCC. The message content will indicate that this is a test distress alert. This will effectively verify the proper function of BDMSS distress communications and connections between BDMSS and RCCs.

4 CRITERIA AND REQUIREMENTS FOR EARTH STATIONS

4.1 Functional requirements

The BDMSS earth station consists of an operational MCS, a backup MCS and an MCC. All compounds of the BDMSS land earth station are designed with hot backup redundancy and are in 24x7 continuous operation. BDMSS operates its services through the primary MCS and the hot backup MCS under construction will be located in distance from the primary to avoid single-point failure and capable of taking over all the services in case of any failure. Each station has multiple antennae to provide link redundancy.

BDMSS has been in continuous operation for 16 years and will continue the operation with investment and upgrade on its land earth station to improve the reliability, availability and service capacity.

The BDMSS land earth station will be directly connected to associated RCCs with redundant connectivity methods, including VPN and dedicated circuits.

The BDMSS land earth station is staffed by professional operators, continuously keeping watch on satellite position and status, satellite-ground connectivity, network connectivity and capacity utilization. A complete fault detection, isolation and correction process is established and implemented to help the operators monitor and maintain the status of BDMSS system and service. Resident software is used to detect critical and time-sensitive hardware failures, which can be corrected by automatic switchover to redundant hardware. For minor faults, remote alarms are generated to warn the operators, who will consequently take corresponding corrective actions to fix them based on their diagnosis.

The BDMSS land earth station is capable of transmitting ship-to-shore distress alerts, shore-to-ship distress relays, ship-to-shore, shore-to-ship and ship-to-ship SAR coordination communications, ship-to-shore MSI transmission, shore-to-ship MSI broadcast and ship-to-shore, shore-to-ship and ship-to-ship general communications. Details of communication flows through BDMSS of the above-mentioned services are described in section 3.1.

4.2 Priority

BDMSS is capable of automatically recognizing the defined four communication priorities (distress, urgency, safety and routine) in ship-to-shore, shore-to-ship and ship-to-ship directions, and designed to preserve the priority of each active session so as to correctly execute prioritization and pre-emption when needed. In ship-to-shore and shore-to-ship communications, MCC gives distress alert (priority one) communications the highest priority over other communications, granting immediate access to satellite channels to establish communication links. Details on the arrangements of message priority are described in section 3.3.

BDMSS will provide multiple methods for communications with MSI providers. The primary one will be a secure and reliable web-based portal accessible from the Internet. MSI providers will be assigned with a secure and valid account to log into the portal. In MSI broadcast, the system will be designed to allow MSI providers to designate the priority of the MSI to be transmitted or assign a default priority to the MSI based on the MSI provider user identification. MSI providers can choose to connect to BDMSS via VPN or dedicated circuits. To ensure link redundancy and optimal service performance, BDMSS will use public network and dedicated circuits to connect to MSI providers.

4.3 Pre-emption

BDMSS is configured to always assign the communication channel to a session with higher priority. RCCs are granted with the option to choose the message priority, allowing them to gain immediate access to communication channels for SAR alerting and communication without any delay.

4.4 Routeing of maritime distress alerts

The BDMSS land earth station is directly connected to associated RCCs via highly reliable and redundant dedicated circuits to support ship-to-shore distress alerts and shore-to-ship

maritime distress relay alerts. The connections between BDMSS and associated RCCs are subject to approval by the administration.

BDMSS will be capable of automatically recognizing and transmitting maritime distress and safety communications via highly reliable links. All ship-to-shore and shore-to-ship distress alerts and messages are automatically transmitted without requiring any manual operations. BDMSS will set unique addresses for associated RCCs to allow BDMSS maritime mobile terminals to automatically route distress and safety related communications to associated RCCs by utilizing these addresses.

Connections between the BDMSS land earth station and RCC are under continuous monitoring by BDMSS operators on a 24/7 basis. When BDMSS cannot be automatically connected to associated RCCs in 60 seconds, an aural and visual alarm is generated to warn the operators on duty. In such a case, operators on duty will promptly take all necessary actions to remedy the failures to restore the connection and meanwhile notify the concerned RCC that the connections to BDMSS are temporarily down. If BDMSS happens to receive a distress alert, the operators will take all possible actions to forward the distress alert and details to associated RCC in 5 minutes. All distress and urgency messages will trigger an aural and visual alarm, which can only be manually canceled.

4.5 Identification

BDMSS assigns a unique identity for each BDMSS maritime mobile terminal, corresponding to the ship's MMSI. BDMSS establishes and updates a database for BDMSS maritime mobile terminals. Based on a specific message format, the BDMSS network will automatically recognize the maritime mobile terminal and transmit its identity and also appropriate additional information, such as MMSI, to RCCs when requested.

4.6 Voice communication systems

BDMSS is applying for recognition by IMO as a GMDSS service provider with its short message communication service.

4.7 Data communication systems

BDMSS will be connected to the internet and utilize the internet to exchange data with MSI providers and RCCs. Public data communication network is also used for general communications. VPN and dedicated circuits will also be deployed to ensure the redundancy of connections between the BDMSS land earth station and RCCs. BDMSS is designed to allow the originator identity to be delivered to the addressee. For distress alerts and messages, the ship identity and land earth station identification information will also be delivered.

Upon receiving ship-to-shore or shore-to-ship distress alerts or communications, BDMSS will immediately attempt to establish connection with the associated RCC and start data transmission, so that distress alerts or messages can be delivered from or received by RCC.

4.8 Store and forward systems

A "store and forward" system generally means that the system stores a message for a finite time, usually of several seconds and sometimes minutes, before forwarding the message for transmission. For BDMSS, messages will be immediately and transparently forwarded without being stored. Therefore, BDMSS does not perform as a store and forward system.

4.9 Facilities for broadcasting Maritime safety information

BDMSS will be connected to MSI providers such as associated RCCs, Hydrographic Offices and Meteorological Offices, via the internet and dedicated circuits, and keep continuous monitoring on the connection links. BDMSS will support MSI broadcasting from authorized MSI providers to vessels as described in section 3.1.5.

The BDMSS broadcast service will support automatic and continuous MSI broadcast in four levels of priority as specified in section 3.3.1. BDMSS maritime mobile terminals are designed with omni-directional antennas to ensure that the terminal can reliably receive MSI messages. BDMSS will support dynamic configuration on message delivery such as re-attempts intervals and retransmission times in case of MSI broadcast failures, so as to ensure the successful delivery of MSI messages.

The BDMSS broadcast service will allow MSI providers to specify MSI broadcasting areas. GNSS coordinates are used to specify the delivery area of MSI, which may fall into the footprint coverage of one or more satellites, up to the whole coverage area of the BDMSS constellation.

In the BDMSS coverage described in section 3.4.1, the BDMSS broadcast service will support MSI broadcasting to all vessels installed with a BDMSS maritime mobile terminal in NAVAREAs/METAREAs as established by IMO, IHO and WMO respectively. In accordance with the geographical boundaries determined by IMO, IHO and WMO, BDMSS will assign a unique area identity for MSI message delivery areas such as NAVAREAs and METAREAs. MSI providers will be able to specify a broadcasting area by utilizing the unique delivery area identities.

The BDMSS broadcast service will support MSI broadcasting to an area specified by the originator, such as rectangular or circular areas. MSI message originators will be able to specify a delivery area of MSI broadcasting by providing the GNSS coordinate of the centre and radius for a circular delivery region, or a series of GNSS coordinates to define the boundaries for a rectangular region.

BDMSS supports the transmission of SAR coordination information, including distress relay alerts, navigational warnings and meteorological warnings and forecasts required by the SOLAS Convention.

By utilizing the secure web-based portal provided by BDMSS, MSI providers will be able to configure the delivery parameters for each MSI message. BDMSS supports MSI broadcasting at a configured fixed interval and also immediate MSI broadcasting upon receiving the request from recognized MSI providers. BDMSS also supports repetitive MSI broadcasting in specified time intervals and transmission times.

BDMSS will assign a unique sequence number for each MSI broadcast message and send the sequence number together with the MSI message to the BDMSS maritime mobile terminal, which will recognize the sequence number and automatically ignore messages already received.

As described in section 4.9.3, the BDMSS broadcast service will support addressing the broadcast of MSI to all properly equipped ships within a specified area, including coastal areas not covered by the International NAVTEX Service, in accordance with the identification system (i.e. the identification characters B1, B2, B3, B4) used in the International NAVTEX service.

5 ADDITIONAL RECOMMENDED CAPABILITIES

5.1 Encouragement to mobile satellite service providers

Each BDMSS maritime mobile terminal will be integrated with the BDS positioning function, which can automatically acquire ship position information. As described in section 4.5, BDMSS will assign for each BDMSS maritime mobile terminal a unique identity corresponding to the MMSI of the vessel. BDMSS will support direct routing of Automatic Location Identification (ALI) and Automatic Number Identification (ANI) along with distress alerts and messages originated from BDMSS maritime mobile terminals to responsible RCCs, when required.

Message format utilized by BDMSS is designed to be recognized by RCCs and related information contained in registration databases, in accordance with resolution A.887(21) on *Establishment, Updating and Retrieval of the Information Contained in the Registration Databases for the Global Maritime Distress and Safety System (GMDSS)*, will be sent together with distress alerts to associated RCCs.

Through the connections to RCCs and MSI providers, defined BDMSS message format and interface service protocols, BDMSS will be able to retrieve in a timely manner MSI messages sent from NAVAREA, METAREA, other relevant coordinators and the International Ice Patrol Service.

6 NOVEL TECHNIQUES

If any novel techniques are to be used for the provision of existing and modernized GMDSS services, BDMSS will seek approval and recognition from IMO according to the requirements set out in resolution A.1001(25).

7 LEGACY SERVICES

BDMSS does not fall into the scope of this section, therefore these requirements are not applicable.

ACRONYMS

ALI	Automatic Location Identification
ANI	Automatic Number Identification
API	Application Programme Interface
BDMSS	BeiDou Message Service System
BDS	BeiDou Navigation Satellite System
GSMC	Global Short Message Communication
GNSS	Global Navigation Satellite System
MCC	Mission Control Centre
MCS	Master Control Station
MIFR	Master International Frequency Register
MMSI	Maritime Mobile Service Identity
MSI	Maritime Safety Information
RSMC	Regional Short Message Communication
VPN	Virtual Private Network