Recognition of Iridium mobile satellite system as a GMDSS service provider

Submitted by IHB

SUMMARY

Executive Summary: This document provides details of the application for consideration of Iridium Satellite LLC to become a Global Maritime Distress and Safety System (GMDSS) mobile satellite services provider, which are relevant to WWNWS-SC

Action to be taken: Paragraph 2.

Related documents: NCSR 1/12 dated 28 March 2014

1. See attached document.

2. The Sub-Committee is invited to note the information provided and take action as appropriate.

INTERNATIONAL MARITIME ORGANIZATION

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SUB-COMMITTEE ON NAVIGATION, COMMUNICATIONS AND SEARCH AND RESCUE
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DEVELOPMENTS IN MARITIME RADIOCOMMUNICATION SYSTEMS AND TECHNOLOGY

Recognition of Iridium mobile satellite system as a GMDSS service provider

Submitted by the United States

SUMMARY

Executive summary:	This document contains in the annex the application for consideration of Iridium Satellite LLC, as required by resolution A.1001(25), to become a Global Maritime Distress and Safety System (GMDSS) mobile satellite services provider
Strategic direction:	5.2
High-level action:	5.2.5
Planned output:	5.2.5.3
Action to be taken:	Paragraph 3
Related documents:	MSC 92/26, MSC 92/9/2, MSC 92/9/3; resolution A.1001(25) and MSC.1/Circ.1414

Introduction

1 The Committee, at its ninty-second session, considered the notification by the United States of the application of the Iridium mobile satellite system for recognition and use in the GMDSS and having noted that, in principle, there were no objections, agreed to refer the matter to the NCSR Sub-Committee for evaluation of the detailed information under its agenda item on "Developments in maritime radiocommunication systems and technologies". The Committee noted that IMSO was prepared to assist the Organization in undertaking the technical and operational assessment to ensure full compliance with all the criteria and procedures, as set out in resolution A.1001(25), as well as the guidance provided in MSC.1/Circ.1414.

Discussion

2 Accordingly, the United States proposes that the Iridium mobile satellite system be considered for recognition in the GMDSS in accordance with the criteria and guidance of resolution A.1001(25) and MSC.1/Circ.1414. In submitting this application in the annex, the United States is providing evidence to show that:

.1 *the satellite system conforms with all the criteria specified in resolution A.1001(25).* The annex application describes in section by section detail how each requirement of resolution A.1001(25) is being met, or will be achieved;

.2 *the charging policies and provisions of resolution A.707(17), as amended, on Charges for distress, urgency and safety messages through the Inmarsat system, are complied with*. The annex application contains evidence that the applicant will comply with the requirements of resolution A.707(17), as described in further detail in the annexed application 2.2.2.2;

.3 *there is a well-founded confidence that the company concerned will remain viable for the foreseeable future, that the company has a well-organized quality and risk management programme, and that the company will remain in a position to deliver the required services over an extended period.* The applicant has been providing continuous services for over 13 years, and that there is no reason to believe that the provider would not be able to continue doing so in the future. Section 2.2.2.3 of the annexed application provides further information in this regard; and

.4 *the provider of the satellite system is ready to submit any recognized services to oversight by IMSO and sign the required Public Services Agreement (PSA) with that organization.* The applicant is ready to submit any recognized services to oversight by IMSO and sign the required Public Services Agreement (PSA) as described in further detail in the annexed application 2.2.2.4.

Action requested of the Sub-Committee

3 The Sub-Committee is invited to:

.1 consider the information contained in the annex related to the application to recognize Iridium Satellite LLC for use in the GMDSS;

.2 instruct the Secretariat to invite IMSO to conduct a technical and operational assessment, and to seek such clarifications or additional information from the applicant as may be necessary for IMSO to perform this evaluation, as set out in resolution A.1001(25), as well as MSC.1/Circ.1414; and to provide its evaluation to the Sub-Committee at its next session;

.3 invite IHO and WMO to provide advice in relation to the shore-to-ship broadcasting of Maritime Safety Information; and to provide their evaluation to the Sub-Committee at its next session;

.4 request other interested Member Governments and international organizations to also review the application and advise IMSO or the Sub-Committee as appropriate; and

.5 consider contributions arising from the above reviews and to decide as appropriate at the next session of the Sub-Committee.

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Application to the International Maritime Organization (IMO) for Iridium Satellite LLC to Provide GMDSS Communications

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Executive Summary

The accompanying document contains the formal application to the International Maritime Organization (IMO) for mobile satellite services, provided by Iridium Satellite LLC (Iridium), to be recognized for use in the Global Maritime Distress and Safety System (GMDSS). The application is formatted to mimic the format of Resolution A.1001(25) to assist in evaluating the information provided against the criteria set out in Res. A.1001(25) for the provision of mobile satellite communication systems in the GMDSS. The Iridium network is capable of fully complying with the criteria and requirements for mobile satellite systems to be provisioned for GMDSS communications.

In addition to the technical criteria defined in Res.A.1001(25), Iridium is prepared to demonstrate compliance with the charging polices and provisions of Res. A.707(17) and submit the recognized services to oversight by the International Mobile Satellite Organization (IMSO) as defined in the Public Services Agreement (PSA).

Iridium Satellite LLC

Iridium owns and operates the only mobile voice and data satellite communications network that spans the entire globe. A technology innovator and market leader, Iridium enables connections to and from anywhere, in real time. Iridium's 66 low-earth orbiting (LEO) cross-linked satellites form the world's largest commercial satellite constellation, and operate as a fully meshed network, supported by multiple in-orbit spares. Covering continents, oceans, airways and polar regions, Iridium is ideally suited to provide critical communications for the maritime, aviation, transportation, emergency services industries as well as government agencies. Iridium works with a consortium of partners for the manufacture and distribution of satellite-based products and services.

The Iridium network is a satellite-based Global Mobile Personal Communications by Satellite System (GMPCS) supporting fully global, wireless digital communications. Iridium provides voice, data, paging, broadband, broadcast and messaging (SMS) services to mobile subscribers using a vast array of user terminals, installed on vehicles, vessels, aircraft or deployed in a remote location.
Iridium currently supports more than 660,000 subscribers worldwide, spanning a variety of industries, with more than 50,000 subscribers in maritime industries. Of the 50,000 maritime subscribers, approximately 10,000 devices are used for voice and/or data communications aboard ships regulated under SOLAS Chapter IV.

Iridium Safety Services

In 2011, Iridium was recognized by the U.S. Federal Aviation Administration (FAA), along with Air Navigation Service Providers (ANSPs) in the North Atlantic and Pacific Oceans to provide Aeronautical Mobile Satellite (Route) Service (AMS(R)S) communications. This was the result of a multi-year effort with the International Civil Aviation Organization (ICAO) and the Radio Technical Commission for Aeronautics (RTCA) to validate Iridium network compliance with the performance-based standards for Controller Pilot Data Link Communications (CPDLC) for safety of flight.

In preparation for, and in support of providing safety communications to the aviation industry, Iridium invested millions of dollars to provide enhanced functionality and infrastructure upgrades to comply with the stringent performance-based standards for providing CPDLC communications. This includes priority and pre-emption functions for voice and data communications to and from AMS(R)S subscribers as well as a new provisioning interface and service packages specific for AMS(R)S users. The number of Iridium AMS(R)S subscribers has grown more than 50% annually since 2011, with aircraft manufacturers Airbus and Boeing adopting Iridium for AMS(R)S communications on new aircraft deliveries.

In preparation for providing GMDSS communications, Iridium has already invested several million dollars in developing and introducing a global broadcast service, and has committed additional funds for integration and validation of GMDSS services with Rescue Coordination Centers (RCCs) and Maritime Safety Information (MSI) providers.

Iridium Network Architecture

The major components of the Iridium Mobile Satellite System architecture are the satellite constellation, consisting of 66 low-earth orbiting (LEO) satellite vehicles, five satellite teleports (“teleports”) for the transfer of voice and data communications between the Iridium gateways and the satellite constellation, gateway earth stations (“gateways”) which provide connectivity to terrestrial voice and data networks and user terminals which provide real-time, mobile communications.

Attribute	Description
Satellites	**66 on-orbit and operational** **Additional on-orbit spares**
Orbital Planes	**6 (11 satellites/plane)**
Orbital Height	**780km (485 mi)**
Orbit Inclination	**86.4°**
Orbital Period	**100 minutes**
Spot Beams	**48 per satellite (250 mi diameter per beam)**
ITU Identifier	**HIBLEO-2 (satellite-to-user terminal links)**
	HIBLEO-2FL (feeder and cross-links)
Frequency Bands:	
Satellite-to-User Terminal Links	**1616 MHz – 1626.5 MHz**
Satellite-to-Satellite Crosslinks	**23.18 GHz – 23.38 GHz**
Satellite-to-Teleport Feederlinks	**19.4 GHz – 19.6 GHz (space-to-Earth)**
	29.1 GHz – 29.3 GHz (Earth-to-space)

The satellite constellation provides the communication links between the user terminals and the teleport(s), which are interconnected to the gateways. The gateways serve as the switching center, routing all communications and providing connectivity into terrestrial networks, such as the PSTN. The gateway also locates, identifies and tracks subscribers for mobility management, and records user activity for billing purposes. User terminals consist of a satellite modem, which is incorporated into a commercial product and an externally installed antenna.

The Iridium satellite constellation of 66 LEO operational satellites supports user terminal-to-user terminal, user terminal-to-gateway, and gateway-to-user terminal communications. The 66 satellites are evenly distributed in six orbital planes with a polar (86.4 degree) inclination, with one or more on-orbit spares for each orbital plane. The Iridium satellites orbit the earth at an altitude of 780 km and take approximately 100 minutes to complete one orbit around the globe. Each satellite L-band antenna has a "footprint," of with a diameter of approximately 4500 km (2800 miles). Adjacent satellite footprints overlap on the Earth's surface, enabling seamless global coverage from pole to pole. The overlapping coverage provided by the Iridium cross-linked satellites operates as a fully meshed network, and each satellite can handle upwards of 1,000 simultaneous voice or data communication sessions.

The on-board processing system of each satellite provides both satellite control and communications routeing. The satellite control includes the telemetry control, temperature control, power control, propulsion and attitude control, and fault management functions. The communications control is the router for the Iridium packet-switched network. The Iridium Satellite Network Operations Center (SNOC) located outside of Washington, DC, manages the satellite constellation and provides network management over the entire Iridium system. The SNOC communicates with the satellites through Telemetry, Tracking and Control (TTAC) facilities. In addition to controlling communications between the SNOC and the satellites, the TTAC sites track the Iridium satellites and receive telemetry data from them.

The Iridium satellites support three types of communication links – satellite-to-satellite, satellite-to-teleport, and satellite-to-user terminal. Each satellite communicates with the satellite immediately ahead and behind in its orbital plane (north/south) and to the nearest satellite in each of the two adjacent orbital planes (east/west). On board each satellite, a Space Vehicle and Routing Computer (SVARC) tracks the satellite's orbit, as well as the orbit of the adjacent satellites. This information is then used to steer the cross-link antenna for the east/west inter-satellite links. The Iridium system is the only Mobile Satellite System employing a cross-linked satellite network architecture. Within the cross-linked architecture, satellites are networked together by inter-satellite links. As a result, a user terminal is not required to be within the same satellite footprint as a gateway in order to gain access to the network. User traffic is routed through the satellite constellation to the supporting gateway. Iridium uses the proprietary Iridium Transfer Mode (ITM) to pass packets of information through the network. Each ITM packet includes a header containing the necessary information to route the packet to its destination. Each satellite routes the ITM packets to its feeder link, cross-link, or user terminal link.

The satellite-to-gateway link uses feeder-link antennas which support the delivery of communications originating or terminating at a gateway, via the satellite teleports, and the Tracking, Telemetry and Control (TTAC) function through separate ground facilities.

The satellite-to-user terminal link uses an L-band antenna system. This antenna system projects 48 spot beams, or cells, on the Earth, with each beam being approximately 400 km (250 miles) in diameter. While these cells are similar to terrestrial cellular coverage, they operate in reverse from a land-based system. Unlike terrestrial mobile systems, where mobile users move through stationary cells, the Iridium cells move across the Earth's surface while the mobile user stays in a relatively fixed position.

When needed, radio channels can be dynamically allocated to provide greater call capacity in high usage volumes areas. With the satellites moving rapidly across the sky, the beam covering the area containing a user terminal changes quite quickly. About once every minute, the cell for a user terminal is provided by a different beam on the same satellite. About once every six minutes, the cell transitions to a beam on an adjacent satellite. As this movement occurs, special processing called a "handoff" is required so that calls are maintained. Because radio frequency channels are reallocated among beams and satellites (to dynamically balance traffic needs of the network), calls may also be handed off from one channel to another within the same beam.

Iridium currently operates five satellite teleports, at five geographically diverse locations around the globe, in support of the commercial network. Four teleports are located in North America (Tempe, Arizona; Fairbanks, Alaska; Yellowknife, Northwest Territories and Iqaluit, Nunavut) and one in Europe (Svalbard, Norway). The teleports interconnect the satellite constellation with the Iridium gateways for the transfer of voice and data communications to and from Iridium user terminals. The primary Iridium commercial gateway is located in Tempe, Arizona, in the south western region of the United States. Operating as a switching center, this gateway provides connectivity between the Iridium network and terrestrial-based networks. Additional gateways are being added around the globe, where appropriate, which can serve to enhance overall system reliability and capacity. Each gateway controls system access, call setup, mobility management, billing, tracking and maintaining all information pertaining to user terminals, such as user identity and geo-location.

Coverage Area

The Iridium network is the only mobile satellite network that provides fully global service coverage. All communication services are provided for user terminals independent of geographic location. Communications are provided by a constellation of LEO satellites with overlapping coverage areas, providing ubiquitous coverage.

The Iridium network and the services that are intended to be recognized for GMDSS communications are fully operational for the entire globe (further described in section 3.4.1). The Iridium network and services are operational in all Sea Areas (A1, A2, A3 and A4) as defined in Chapter IV, regulation 2 of the SOLAS Convention. The Iridium network is uniquely capable of providing reliable satellite communications beyond 75° N and 75°S latitude. If Iridium

is authorized to provide GMDSS communications Sea Areas A3 and A4, as presently defined, may have to be revisited.

Network Availability

The Iridium network provides voice, data and broadcast services globally on a 24 x 7 basis. System performance for each of the services is continuously monitored worldwide through numerous mechanisms including the use of Iridium user terminals to continuously make voice and data calls through the Iridium network and report a wide range of call statistics.

Iridium proposed services for recognition and the Iridium network consistently achieves the 99.9% availability threshold for GMDSS communications, as defined in Res. A1001(25). Additionally, the ongoing investment and modernization activities that Iridium has underway have resulted in further improvement in network availability. For calendar year 2013, the Iridium network reliability for voice and data services were 99.98% and 99.94% respectively.

Service Restoration

The Iridium constellation architecture ensures high reliability, low-latency voice and data communications. In the event of a satellite vehicle failure, services will be fully restored within minutes for all users affected by the failed satellite vehicle. The Iridium constellation architecture and operation does not permit a single satellite to cause an extended service interruption to a region. In cases where a failed satellite vehicle cannot be restored to full service, a spare satellite vehicle already on-orbit will be repositioned into the operational orbit to replace the failed satellite vehicle.

In the event of a satellite failure, due to the orbit velocity of the satellites, an adjacent satellite will restore service to a region within minutes. Complete failure of a satellite vehicle would have the greatest impact as the satellite passes over the equator. As the satellite continues its orbit it will move north/south, reducing the void in coverage as the adjacent satellites provide overlapping coverage. Once the failed satellite reaches 55 degrees North/South Latitude the void in service will be fully restored by the adjacent satellites. A detailed description of service restoration is provided in Section 3.6.1.

Iridium Network Functional Capabilities

The Iridium network currently possesses the requisite functionality to comply with the criteria and requirements as defined in Res. A.1001(25) for the provision of mobile satellite communication systems in the GMDSS.

The Iridium network supports ship-to-shore, shore-to-ship and ship-to-ship calls for maritime safety communications. Iridium's safety voice service not only supports the required call types, but also provides for four levels of prioritization of all calls and performs pre-emption of lower priority calls, if necessary. The safety voice service utilizes an enhanced calling platform, restricted to select users, which also transfers calling party identification and call priority to the terminating party. Further explanation as to the features and functionality of the Iridium network and safety voice service is contained in Section 3, and the accompanying subsections, of the included application.

The Iridium short-burst data (SBD) service is a packet data service which has been optimized for safety communications. The SBD service supports ship-to-shore and shore-to-ship alerts and messages. Additionally, the SBD service has been designed to support four levels of priority to ensure expedient delivery of distress, urgency and safety communications to and from the maritime mobile terminal. Further explanation as to the features and functionality of the Iridium short-burst data (SBD) service is contained in Section 3, and the accompanying subsections, of the included application.

Iridium has also introduced a data broadcast service capable of delivering shore-to-ship messages globally. The data broadcast service will provide for the delivery of MSI broadcast messages to all NAVAREAs. Just as with the safety voice and SBD services, the data broadcast service has been designed to support the requisite four levels of priority. Iridium data broadcast service functionality is further explained in Sections 3.1.5 and 4.9 (and accompanying subsections), of the included application.

Iridium NEXT

The Iridium satellite constellation, including the on-orbit spares, is forecast to continue service until at least 2018; and recent third -party analysis shows that the constellation could support service for several years beyond then. However, Iridium has been planning and preparing for a successive generation of satellites for many years. The second-generation satellite constellation, known as Iridium NEXT, is a fully funded capital program to upgrade the satellite constellation, teleport network and gateways. The Iridium NEXT constellation will maintain the existing Iridium network architecture, thereby maintaining the attributes which set Iridium apart from other mobile satellite networks.

All Iridium NEXT satellites are designed to be fully compatible with existing products and services. This will alleviate dependency on the current constellation as Iridium NEXT satellites are deployed and existing user terminals will seamlessly transition operation between current Iridium satellites and Iridium NEXT satellites. Iridium NEXT's compatibility with existing user terminals, and services, also mitigates the necessity for vessel operators to purchase new equipment to support the transition to the new constellation.

Many of the teleport and gateway enhancements have been completed in preparation for the Iridium NEXT satellite deployment, which will consist of eight separate launches in order to deploy 72 new satellite vehicles (66 operational and 6 on-orbit spares). The eight satellite launches are scheduled to take place by the end of 2017. The Iridium NEXT satellites will be proactively moved into an operational orbit location, one by one, following on-orbit testing. Iridium NEXT will enable lower latency, higher throughput and capacity gains for Iridium user terminals. Moreover, the Iridium NEXT satellite vehicles and the complement of on-orbit spares are projected to extend the Iridium network beyond 2025.

Unique Attributes of the Iridium Network

The Iridium network is unlike any other mobile satellite network. The Iridium network architecture of 66 LEO, cross-linked satellites and on-orbit spares, connecting to a series of

geographically diverse satellite teleport locations provides a redundancy and diversity that is unmatched. Additionally, the Iridium network is the only mobile satellite network that provides fully global coverage. Furthermore, the Iridium network and user terminals are largely immune to the solar activity that can negatively affect high frequency (HF) radio communications. Therefore, the Iridium network can not only offer better coverage for GMDSS communications, but can operate more reliably than current technologies utilized in polar regions.

Another unique attribute of the Iridium network is that in many instances a user terminal is within the coverage area of more than one satellite. This is particularly useful in rough waters where a stabilized antenna may struggle to maintain a link with a single satellite when it is needed most. All Iridium user terminals utilize omnidirectional antennas, alleviating the need for mechanically steered antennas. This is particularly advantageous in rough seas where the user terminal may be able to switch to an alternate satellite, which is in range, seamlessly to seamlessly maintain connectivity.

The Iridium network is not only capable of supporting the criteria as described in Res. A.1001(25) and accompanying documents, but also serves to enhance maritime safety communications in the decades to come.

Proposed Implementation Activities for the Provision of Mobile Satellite Communications Provided by Iridium Satellite LLC for Use in the GMDSS

In preparation for recognition by the IMO for Iridium Satellite LLC to provide mobile satellite communications for use in the GMDSS, Iridium intends to undertake several technical and administrative efforts.

Iridium will continue its discussions with IMSO to solidify terms for the PSA. Once mutually agreed terms are established for the PSA, Iridium intends to sign a memorandum of understanding (MOU) with IMSO which will be formalized upon the MSC issuing a resolution recognizing Iridium Satellite LLC to provide mobile satellite GMDSS communications.

Iridium will also initiate, or advance, discussions with several rescue coordination centers (RCCs) and Maritime Safety Information (MSI) providers to discuss interconnection with the Iridium gateways to support voice, data and broadcast communications. Iridium is prepared to make available, on a trial basis, each of the proposed services to be utilized for GMDSS communications with RCCs and MSI providers ahead of an MSC Resolution. The desired outcome of discussions and trial use of the services will be to sign MOUs with each of the RCCs and MSI providers for the provision of GMDSS communications following a resolution from MSC, with the ability to commence services immediately following such resolution.

Iridium will also work with maritime mobile terminal manufactures and the International Electrotechnical Commission (IEC) to develop standards and testing criteria for Iridium-based GMDSS user terminals. Iridium is already in discussions with multiple experienced maritime mobile terminal manufacturers for the development and manufacture of Iridium-based GMDSS communications terminals and integration with other GMDSS systems that may already be on board a vessel.

Iridium looks forward to the opportunity to contribute to the enhancement and advancement of maritime safety communications through the provision of GMDSS communications. With network functionality in place to comply with the criteria and requirements as established in Res. A.1001(25), Iridium is targeting to complete administrative and integration activities, with IMSO, RCCs and MSI providers, such that GMDSS communications can begin before the end of 2015.

1 DEFINITIONS

1.1 Mobile Satellite Communication System

System to include

1.1.1 Earth Station = Gateway

1.1.2 Maritime mobile terminal = Shipborne equipment

1.1.3 Space segment = Satellites and links with earth

1.1.4 Terrestrial networks = land-based facilities

1.2 Mobile Satellite Communication Service = all services recognized by IMO for use in the GMDSS

1.3 Coverage area = geographical area where service is provided and continuous alerting is available

1.4 Availability = (operating time - downtime) / operating time

2 RECOGNITION OF MOBILE SATELLITE COMMUNICATION 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.

2.2 Application for Recognition

2.2.1 Satellite system providers wishing to participate in the GMDSS should apply to the Organization, through a Member State, for recognition as a radio system providing maritime distress and safety satellite communication capabilities for use in the GMDSS. Such applications should be notified to the Organization by Governments, either individually or in cooperation with other Governments. The application will be reviewed by the Maritime Safety Committee (MSC) in relation to its policy for the expansion of satellite services in the GMDSS. If the MSC decides that there are no objections in principle to the application, it will forward the application to the COMSAR (now NCSR) Subcommittee for evaluation. Recognition of the satellite provider to operate in the GMDSS will be undertaken by the committee on the basis of the evaluation report.

This application is submitted for review and evaluation, by Iridium Communications, through the United States of America, to the IMO.

2.2.2 The Governments concerned should make available to the Organization all necessary information to enable it to evaluate the satellite system in relation to the criteria indicated below.

2.2.2.1 In particular, Governments proposing such satellite systems for possible recognition and use in the GMDSS should provide evidence that: The satellite system conforms with all the criteria specified in annex Resolution A.1001(25)

Statement to be provided by the US delegation

2.2.2.2 The charging policies and provisions of Resolution A.707(17), as amended, on Charges for distress, urgency and safety message through the Inmarsat system, are complied with;

As an authorized provider of GMDSS communications Iridium Communications will fully comply with the charging policies and provisions as described in Resolution A.707 Recommends 1 and 2, for communications utilizing the Iridium network. Upon receiving authorization by the IMO to provide GMDSS communications Iridium intends to make available new service packages specifically for GMDSS users which will comply with Resolution A.707.

Iridium will provide ship-to-shore and shore-to-ship distress calls, distress alerts and distress traffic to and from the responsible RCC at no charge to the originator or the addressee. Ship-to-shore and shore-to-ship messages for medical assistance for persons in grave and imminent danger will also be provided to and from the responsible RCC or the competent authority at no cost. Additionally, Iridium will provide shore-to-ship broadcasts of search and rescue Maritime Safety Information (MSI), including distress alert relays from the RCC at no charge. Urgent ship-to-shore navigational and meteorological danger reports using data communications will also be provided at no charge to the responsible RCC or competent authority. Specifically, all non-distress GMDSS shore-to-ship broadcast messages will be charged to the originator with no charge to the addressee. For the delivery of MSI broadcast messages, other than search and rescue, Iridium intends to contract with each of the MSI providers for an annual fixed price contract that will cover the delivery of all broadcast messages in their respective geographic areas.

2.2.2.3 there is a well-founded confidence that the company concerned will remain viable for the foreseeable future and will remain in a position to deliver the required services over an extended period, in keeping with the expectation of the Organization and the maritime industry as to the continuity, durability and reliability of the service; and

The Iridium network is owned and operated by Iridium Communications Inc. a publicly traded company on the NASDAQ exchange (ticker symbol IRDM). Iridium Communications Inc. has a demonstrated track record of growing revenue, earnings and operating margin year on year. Iridium Communication Inc. is in good financial standing, with total revenues of USD$383 Million in 2013 with an operating margin of 53%.

As of the end of 2013, Iridium has a customer base of more than 660,000 subscribers globally. Of the 660,000 subscribers more than 50,000 are in the maritime market, with roughly 10,000 devices used aboard SOLAS class vessels. Additionally, the Iridium network is currently utilized for Ship Security and Alert System (SSAS) and Long Range Identification and Tracking (LRIT) communications around the globe.

Furthermore, Iridium Communications Inc. has a fully funded program underway to design, build and launch a second generation satellite constellation and ground infrastructure. This program is underway, with the first satellites schedule to launch in 2015. The second generation network will be compatible with existing subscriber devices and maritime terminals, thereby ensuring a continuity and reliability of service to at least 2030.

2.2.2.4 The provider of the satellite system is ready to submit any recognized services to oversight by IMSO and sign the required Public Services Agreement (PSA) with that organization.

Iridium Communications is ready to submit any recognized services to oversight by IMSO upon receiving authorization by the IMO, to provide GMDSS communications. Iridium Communications has had an ongoing dialogue with IMSO since June 2013 and Iridium personnel have met with IMSO representatives on multiple occasions since that time to discuss the terms of the proposed PSA and how IMSO would perform its oversight duties for the Iridium network. Also, Iridium has been reviewing the standard PSA agreement with the intention of finalizing terms with IMSO, in preparation for an IMO resolution authorizing the Iridium network to provide GMDSS communications.

2.3 Verification and Evaluation

2.3.1 The COMSAR Subcommittee should verify and evaluate the information, seeking clarification as required direct from the service provider concerned, and decide whether the satellite system meets the criteria established by Res. A.1000(25). In reaching its decision, the COMSAR Subcommittee should take into account provisions of the relevant regulations of chapter IV of the 1974 SOLAS Convention, as amended as the criteria established by this resolution.

This technical application is submitted to the NCSR Subcommittee by Iridium Communications, through the United States of America, such that the Subcommittee can evaluate and verify the information provided. Iridium Communications will provide clarification, answer any questions submitted by the Subcommittee, and provide additional information for clarification where possible.

2.3.2 Recognition by the Organization should be recorded in an MSC resolution entitled Statement of Recognition of Maritime Mobile Satellite Services provided by [Company Name], detailing the specific services provided by the company which have been recognized by the Organization. A copy of the statement of recognition should be provided to IMSO.

If the IMO determines that the Iridium satellite network satisfies the requirements as defined in Res. A.1001(25) and elects to recognize specific services for inclusion in the GMDSS, it is expected that this decision would be formally recorded in an MSC resolution, at the first MSC meeting to take place following a positive recommendation by the NCSR Subcommittee.

2.3.3 If, following evaluation, the Organization is unable to recognize the company or the service(s) offered for the GMDSS, the Organization should communicate this decision to the company and IMSO in writing, setting out the reasons for the decision and any actions the company may take to achieve recognition n in the future.

If the NCSR Subcommittee and the MSC conclude that they are unable to recognize the Iridium satellite system and its services for inclusion in the GMDSS, formal notice as to the reasons for such a decision as well as proposed or recommended actions to achieve recognition would be welcomed by the USA delegation and Iridium Communications. Formal notice would be expected to be received no later than 30 days from the date of such a decision by the IMO.

2.4 The Public Services Agreement

2.4.1 Recognized services are subject to oversight by IMSO according to the rules and arrangements set out in the public services agreement (PSA) concluded between the service provider and IMSO. No maritime satellite system should be used in the GMDSS unless it has first been recognized by the Organization in accordance with the above procedure and the service provider has signed a PSA with IMSO.

Upon approval by the IMO Iridium will conclude a Public Services Agreement (PSA) with IMSO, arranging for the oversight of the recognized services by IMSO. The PSA will describe the services and method by which IMSO will perform oversight of the Iridium network for the use in GMDSS communications as well as reporting and financial considerations for the oversight activities undertaken.

2.4.2 IMSO should conduct its oversight of the recognized services on a continuing basis.

IMSO will provide oversight of the Iridium network and services which are utilized for GMDSS communications on a continuing basis for as long as Iridium is part of the GMDSS. The PSA will describe the method by which oversight is performed, but it is expected that IMSO will perform oversight on a 24x7 basis, 365 days a year.

2.4.3 Responsibility for ensuring compliance with the standards established by this annex, other relevant mandatory international instruments and, to the extent necessary, those recommendations, resolutions and procedures of the IMO and ITU which are of a recommendatory nature insofar as the relate to the provision of GMDSS services, rests with IMSO under the terms of the Public Services Agreement.

IMSO will be responsible to ensuring that the Iridium network and services are in compliance with Res. A.1001 and other applicable rules as appropriate for GMDSS communications. Iridium will provide to IMSO performance statistics, and analytical tools as appropriate, which will be described in the PSA for IMSO to perform the requisite oversight and validate compliance. IMSO will provide a report annually to the IMO with a summary of their findings.

2.5 Reports

At least once a year, IMSO should make available to the Organization a report on the availability, performance and other relevant information in respect of each recognized service, for the period since the preceding report, in accordance with section 3.5.2 of the criteria indicated below.

IMSO will have the responsibility to provide an annual report to the IMO on the performance of the Iridium network and the services utilized for GMDSS communications. Iridium shall work with IMSO to monitor and evaluate space segment availability, provision of spare capacity and network availability as defined in section 1.4 of Resolution A.1001(25). Iridium will undertake the task to provide IMSO the tools and data to perform requisite analysis and calculations in order to provide a comprehensive report to the IMO.

3 CRITERIA AND REQUIREMENTS FOR THE RECOGNIZED MOBILE SATELLITE COMMUNICATION SYSTEM

3.1 Functional requirements

Satellite systems for maritime distress and safety communication services and forming part of the GMDSS radio systems specified in chapter IV, regulation 5 of the 1974 SOLAS Convention, as amended, should provide capabilities for at least the following maritime distress and safety communications:

The Iridium network uses radio frequency assignments that have been coordinated and Notified in accordance with the provisions of the Radio Regulations under the aegis of the International Telecommunication Union (ITU). The service-links between the mobile earth stations and the satellites use assignments in the frequency band 1616.0 - 1626.5 MHz. In conformity with footnotes Nos. 5.364 & 5.365, these assignments have been fully coordinated under No. 9.11A, and Notified under No. 11.32. The system also uses Inter-satellite communication links to interconnect the 66 satellites in 6 orbital planes in the band 23.15-23.55 GHz, and the system operates through feederlinks in the bands 19.4-19.6 GHz (space-to-Earth) / 29.1.-29.3 GHz (Earth-to-space) for connection to the switched network.

The spectrum used for the Iridium satellite service is regulated according to Nos. 5.359, 5.364, 5.365, 5.366, and 5.367 of the Radio Regulations. No. 5.364 specifies sharing conditions and coordination requirements for MSS (Iridium) earth stations in the Earth-to-space direction. No. 5.365 requires coordination for the space-to-Earth transmissions. The required co-ordinations have been carried out and the Iridium System service link spectrum was Notified to the ITU-BR in 1998. An indication of this may be found in the ITU-BR International Frequency List (IFL), and thereby the frequency assignments in the Notification are entitled to protection.

Finally, coordination with Fixed services in the countries indicated in 5.359 has also been carried out. This regulation encourages the indicated countries to not authorize additional fixed stations in the band.

Maritime mobile terminals providing the functionality described herein are currently under development and are expected to be commercially available in 2015. Iridium-based, GMDSS capable maritime mobile terminals will be available from multiple manufacturers, through a vast, global distribution network.

3.1.1 Ship-to-shore distress alerts/calls;

The Iridium network supports ship-to-shore distress calls using the Iridium Safety Voice service, and ship-to-shore distress alerts using the Iridium Short-Burst Data (SBD) service. Ship-to-shore distress alerts and calls are initiated by the maritime mobile terminal subscriber equipment installed on the vessel. Distress calls and alerts are then routed from the shipboard subscriber equipment to the best candidate satellite in range of the subscriber equipment based on the link margin between the maritime mobile terminal and the satellite. The maritime mobile terminal subscriber equipment will be provided a channel assignment for an L-band communications channel for the delivery of the distress call or alert to the satellite. Once the session is established the distress alert or distress call is routed from the best candidate satellite and is then routed from satellite to satellite, via crosslink, and grounded at one of several satellite teleport ("teleport") locations around the globe. From the teleport location the distress call or alert message is routed via redundant dedicated circuits to the Iridium gateway. Distress calls will be terminated into the PSTN, via a major global telecom provider, for connection to a Rescue Coordination Center (RCC). If a distress call is not delivered to, or answered by an RCC, the Iridium network operations staff will receive a visual and audible notification as described in Sec. 4.8.2. Distress alert messages will be routed from the Iridium gateway to the responsible RCC, using redundant dedicated circuits. Network latency for the delivery of a ship-to-shore call or message is less than 60 seconds more than 95 percent of the time, for users that have a dedicated connection to an Iridium gateway(s). A call flow diagram for a ship-to-shore distress call or distress alert is provided in Figure 3.1.1-1.

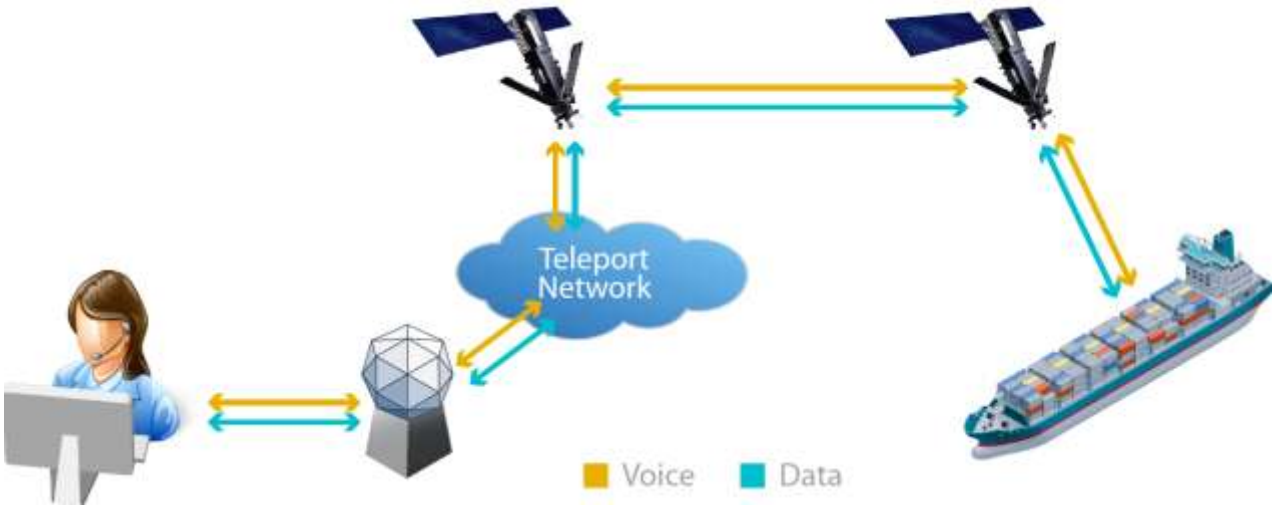


Figure 3.1.1-1

3.1.2 Shore-to-ship distress relay alerts/calls;

The Iridium network supports shore-to-ship distress relay calls using the Iridium Safety Voice service, and shore-to-ship distress alerts using the Iridium SBD service. Upon connection/delivery to an Iridium Gateway, shore-to-ship distress alerts and distress calls are immediately processed for delivery to the maritime mobile terminal.

Shore-to-ship distress alerts and distress call are initiated at the RCC or other appropriate party. The distress alert(s) and distress call(s) are then routed to the Iridium gateway via the PSTN for distress calls or dedicated circuits for distress alerts. The Iridium gateway would then route the distress call or distress alert to a teleport for delivery a satellite. The teleport then transmits the distress alert or distress call to the satellite. The distress alert or distress call is then routed from satellite to satellite until it reaches the best candidate satellite where the maritime mobile terminal with within the coverage area of the satellite. The distress alert or distress call is then communicated via an L-band communications channel to the maritime mobile terminal subscriber equipment on the vessel. A call flow diagram for a shore-to-ship distress call or distress alert is provided in Figure 3.1.2-1.

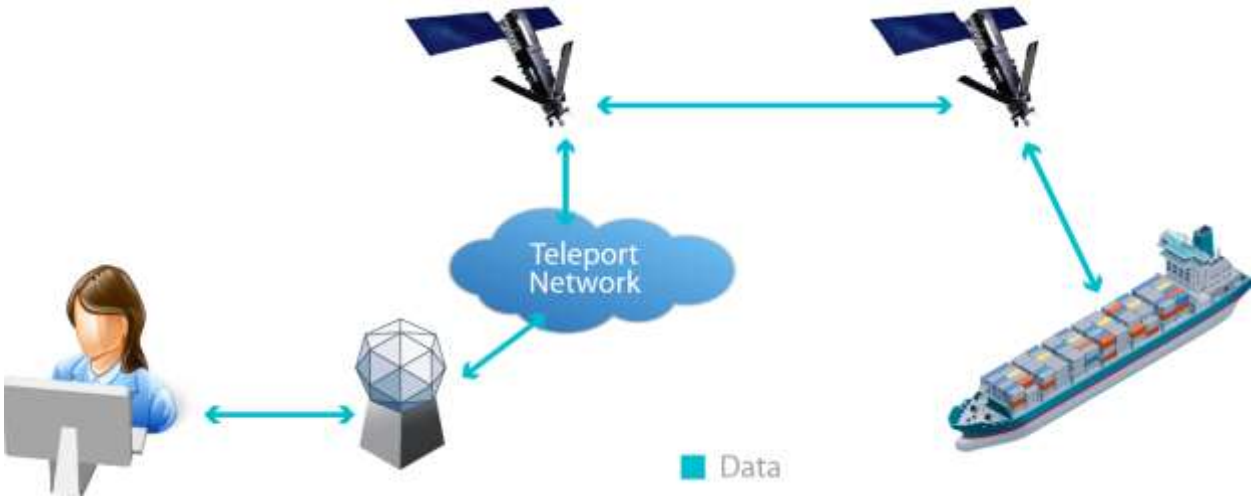


Figure 3.1.2-1

3.1.3 Ship-to-shore, shore-to-ship and ship-to-ship search and rescue coordinating communications;

The Iridium Safety Voice service supports ship-to-shore, shore-to-ship and ship-to-ship search and rescue coordination communications. This service permits prioritized communications between parties, such that search and rescue communications can be conducted without interruption.

Ship-to-shore, and shore-to-ship search and rescue coordinating communications would be routed in the same manner as described in sections 3.1.1 and 3.1.2. The Rescue Coordination

Center(s) (RCC) will serve that the centralized point for rescue coordination communications. The RCC will act as the originator or recipient for all rescue coordination messages.

Ship-to-ship search and rescue communications would be initiated aboard the vessel and routed to the maritime mobile terminal subscriber equipment. The maritime mobile terminal subscriber equipment will receive a channel assignment for an L-band, communications channel. Once the session is established between the maritime mobile terminal and the satellite the call is routed from satellite to satellite, and grounded at one of the teleport locations. From the teleport location the call is routed to the Iridium gateway. If the call is destined for another vessel, the Iridium gateway would automatically recognize this and route the call to the maritime mobile terminal on the other vessel as appropriate. A call flow diagram for ship-to-shore, shore-to-ship and ship-to-ship search and rescue coordinating communications is provided in Figure 3.1.3-1 below.

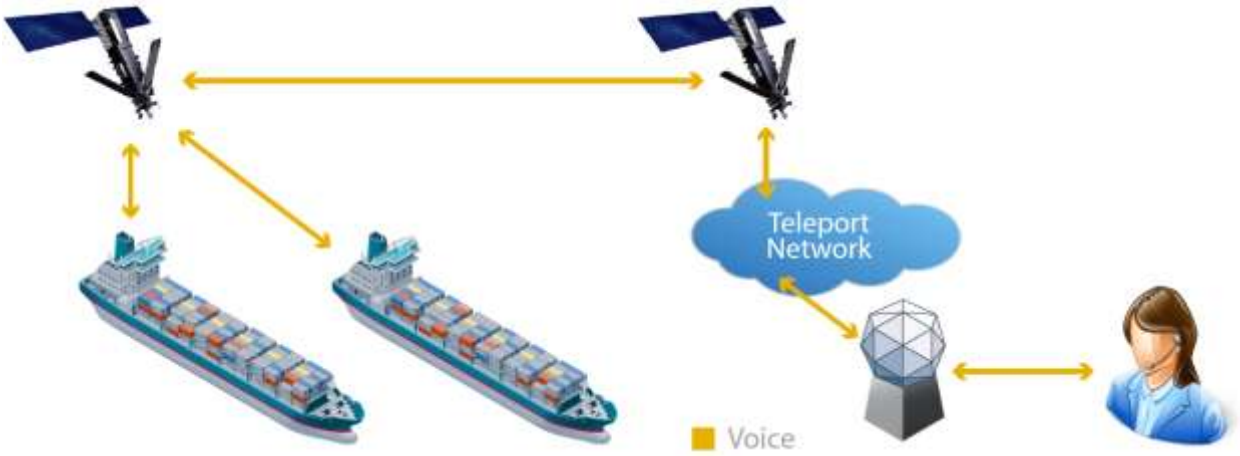


Figure 3.1.3-1

3.1.4 Ship-to-shore transmissions of Maritime Safety Information;

The Iridium network supports the ship-to-shore transmission of Maritime Safety Information (MSI) using the SBD service. Maritime Safety Information generated aboard a vessel would be routed to the maritime mobile terminal subscriber equipment installed on the vessel. The maritime mobile subscriber equipment will be provided a channel assignment for an L-band communications channel for the delivery of the maritime safety information message to the satellite. The message is then routed from satellite to satellite, via crosslink until the message is delivered to one of the network teleports. The maritime safety information message is then routed from the teleport to an Iridium gateway for delivery to the appropriate RCC or Navigational Area Coordination authority, via redundant dedicated circuits. A call flow diagram for ship-to-shore transmissions of Maritime Safety Information is provided in Figure 3.1.4-1.

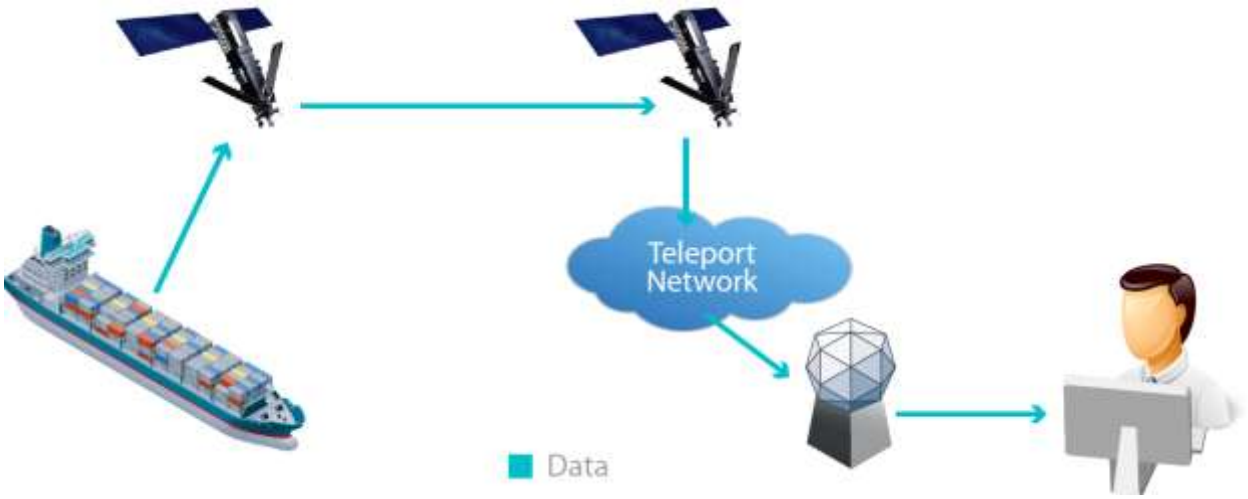


Figure 3.1.4-1

3.1.5 Shore-to-ship broadcasting of Maritime Safety Information; and

The Iridium network supports the broadcasting of Maritime Safety Information (MSI) messages to vessels using the Iridium data broadcast service. MSI broadcast messages will be initiated via a secure, web-based portal that Iridium will make available to MSI providers. Using the portal MSI providers will input the text of the message and specify the delivery characteristics for each message. The delivery characteristics that the MSI providers will specify will include, message priority, geographic region for distribution, frequency of distribution, and termination of distribution. Alternatively, MSI providers may elect to have a direct connection to the Iridium gateway using a VPN or dedicated circuit(s). Utilizing this interface, the MSI broadcast priority, delivery area, frequency of distribution and termination of distribution would be specified by the message originator when the MSI broadcast message is sent to an Iridium gateway for delivery.

Each broadcast message is queued at a server in the Iridium gateway and scheduled for delivery. When queued for delivery, the message is routed to the appropriate teleport(s) for delivery to the satellite(s). The broadcast message is then routed from the teleport to one, or more, satellite(s) depending on the geographic region for distribution. The satellite then utilizes an L-band channel to transmit the MSI message to the maritime mobile terminal. If specified by the MSI provider initiating the MSI broadcast retransmission of the MSI message is perform at specified time intervals for the geographic area. A flow diagram for shore-to-ship broadcasting of Maritime Safety Information is provided in Figure 3.1.5-1 below.

Unique geographic areas will be defined for each NAVAREA, which will be identified by a unique group identification number (group ID). The delivery area for the broadcast messages is defined by a set of GPS coordinates which provides the boundary of the delivery area. The delivery area for each NAVAREA will extend from the coastline of each of the regions to 100 nautical miles beyond the line of demarcation with an adjacent NAVAREA. This will permit maritime mobile terminals outside of a NAVAREA to receive a broadcast in the adjacent region if it is within 100nm of a NAVAREA boundary.

Furthermore, each MSI provider will have the ability to establish a dynamic delivery area for a broadcast message. In the event an MSI provider desires to communicate with maritime mobile terminals that are beyond the unique geographic delivery area defined for a specific NAVAREA, they can specify an alternate delivery area for a message intended for the unique group ID.

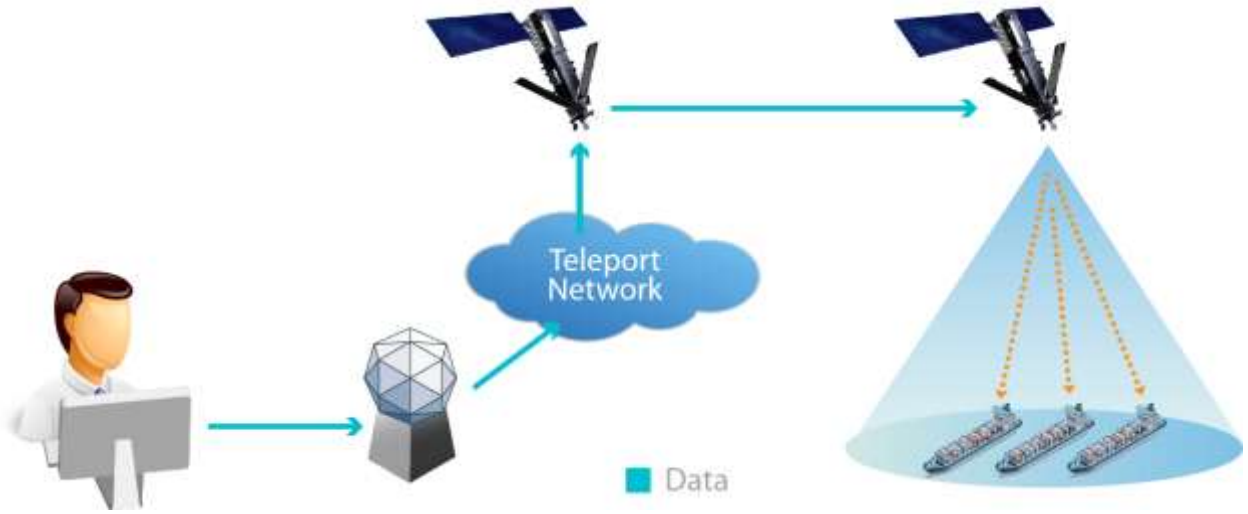


Figure 3.1.5-1

Aboard the vessel, the maritime mobile terminal will be interconnected to a message terminal, keyboard, printer and alarm panel which will perform the proper filtering, recording, alerting and display of broadcast messages. The maritime mobile terminal will receive the broadcast message, and then transfer the message content, along with the message priority to the other components of the GMDSS system on board the vessel.

3.1.6 Ship-to-shore, shore-to-ship, and ship-to-ship general communications.

The Iridium network supports ship-to-shore, shore-to-ship, and ship-to-ship general communications for a maritime mobile terminal in addition to distress and maritime safety information communications. The maritime mobile terminal subscriber equipment and services utilized to support ship-to-shore and shore-to-ship distress alerts and distress calls, ship-to-shore, shore-to-ship and ship-to-ship search and rescue coordination communication, ship-to-shore transmission of MSI messages and shore-to-ship broadcast of MSI messages are all capable of also being utilized for general communications to and from the vessel. The same terrestrial network and space segment infrastructure is utilized for maritime safety and general communications.

3.2 Capacity

The satellite system should be designed to provide sufficient channel and power capacity to process effectively, with the availability stated in section 3.5, the maritime distress, urgency, safety and general communication traffic estimated to be required by the ships using the system.

The Iridium constellation supports the GMDSS channel loading requirements and the impact of this loading on satellite vehicle (SV) power consumption. Usage statistics of the current GMDSS provider, as reported to IMSO and the IHO by Inmarsat and its users over a period of 10 years were analyzed for alerts, broadcasts, and voice transactions. These numbers were quadrupled for the purposes of projecting a conservative capacity usage estimate. The analysis conducted showed an expected increase in Iridium constellation loading of 0.003%. The conclusion from this analysis is that the Iridium constellation can easily support the addition of GMDSS traffic with no impact on quality of service.

The satellite vehicle power system for all Iridium satellite vehicles has been designed to accommodate 100% loading. The impact of the additional GMDSS traffic will have little effect on satellite average and peak power consumption.

3.3 Priority access

3.3.1 Satellite systems in the GMDSS should be capable of processing maritime distress, urgency, safety and routine communications in accordance with the message priority as defined by the ITU Radio Regulations. The order of processing of these communications should be:

The Iridium network supports the prioritization of voice calls and data messages to and from the maritime mobile terminal. The network supports a minimum of four levels of priority for voice and data traffic such that unique priorities can be assigned to distress, urgency, safety and routine communications to and from the maritime mobile terminal. The call originator establishes the priority for each call, as part of the dialing string, and will assign priority one (1) to distress calls, priority two (2) to emergency calls, priority three (3) to safety calls and priority four (4) for routine communication. The Iridium network will manage and queue low-priority calls until a channel is available. Additionally, the Iridium network will preempt lower priority calls to allow immediate connection to the maritime mobile terminal for a higher priority shore-to-ship call.

The Iridium network also supports the transmission of ship-to-shore and shore-to-ship alert messages via the Iridium SBD service. The ship-to-shore application originating the alert will assign the priority for each message, which will be communicated by the maritime mobile terminal.

The Iridium system supports priority routing of shore-to-ship distress alerts and emergency communication using the Iridium SBD service. Priority is assigned by the message originator and used by the Iridium network to determine delivery order for shore-to-ship communications. The Iridium SBD and data broadcast services support the same priority categories as specified for voice calls: Priority 1 for distress, priority 2 for urgency, priority 3 for safety and priority 4 for routine communications.

Priority	Level
Distress	1
Urgency	2
Safety	3
Routine	4

3.3.1.1 Distress

The Iridium network supports the processing of voice call traffic from ship-to-shore and shore-to-ship based on call priority assigned by the call originator. The call originator will specify the call priority as part of the dialing string for distress calls. Call priority specification may be automated for ship-to-shore calls based on call destination. Calls deemed as distress by the calling party will be assigned priority of one (1). Priority one calls shall preempt all other lower priority calls to, or from, the maritime mobile terminal. Priority one (Distress) calls cannot be preempted by any other calls to maritime mobile terminal.

The Iridium SBD service also assigns priority one (1) to ship-to-shore and shore-to-ship distress alerts. The message originator will specify the message priority in the message routing information provided to the Iridium gateway for shore-to-ship messages. Message priority will be dynamically assigned for ship-to-shore messages based on message routing and destination information provided by the maritime mobile terminal. Priority-one messages are immediately scheduled for delivery, preempting any lower priority communications that may be queued for delivery to the same maritime mobile terminal. Priority one (Distress) messages cannot be preempted by any other messages to the maritime mobile terminal.

The Iridium network restricts the use of the distress priority for ship-to-shore and shore-to-ship calls and messages such that it cannot be abused for commercial purposes.

3.3.1.2 Urgency

The Iridium network supports the processing of voice call traffic from ship-to-shore and shore-to-ship based on call priority assigned by the call originator. The call originator will specify the call priority as part of the dialing string for urgency calls. Call priority specification may be automated for ship-to-shore calls based on call destination. Calls deemed as urgency by the calling party will be assigned priority two (2). Priority two calls shall preempt all other lower priority calls to, or from, the maritime mobile terminal. Priority two calls can be preempted by priority one (Distress) calls, but not by lower priority safety or routine communications.

The Iridium SBD service also assigns priority two (2) to ship-to-shore and shore-to-ship urgency communications. The message originator will specify the message priority in the message routing information provided to the Iridium gateway for shore-to-ship messages. Message priority will be dynamically assigned for ship-to-shore messages based on message routing and destination information provided by the maritime mobile terminal. Priority two messages are

immediately scheduled for delivery, preempting any lower priority communications that may be queued for delivery to the same maritime mobile terminal. Priority one (Distress) messages will be queued ahead of priority two messages scheduled for delivery to the maritime mobile terminal.

3.3.1.3 Safety; and

The Iridium network supports the processing of voice call traffic from ship-to-shore and shore-to-ship based on call priority assigned by the call originator. The call originator will specify the call priority as part of the dialing string for safety calls. Call priority specification may be automated for ship-to-shore calls based on call destination. Calls deemed as safety communications by the calling party will be assigned priority three (3). Priority three calls shall preempt all other lower priority calls to, or from, the maritime mobile terminal. Priority three calls can be preempted by priority one (Distress) and priority two (Urgency) calls, but not by lower priority routine communications.

The Iridium SBD and data broadcast services also assign priority three (3) to ship-to-shore and shore-to-ship safety communications. The message originator will specify the message priority in the message routing information provided to the Iridium gateway for shore-to-ship messages and broadcasts. Message priority will be dynamically assigned for ship-to-shore messages based on message routing and destination information provided by the maritime mobile terminal. Priority three messages are immediately scheduled for delivery, preempting any lower priority communications that may be queued for delivery to the same maritime mobile terminal. Priority one (Distress) and priority two (Urgency) messages will be queued ahead of priority three messages scheduled for delivery to the maritime mobile terminal.

3.3.1.4 routine (general communications).

The Iridium network supports the processing of voice call traffic from ship-to-shore and shore-to-ship based on call priority assigned by the call originator. . The call originator will specify the call priority as part of the dialing string for routine calls. Call priority specification may be automated for ship-to-shore calls based on call destination. Calls deemed as routine communications by the calling party will be assigned priority four (4). Priority four calls cannot preempt any other calls to, or from, the maritime mobile terminal. Priority four calls can be preempted by priority one (Distress), priority two (Urgency) and priority three (Safety) calls.

The Iridium SBD and data broadcast services also assign priority four (4) to ship-to-shore and shore-to-ship routine communications. The message originator will specify the message priority in the message routing information provided to the Iridium gateway for shore-to-ship messages and broadcasts. Priority will be the default priority assigned for ship-to-shore messages, unless otherwise specified by the maritime mobile terminal. Priority four messages are immediately scheduled for delivery, but will be queued behind any higher priority messages or broadcasts scheduled for delivery to the same maritime mobile terminal. Priority one (Distress), priority two (Urgency) and priority three (Safety) messages will be queued ahead of priority four messages scheduled for delivery to the maritime mobile terminal.

3.3.2 In implementing these four levels of priority:

3.3.2.1 Distress alerts and distress calls (level 1) should be given priority treatment by providing immediate access to satellite channels. For store and forward systems, distress alerts and calls should be placed ahead of all other traffic.

All distress alert messages and calls (priority 1) shall be prioritized above other communications from the respective maritime mobile terminal and will also receive priority access to satellite communication channels. The Iridium network utilizes a protocol which establishes access priority for subscribers to satellite communication channels. GMDSS distress alerts and calls from a vessel will be provided immediate access to an available satellite communication channel.

For shore-to-ship distress alerts and calls, prioritization is established at the gateway and pre-emption is automatically performed, if necessary, terminating the lower priority communication to provide immediate access to the specified maritime mobile terminal.

3.3.2.2 Satellite systems used for providing other mobile satellite communications in additional maritime communications should be capable of automatically recognizing requests for maritime communications from:

- **maritime mobile terminals; and**
- **recognized entities of critical importance for safety at sea, such as MRCCs, hydrographic and meteorological offices, medical centers, etc., registered with the earth station.**

The system should process such maritime communications in the ship-to-shore and shore-to-ship directions for levels 1 to 3 with priority over other communications.

The Iridium network and the communication services that will be utilized for GMDSS communications support both maritime and non-maritime subscribers. Priority one, priority two and priority three calls and messages from Iridium GMDSS subscribers will automatically be recognized and routed by the Iridium network. Each of the Iridium services utilized will have a defined dialing string or message format that will automatically convey to the Iridium network the priority and end destination for the call or message. This is in addition to the priority designation that will be provided to the Iridium GMDSS subscribers, such that each maritime mobile terminal also receives immediate access to a satellite channel for priority communications.

The Iridium network will automatically recognize and give priority access and/or routing to safety-related entities which are registered with the Iridium network, providing GMDSS communications. Each recognized safety-related entity shall be registered on the Iridium network and will be assigned a unique access code or address for communicating with the Iridium network. The Iridium network and services support the automatic recognition and prioritization of communications from registered users to maritime mobile terminals for priority one, priority two and priority three communications.

3.3.2.3 In processing maritime distress, urgency, safety and routine communications, the satellite system and the earth station should be capable of:

3.3.2.3.1 Automatically recognizing the message or access priority for ship-to-shore communications;

As described in section 3.3.1, the Iridium network will automatically recognize and provide priority access to satellite channels for ship-to-shore calls and messages based on the priority provided by the maritime mobile terminal. The Iridium network and services are able to identify and establish priority for ship-to-shore communications in real-time based on the destination.

3.3.2.3.2 Automatically recognizing the message or access priority for shore-to-ship communications, if any are provided, from, as a minimum, recognized entities of importance for safety at sea, registered by the earth station;

The Iridium network will automatically recognize and provide priority access to registered safety-related entities for shore-to-ship calls and messages. The safety-related entity will be expected to specify the priority for the call or message when communicating with the Iridium network. The network will automatically recognize this input and prioritize appropriately for delivery to the maritime mobile terminal. In this manner each call and/or message has a defined priority and the Iridium network and services are able to identify and establish priority for shore-to-ship communications in real-time.

3.3.2.3.3 Preserving and transferring the priority;

The Iridium network preserves and transfers the priority for all GMDSS related calls and messages to and from the maritime mobile terminal. As calls or messages are delivered to the Iridium network, a priority will be established and recorded for each communication. Additionally, the priority utilized by the network will be transferred along with the communication to the terminating party. An Application Program Interface (API) has been developed and documented by Iridium that specifies how to input and retrieve the priority information for safety-related communications.

3.3.2.3.4 Giving distress alerts and distress calls immediate access, if necessary by preempting ongoing communications of routine priority;

As described in sections 3.3.1, 3.3.1.1 and 3.3.2.1, the Iridium network will give immediate access to satellite communication channels and preempt, if necessary, any ongoing routine communications for distress alert messages and distress calls. Distress alerts and calls from a maritime mobile terminal will be provided the highest commercially available priority to insure immediate access to satellite communication channels. Moreover, any ongoing lower priority calls to a maritime mobile terminal will be preempted in support of a distress call to that subscriber.

3.3.2.3.5 Automatically recognizing maritime distress communications and automatically routing maritime distress alerts and distress calls directly to an associated MRCC, or responsible RCC if this capability exists; and

As described in sections 3.3.2.2, 3.3.2.3.1 and 3.3.2.3.2, the Iridium network automatically recognizes maritime distress alert messages and calls. Based on the destination address or terminal information provided by the calling party, the Iridium network will automatically route

distress alert messages and calls to the responsible RCC. Furthermore, the Iridium network recognizes the priority for all traffic to and from an Iridium GMDSS maritime mobile terminal and will automatically route messages and calls for all priorities to the responsible RCC and transfer the priority of such communications, as described in section 3.3.2.3.3, where appropriate.

The responsible RCC is automatically identified by the maritime mobile terminal and communicated to the Iridium network for proper routing. Each maritime mobile terminal will be required to have an integrated GPS receiver. When a distress call or alert is initiated in the ship-to-shore direction, the maritime mobile terminal will cross reference the current vessel GPS position information with a database stored in the maritime mobile terminal that will identify the responsible RCC. The maritime mobile terminal will then use the short code assigned to the responsible RCC when initiating the distress call or alert, which will allow the Iridium network to route the call/message directly to the responsible RCC.

If this Iridium 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.

3.3.2.3.6 Processing maritime urgency and safety communications in the ship-to-shore and shore-to-ship directions with the required priority, for example by allocating the first vacant channel, if no channel is immediately available.

As described in sections 3.3.2.1 and 3.3.2.2, the Iridium network supports uniquely defined priorities for urgency and safety communications to and from a maritime mobile terminal and will provide a priority appropriate for allocation to the first available satellite communications channel. And, as described in section 3.3.2.3.3, the Iridium network will preserve and transfer the associated message or call priority to the terminating party (ship-to-shore, shore-to-ship and ship-to-ship) for urgency and safety communications.

3.3.2.4 Selection and use of message or access priority for urgency and safety transmissions by maritime mobile terminals should preferably be automatic and should be restricted to calls to special, recognized entities such as medical centers, maritime assistance, hydrographic and meteorological offices, etc., registered with the earth station. The earth station should automatically route such calls directly to the relevant entity.

The maritime mobile terminals which utilize the Iridium network for GMDSS services will be required to comply with the Iridium safety communications API as referenced in section 3.3.2.3.3. This API defines addressing and priority for messages and calls to respective parties such that the maritime mobile terminal, or registered safety-related entity, can automatically assign and convey this information on behalf of the calling party through the Iridium network to its final destination. Additionally, a maximum priority will be configured for communications to or from each party such that priority assignments are not misused and are properly restricted to those parties or communications which may actually need them.

3.4 Coverage area

3.4.1 Is the geographical area within which the satellite system provides an availability in accordance with the criteria in section 3.5 in the ship-to-shore and shore-to-ship directions, and within which continuous alerting is available.

The Iridium network provides fully global service coverage while meeting the availability requirements described in section 3.5 of Resolution A.1001(25). All communication services are provided independent of latitude and longitude position on the globe. Ship-to-shore, shore-to-ship and ship-to-ship communications are provided by a constellation of low earth orbiting satellites with overlapping coverage areas, providing ubiquitous coverage. Figure 3.4.1-1 depicts the overlapping service coverage of the 66 satellites by each of the red circles and the direction of each polar orbit is depicted by the arrows at the center of each coverage area.

Voice, data broadcast, and SBD services are provided globally on a 24 x 7 basis. Service bearing communications is networked between the satellites in the constellation over the crosslinks. Crosslinks provide connectivity between satellites without going through a terrestrial earth station (Figure 3.6.1-2). Data is transferred to the ground through one of the five teleport locations around the globe (Figure 3.6.1-3).

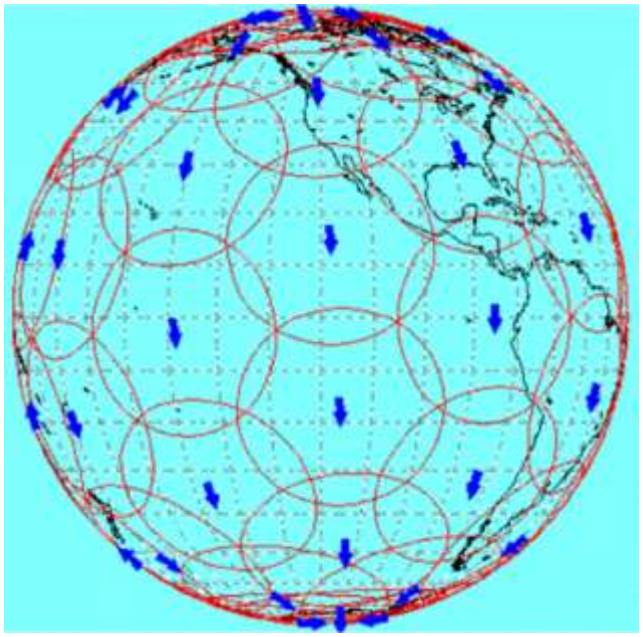


Figure 3.4.1-1 Global Iridium Constellation Coverage

3.4.2 The coverage area is to be delineated on a map and also described in relation to the sea areas defined in Chapter IV, regulation 2 of the SOLAS Convention. Documentation on the coverage area of the satellite system, as defined in Res. A.1001(25) section 1.3, should be forwarded to the Organization.

The Iridium network and services that are intended to be utilized for GMDSS communications are fully operational for the entire globe, as described in section 3.4.1. The Iridium network and services are operational in all Sea Areas (A1, A2, A3 and A4) as defined in Chapter IV, regulation 2 of the SOLAS Convention. However, if Iridium is authorized to provide GMDSS communications Sea Area 4, as presently defined, may have to be revisited as there will be no region outside of satellite coverage.

3.4.3 Information on coverage areas for satellite systems forming part of the GMDSS should be published by the Organization in the GMDSS Master Plan.

The coverage map provided in section 3.4.2 is to be included in the GMDSS Master Plan upon approval by the IMO for Iridium to provide GMDSS communications.

3.5 Availability

3.5.1 The satellite system should provide continuous availability for maritime distress and safety communications in the ship-to-shore and shore-to-ship directions.

The Iridium network provides continuous availability for maritime distress and safety communications. As described in Sections 3.1 and subsections, the Iridium network supports ship-to-shore, shore-to-ship and ship-to-ship communications, which can be utilized for maritime distress and safety communications throughout the global coverage area as described in Section 3.4.

All segments of the Iridium satellite constellation and ground systems operate on a 24 x 7 basis thereby providing continuous availability for voice and data communications.

Iridium telephony (voice) service is continuously provided via a “make-before-break” methodology wherein an existing call is transitioned to an adjacent satellite before the connection is terminated with the current servicing satellite. This “hand-off” of the call is performed seamlessly and is not perceptible to the user. No action is required by the user or the maritime mobile terminal to perform the call transition.

The Iridium SBD and broadcast services utilizes consecutive short duration channel assignment timeslots and therefore does not require the “make-before-break” methodology to transfer its message payload. The SBD service provides a continuously connected experience for the message originator and addressee even though the message(s) may be delivered in several small data packets.

3.5.2 The availability of the space segment, provision of spare satellite capacity and the network control function (i.e. the network availability), as defined in section 1.4

above, should be monitored by IMSO, which should report on the recorded availability of the system to the Organization at least once a year.

Iridium will work with the IMSO to define and determine the appropriate level and reporting periodicity and monitoring necessary to fulfill this requirement.

Iridium will calculate availability for the included services as defined in Section 1.4.

3.5.3 Service providers should advise their associated RCCs and IMSO of planned outages of recognized services and advise ships of scheduled downtime and known interruptions in service, and supply any other relevant network information. Service providers should also advise IMSO of unscheduled interruptions in any recognized services, as soon after the commencement of the interruption as possible, and when the recognized services have been restored.

Iridium will provide notices of planned outages and known interruptions using established Iridium practices to appropriate and applicable entities, including RCCs, IMSO, NAVAREA and METAREA coordinators and vessels as defined in the PSA referenced in Section 2.4. Iridium will provide 24 to 48 hour advanced notification for planned outages, when possible. Iridium intends to select a designated group of RCCs for distribution as a standard alert destination and will provide notifications of planned outages to these RCCs. These RCCs will in turn forward the notifications to additional parties as it deems appropriate.

Iridium will provide notices of unscheduled interruptions to RCCs, IMSO and NAVAREA and METAREA coordinators using established Iridium practices. Iridium will notify IMSO of unscheduled interruptions within 15 minutes of service interruption confirmation. Iridium will notify IMSO of the service interruption via electronic mail, which will be followed up with a phone call to a designated IMSO representative.

3.5.4 Network availability. The complete mobile satellite communication network, including earth stations for the recognized services, is expected to achieve at least 99.9% availability (equivalent to a total of 8.8 hours down time per year).

The Iridium network is architected, engineered and built to provide highly reliable, continuous communications globally. Iridium operates fully redundant gateway infrastructure to automatically restore full system operation in the event of a hardware failure. Additionally, Iridium operates five teleport locations geographically diverse to address local or regional phenomena which may impact network latency or capacity. Furthermore, Iridium operates several in-orbit spare satellite vehicles which can be deployed to address performance issues or failure of a satellite vehicle. Due to the redundant architecture and implementation in the Iridium gateway(s) and network infrastructure the Iridium network availability will achieve a minimum availability of 99.9% (as calculated in section 1.4) for the recognized services on an annual basis.

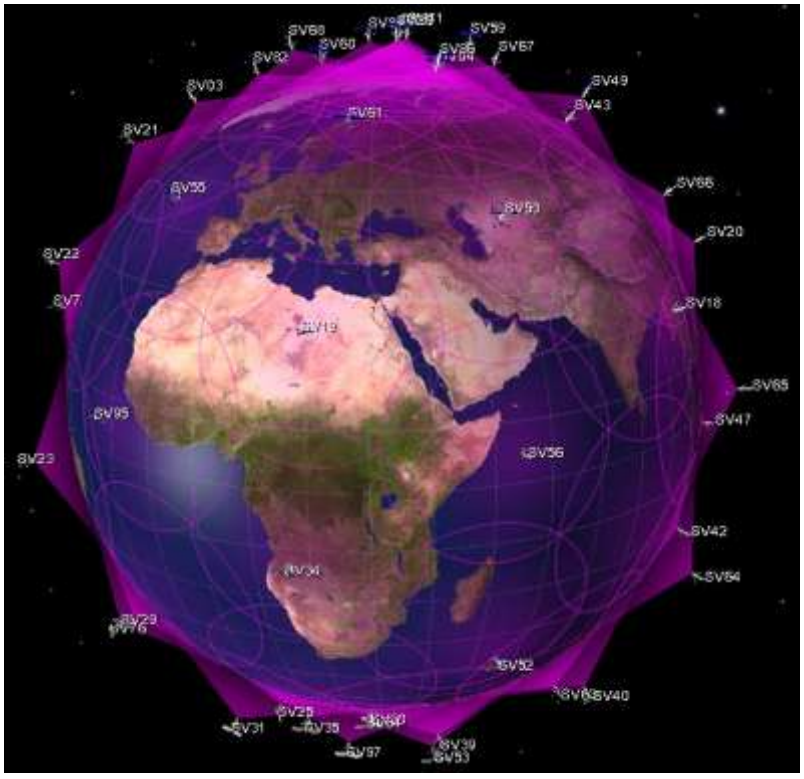
As a point of reference, for calendar years 2012 and 2013 the Iridium telephony service experienced cumulative outage duration of 6.0 hours and 2.2 hours respectively. This reflects a

service availability of 99.93% for 2012 and 99.98% for 2013. The Iridium SBD service experienced cumulative outage duration of 15.4 hours in 2012, resulting in a service availability of 99.83%, and total outage duration in 2013 of 5.4 hours with a service availability of 99.94%. The Iridium telephony service achieved 99.9% availability or greater 20 of the last 24 months and the Iridium SBD service met or exceeded 99.9% availability 19 of the last 24 months.

3.6 Restoration and spare satellites

3.6.1 Spare satellite capacity and arrangements prepared in advance should be provided to ensure that, in the event of a partial or total satellite failure, the recognized maritime distress and safety communication services in the area concerned can be restored to their normal availability, not more than one hour after failure occurs.

The Iridium constellation consists of 66 low-earth-orbiting (LEO), cross-linked satellites operating as a fully meshed network and supported by multiple in-orbit spares.



The Iridium constellation architecture ensures high reliability, low-latency voice and data communications. Iridium is the only satellite communications network that is truly global and works reliably above 75 degrees north latitude (North Pole) and below 75 degrees south latitude (South Pole). The Iridium constellation dynamically rotates the earth in a near-polar orbit (an orbit that passes over the poles of a planet) providing continuous service coverage over the entire globe.

The architecture and operation of the Iridium network, and the satellites, does not provide for a single satellite to cause an extended service interruption to a region. In the event of a satellite vehicle failure, services will be fully restored, within minutes for all users affected by the failed satellite vehicle. In cases where a failed satellite vehicle cannot be restored to full service, a spare satellite vehicle already in a storage orbit will be repositioned into the operational orbit to replace the failed satellite vehicle.

Each Iridium satellite has three distinct communication domains. The three domains consist of the L-band service link for communications to and from subscriber devices, inter-satellite communication links ("crosslink") and feederlink communications from the satellite to the teleport for the aggregated delivery of service bearing traffic. The resulting service impact of each of these types of failures, and the planned restoration of service is described below.

Each satellite L-band antenna has a "footprint" of with a diameter of approximately 2800 miles. Adjacent satellite "footprints" overlap on the earth's surface, with the least amount of overlap at the equator and complete overlap of adjacent satellite footprints above/below 55 degrees latitude. Complete failure of a satellite vehicle, or the L-band communications would have the greatest impact as the satellite passes over the equator. As the satellite continues its orbit it will move north/south reducing the void in coverage as the adjacent satellites provide overlapping coverage. Once the failed satellite reaches 55 degrees North/South Latitude the void in service will be fully restored by the adjacent satellites. Failure of a satellite vehicle at the equator is simulated and shown in Figure 3.6.1-1. Due to the orbit velocity of the satellites, an adjacent satellite will restore service to a region within minutes. The outage time experienced by a user is a function of the geographic position of the mobile maritime terminal. See Table 3.6.1 below.

SV Latitude (degrees)	Service Disruption (minutes)
0	5.6
10	5.5
20	5.2
30	4.0
40	3.0
50	1.3
>60	0.0

Table 3.6.1 Service Outage Duration by Latitude

The failed satellite, depicted in figure 3.6.1-1, will cause a dynamic coverage hole that will vary in size based on geographic position of the satellite vehicle. Once an adjacent satellite moves into coverage, services are automatically restored with the maritime mobile terminal. The failure of an Iridium satellite or the L-band communications on an otherwise functioning satellite will result in a service impairment rather than a service outage as the maximum service outage duration for a satellite failure is approximately 6 minutes.

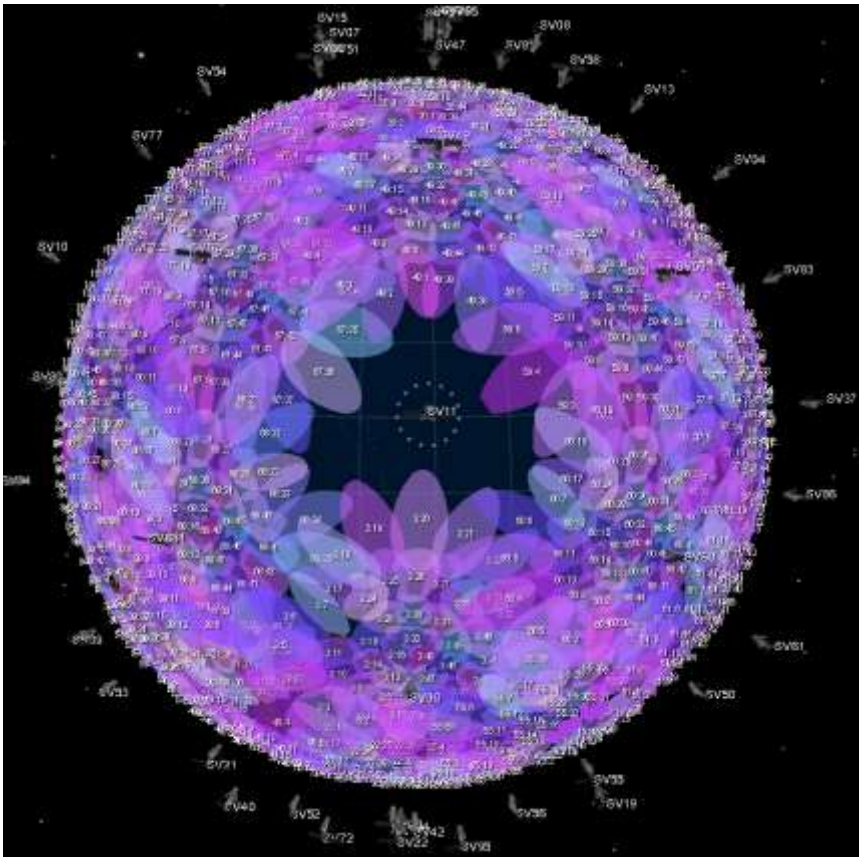


Figure 3.6.1-1 Simulated Satellite Failure

All satellites have multiple crosslink connections to adjacent satellites. If a crosslink connection were to fail between a satellite vehicle and an adjacent satellite vehicle, all traffic which was being routed over that connection would automatically be rerouted via one of the alternate crosslink connections to another adjacent satellite vehicle. During a satellite failure, service bearing data and control/telemetry data is rerouted over fore/aft and east/west crosslinks to provide service continuity. Other than a possible dropped call, no ongoing service disruption would be experienced by users as a result of a failed crosslink. The Iridium crosslinks, the connections between satellites, are depicted as blue lines in Figure 3.6.1-2 and shows a single satellite coverage and direction of travel.

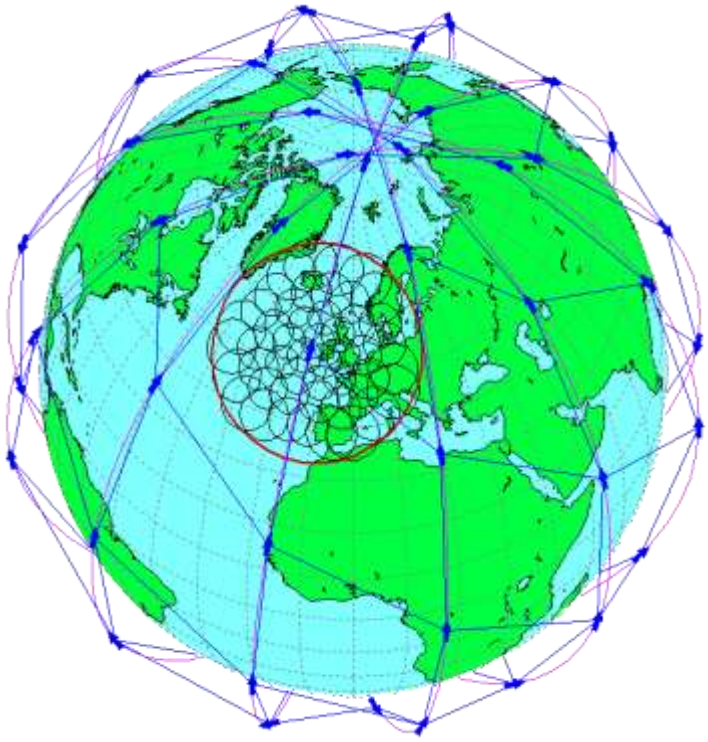


Figure 3.6.1-2 Crosslink Connectivity Between Satellites

In addition to crosslink redundancy, each satellite can be configured to deliver service bearing traffic to multiple Teleport Network sites (TPN), shown in Figure 3.6.1-3. The TPN consists of five (5) geographically diverse ground sites with multiple antennae at each site to provide link redundancy. In the event of a satellite failure, or the failure of the feederlink to a teleport, traffic can be rerouted through an alternate satellite to another teleport location. If communications are not able to be rerouted and the link between a satellite and the teleport is lost it can cause a service disruption of up to approximately 5 minutes, which is the duration until an adjacent satellite will come into coverage of the teleport and automatically restore communications. The failure of a satellite will in no instance provide a continuous service disruption of more than a few minutes.

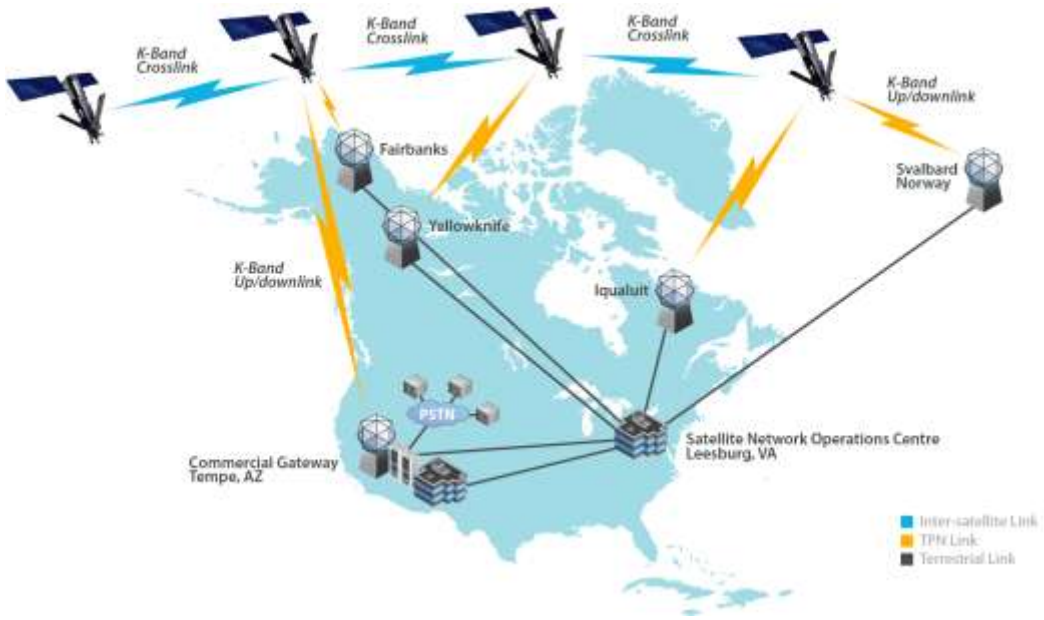


Figure 3.6.1-3

3.6.2 Full information on the means and arrangements prepared for restoration of the maritime distress and safety communication services in the event of a satellite failure should be notified to IMSO. IMSO and the service provider should conduct exercises from time to time to provide the efficiency and effectiveness of these planned arrangements.

The restoration plan for Iridium GMDSS communications for each of the services will be provided to IMSO. In the event of a failure of service Iridium shall provide to IMSO a detailed plan and the timeline for the restoration of service as defined in the PSA referenced in section 2.4.

Iridium and IMSO may arrange for periodic exercises to be conducted to demonstrate the ability and efficiency to restore service in a timely manner in the event of disruption in service. The frequency and method for conducting such exercises are to be agreed between Iridium and IMSO and documented in an appropriate business arrangement.

3.7 Identification

The satellite system should be capable of automatically recognizing and preserving the identification of maritime mobile earth stations.

The Iridium network shall support a unique identifier for each Iridium GMDSS maritime mobile terminal. A database of Iridium GMDSS maritime mobile terminals will be created and updated as maritime mobile terminals are provisioned for GMDSS communications on the Iridium network. Also, the Iridium network shall automatically recognize and preserve the identification of all Iridium GMDSS maritime mobile terminals. Furthermore, the Iridium network and services

shall support the transmission of the identification of the maritime mobile terminal (the MMSI or other unique vessel identifier (e.g. IMO number) to the serving MRCC or RCC as defined in the Iridium safety communications API, referenced in section 3.3.2.3.3.

3.8 Information to be made available to SAR authorities

For all distress, urgency and safety communications, the maritime mobile terminal identification number or Maritime Mobile Service Identity (MMSI) should be an integral part of the distress alert and be provided to the RCC with the alert. When available, all additional registration, commissioning or other data relevant to the search and rescue prosecution of a false alert should be referenced to this number and made available to the proper SAR authority or RCC upon request.

The Iridium network will provide the MMSI information to the terminating party for all distress, urgency and safety calls and messages. This method and format for communication of this information is defined in the Iridium safety communications API as referenced in 3.3.2.3.3. For all distress, urgency and safety communications, the MMSI information along with the call or message priority will be communicated to the terminating party, most likely a SAR authority.

3.9 Reception of distress alerts

The satellite system should allow for addressing a maritime distress alert to a specific MRCC chosen by the ship's operator and covering the area concerned, but should also provide for automatic routing of manually initiated maritime distress alerts. Means should be provided to allow the MRCC to easily identify the system and specific mobile station from which an alert or other priority message has been received, to enable the MRCC to establish shore-to-ship communications

The Iridium network will allow for the addressing of a distress alert to a specific MRCC or RCC. Iridium will assign unique identifiers for each MRCC and RCC such that a maritime mobile terminal can specify delivery of a distress alert to a specific party. Transmissions from maritime mobile terminals will include unique identification details enabling the specific MRCC to identify the maritime mobile terminal and to establish shore-to-ship communications with the ship concerned.

If a particular MRCC or RCC is not connected to the Iridium network, it will remain possible for other RCCs to assist in delivery of the distress alert to the specified MRCC. The MRCC will receive the distress alert along with the MMSI or other unique vessel identifier (e.g. IMO number) and the location information for the maritime mobile terminal. The MRCC will then be expected to forward the distress alert to the MRCC specified by the maritime mobile terminal originating the message.

The Iridium network will enable an MRCC to easily identify ship-to-shore communications from, and establish shore-to-ship communications with an Iridium GMDSS maritime mobile terminal. The Iridium safety communications API, referenced in section 3.3.2.3.3 defines the format for receiving the MMSI and priority information for a priority message as well as the format for

communicating with a specific maritime mobile terminal. The MMSI or other unique vessel identifier (e.g. IMO number) will be utilized for Iridium GMDSS subscribers as described in section 3.7 and communicated to an MRCC as described in section 3.8.

Additionally, the Iridium network will provide the unique identifier for an MRCC or RCC, and the call or message priority to the maritime mobile terminal for display aboard the vessel for shore-to-ship communications. This will enable parties aboard the vessel to have knowledge of which RCC is contacting them and the priority level of such communications.

3.10 Control of maritime mobile terminals

Access control arrangements for controlling and giving, or temporarily denying, access by maritime mobile terminals to the system should at all times allow maritime mobile terminals access for transmission or maritime distress alerts/calls and distress messages.

The Iridium network supports delivery of a distress call from a maritime mobile terminal, to an MRCC, which has otherwise been denied commercial access to the system. The maritime mobile terminal will utilize a short code defined by Iridium for the distress call, which will then be routed to an MRCC.

In order to support delivery of a distress call in the ship-to-shore direction Iridium will implement a new GMDSS-specific service package that enable distress communication to/from the maritime mobile terminal, which has otherwise been denied commercial access to the system.

3.11 Test facilities

The system should provide facilities making it possible for maritime mobile terminals to test the distress capability of their stations without initiating a distress alert/call.

The Iridium network supports the ability for a maritime mobile terminal to test the ability to place a ship-to-shore call, verifying proper operation, without initiating a distress call/alert. Iridium will establish test phone numbers specifically for maritime mobile terminals to test the proper functionality and operation of a maritime mobile terminal. Maritime mobile terminal test calls will be routed through the satellite network to a teleport and finally to an Iridium gateway. The gateway call platform will answer the call and provide an automated response to the user identifying that they have called a test phone number and that the mobile maritime terminal if functioning properly.

4 CRITERIA AND REQUIREMENTS FOR EARTH STATIONS

4.1 Functional requirements

4.1.1 Earth stations serving the GMDSS should:

4.1.1.1 be in continuous operation;

The Iridium earth stations include the teleport network (TPN) sites, the System Network Operations Center (SNOC), Iridium Gateway (GW), and the Backup Operations Center (BOC) as shown in Figure 3.6.1-3. All Iridium earth stations are in continuous operation around the clock, 24 hours a day, seven days a week, 365 days a year. All network elements include hot backup redundancy, to maintain full earth station functional operation, in case of failures. All links between the satellite and TPN sites, and the TPN sites and Gateways/SNOC sites are available continuously to support transfer of service bearing data and command/control/telemetry. The Iridium Gateway and SNOC sites include redundant hardware platforms along with backup generators to maintain operation in the event of a power outage.

The Iridium earth stations and the many components that construct the Iridium terrestrial network have been in continuous operation for more than 15 years. In that time Iridium has made continuous investment and enhancement to the earth stations to improve reliability, availability and capacity.

4.1.1.2 be connected to an associated RCC;

The Iridium earth station(s) shall be connected to one or more rescue coordination centers. In each case the Iridium gateway(s) will be connected to an RCC using diverse and redundant connectivity methods. To connect to an RCC, Iridium-owned and managed router(s) would be placed at the RCC, which shall be connected to the Iridium gateway(s) via a dedicated circuit and at least one alternate means (i.e. ISDN or VPN).

4.1.1.3 keep continuous watch on all appropriate satellite communication channels; and

Iridium earth station operations specialists continuously monitor satellite position, satellite health, inter-satellite and gateway connectivity and capacity utilization among other items. All Iridium earth stations are manned and monitored continuously, with a defined and tested fault detection, isolation, and corrective response process in place. Critical, time sensitive faults or failures are typically corrected autonomously through detection of a hardware failure by the resident software, and a switchover to the redundant hardware. Less critical faults are generated as telemetric alarms and diagnosed by operations specialists to decide what type of corrective action is required.

4.1.1.4 be capable of transmission and reception of at least the maritime distress safety communications services included in 3.1.

The Iridium earth station(s) are capable of transmitting and receiving ship-to-shore distress alerts/calls, shore-to-ship distress relay alerts/calls, ship-to-shore, shore-to-ship and ship-to-ship search and rescue coordination communications, ship-to-shore transmissions of MSI messages, shore-to-ship broadcasting of MSI messages and ship-to-shore, shore-to-ship and ship-to-ship general communications. All Iridium commercial earth stations support the requisite telephony and data services to support GMDSS distress and safety communications as defined in Res. A.1001(25) section 3.1.

4.2 Priority

4.2.1 The earth station should be capable of automatically recognizing the priority of ship-to-shore and shore-to-ship communications, and should process maritime mobile communications while preserving the four levels of priority specified in paragraph 3.3.1

The Iridium network supports the automatic recognition of the four defined priorities (distress, urgency, safety and routine) for ship-to-shore and shore-to-ship communications. Call or message priority is established based on recognition of the calling party or call destination for telephony communications and message originator or message destination address for data messages and broadcasts. Additionally, the Iridium network can accept dynamic priority assigned by the call or message originator.

The Iridium earth station preserves the call and/or message priority for each active session such that the prioritization and/or preemption functions can be properly executed if required.

4.2.2 Priority access should be given for distress alerts and calls in real time. In any case, distress alerts and calls should be given priority treatment by providing immediate access to satellite channels, and distress alerts and calls for store and forward systems should be placed ahead of all routine traffic. Any satellite system designed for use in the GMDSS should be able to recognize the four levels of priority and give appropriate access for communications in the ship-to-shore direction and in the shore-to-ship direction for distress, urgency and safety traffic originated by RCCs or other Search and Rescue Authorities.

The Iridium gateway(s) prioritize all distress alert messages and distress calls (priority 1) above other communications for shore-to-ship delivery to the maritime mobile terminal. Distress calls and distress alerts are given the highest priority by the Iridium earth station(s) and hence would be given immediate assignment to a satellite channel for connection to the maritime mobile terminal. The Iridium earth station(s) recognize the four levels of priority (as defined in section 3.3.1) and give appropriate access to network resources for communications in the ship-to-shore and shore-to-ship direction, as described in section 3.3.2 and subsections therein.

4.2.3 Limitations in existing public switched networks concerning facilities for identification and use of priority access codes might necessitate special arrangements such as the use of leased lines between, for example, MSI providers and the earth station, until such facilities become available in the public switched network.

The Iridium gateway(s) will support two options for communications with MSI providers. The primary option will be the use of a secure, web-based portal that will be readily accessible from the Internet. Access to this portal will not be dependent on PSTN infrastructure or any specific functionality of the PSTN such as calling party identification presentation. The MSI providers will access the portal using a secure login and user verification. MSI providers will have the opportunity to specify priority for the broadcast message, or a default priority will be assigned based on the user identification used during the login in process. Alternatively, an MSI provider may elect to use a VPN, leased line or dedicated circuit to connect to an Iridium gateway. This connectivity method would still permit use of the web-based portal, but more likely would use a direct connection to the broadcast service platform. If an MSI provider elects to use a VPN or leased line connection to the broadcast service interface, the broadcast message delivery parameters will still be provided as described in section 3.1.5 for each message. Network addressing will uniquely identify the message originator so a default priority can be assigned to a message if one is not specified.

In an effort to provide redundancy, and maximize service availability, a combination of the above options may be utilized to provide connectivity to the Iridium gateway(s) for the delivery of GMDSS alerts and messages.

4.3 Pre-emption

Satellite systems participating in the GMDSS should make arrangements to ensure that it will always be possible for an MRCC to obtain an immediate connection to a maritime mobile terminal and that the MRCC could use the systems for SAR alerting and communication without any delay. This may be achieved by a process of pre-emption or by other suitable means approved by IMSO.

The Iridium network supports four priority levels for voice, data and broadcast communications. The Iridium network is configured to always give preference to higher priority communications and ruthlessly preempt any active lower priority communications if sufficient communication channels are not available for a maritime mobile terminal. This functionality will ensure immediate connection between the MRCC and the maritime mobile terminal at all times for distress communications.

4.4 Routing of maritime distress alerts

4.4.1 The satellite system should have reliable communication links to one or more associated MRCCs. These links may be implemented directly between the MRCC and an earth station, or some other suitable point in the system's network. The arrangements between the system and the MRCC are subject to approval by the national administration.

The Iridium network supports highly reliable communication links to multiple MRCCs for the routing of ship-to-shore and shore-to-ship maritime distress alerts. The Iridium gateway(s) shall be connected to MRCCs using redundant, dedicated circuits to allow for the transmission and receipt of maritime distress alerts. The expectation is that the Iridium gateway(s) and the MRCC will be directly connected, but will be subject to the approval by the MRCC national administration.

4.4.2 The system's network should be capable of automatically recognizing maritime distress and safety communications and of routing, as far as possible automatically, maritime distress alerts/calls directly to the associated MRCC, via a highly reliable communication link. In cases where capability exists, the system may route alerts directly to the responsible RCC as defined in the IAMSAR Manual.

The Iridium network supports automatic recognition and routing of maritime distress and safety communications via highly reliable link. The Iridium network routes all ship-shore and shore-ship distress alert calls and messages immediately without any required human intervention. For ship-to-shore maritime distress and safety communications the maritime mobile terminal will utilize a series of unique addresses to automatically route messages directly to the associated MRCC. Iridium will define and implement at least one unique ID ("short code") for each MRCC. All maritime distress and safety communications generated by the maritime mobile terminal will be automatically identified and routed to the associated MRCC based upon the unique ID specified. The distress or safety message will be delivered to the associated MRCC using highly reliable communications links as described in section 4.4.2.

4.4.3 The earth station or other relevant part of the system's network should be provided with an aural and visual alarm to alert a designated responsible person in the event that an automatic connection to the MRCC cannot be achieved within 60 seconds. In this case, all necessary action should be taken to immediately inform the MRCC of the details of the distress alert or call. Personnel should always be available to react to such an alarm so as to ensure that the distress alert or call can be forwarded to an MRCC within 5 minutes of the alarm being triggered. All messages with distress or urgency priority should sound an alarm at the earth station or other relevant part of the system's network, which should require manual cancellation.

The Iridium gateway(s) support aural and visual alarms in the event that a connection between the Iridium gateway(s) and an MRCC is lost. The communication link between the Iridium network and the MRCC(s) will be actively monitored and managed, by Iridium operations

personnel 24 hours per day. The connection between the Iridium gateway(s) and the MRCC(s) will be secure, persistent data connections. In the event that a connection to an MRCC is lost, upon detection, an alarm will immediately be generated to alert the Iridium operations personnel. The operations personnel will immediately begin troubleshooting efforts to restore the connection and will establish communications with the affected MRCC(s) to alert them that the connection between the Iridium gateway(s) and the MRCC(s) is non-operational.

4.4.4 The MRCC should be provided with reliable communication links to the system's network for efficient handling of shore-to-ship distress alert relays and distress traffic, preferably via dedicated communication links.

The Iridium GMDSS earth station shall be connected to the one or more MRCC(s) via redundant, dedicated communication links. Iridium will implement diverse and avoidance-managed communication links to the MRCCs for the recognized services, which will provide efficient handling of shore-to-ship distress communications.

4.5 Identification

The system should be capable of automatically identifying ship earth stations. If other identification than Maritime Mobile Service Identity (MMSI) is used in the system, the means should be provided 24 hours per day to easily identify the ship and provide the MRCC with all the appropriate additional information necessary for effecting rescue, including the MMSI number where available.

The Iridium supports automatic recognition and identification of maritime mobile terminals. The Iridium supports the transmission of the MMSI for the vessel on which the maritime mobile terminal is installed in the call setup to the associated MRCC.

For alerts to the MRCC delivered via the Iridium SBD service, the Iridium networks shall send the MMSI as part of the header information, or message content to the MRCC. The Iridium gateway(s) will forward the identification information for the maritime mobile terminal to the associated MRCC as described in section 3.7.

4.6 Voice communication systems

4.6.1 The communication links for mobile-satellite voice communication systems should be connectable to the public switched network in accordance with relevant ITU-T Recommendations.

The Iridium network supports connection to the public switched network for ship-to-shore and shore-to-ship voice communication. Although there are proprietary technologies utilized in the Iridium network, all connections with MRCCs will adhere to industry standards. The Iridium network is connected to the PSTN via multiple world-class telecom providers. All ship-to-shore and shore-to-ship voice calls will be routed through redundant PSTN capacity automatically. Calls to/from the maritime mobile terminal will be passed immediately with the calling party identification information included.

4.6.2 Satellite systems using the public switched network for routing maritime distress calls and distress traffic to and from MRCCs should, upon receipt of ship-to-shore or shore-to-ship distress alerts/calls or distress traffic, immediately attempt to establish the connection necessary for transfer of the distress alert or distress message.

The Iridium network supports immediate connection of ship-to-shore and shore-to-ship distress calls. The Iridium network, upon receipt of ship-to-shore or shore-to-ship distress call(s), shall immediately attempt to establish the connection necessary for transfer of the distress call to/from MRCCs as required. This is further described in sections 3.1.1, 3.1.2, 3.3.1.1, 3.3.2.3.4 and 3.3.2.3.5.

4.7 Data communication systems

4.7.1 The communication links for mobile-satellite data communication systems should be connectable to the public data communication network in accordance with relevant ITU-T Recommendations. The system should provide the capability to transfer the identity of the calling subscriber to the called subscriber. Maritime distress alerts/calls and distress messages should include the ship identity and the earth station identity, or other means of identifying the point of access to the satellite network.

The Iridium gateway(s) are connected to the World Wide Web for data communication transmission to and from distribution partners and MRCCs. Secure communications can be established with an MRCC via a virtual private network (VPN) connection, via dedicated circuits or a combination of the two. All ship-to-shore and shore-to-ship data communications will be routed through a redundant broadband IP network to and from the Iridium gateway(s). The Iridium network supports transmission of the identity of the calling subscriber to the called subscriber and the ship identity (MMSI) for distress alerts and messages.

Communication of the earth station ID, or gateway ID, is not relevant based on the Iridium network architecture. All external parties will utilize a single address (point of access) to connect to the Iridium network, hence the addition of an earth station identification provides no additional value or benefit.

4.7.2 Satellite systems using the public switched network for routing distress alerts/calls and distress traffic to and from MRCCs should, on receipt of ship-to-shore or shore-to-ship distress alerts/calls or distress traffic immediately attempt to establish the connection necessary for transfer of the distress alert or distress message.

The Iridium system, upon receipt of ship-to-shore or shore-to-ship distress alerts/calls or distress traffic, shall immediately attempt to establish the connection necessary for transfer of the distress alert or distress message to or from MRCCs as required. The Iridium network will be connected to the MRCCs using a permanently established data connection. This connection will be actively monitored and managed such that in the event of a disruption in the connection immediate action can be taken to restore the connection. Therefore, the action required by the Iridium network to immediately establish connection for ship-to-shore or shore-to-ship distress alerts or distress messages is to assign a communications channel to complete the transfer of the distress alert or distress message. This functionality is described in sections 3.3.2.1, 3.3.2.3.4 and 4.2.2.

4.8 Store and forward systems

Satellite systems using store and forward communication systems should:

4.8.1 Make an initial attempt to deliver a ship-to-shore or shore-to-ship message within 60 seconds for any maritime distress alert or distress traffic, and within 10 minutes

for all other maritime messages, from the time receiving station receives the message (the message should include the ship identity and the earth station or system identity); and

This requirement is not applicable to the Iridium network. The Iridium network is not based on store–and-forward functionality within the satellite constellation. For ship-to-shore and shore-to-ship communications the Iridium network will immediately, upon receipt of the message, attempt to deliver the message to the designated party(ies). In the event that a higher priority message is being delivered, the Iridium network will immediately attempt delivery of the message following successful delivery of the higher priority message. The Iridium network successfully delivers more than 95 percent of messages in 60 seconds and more than 99 percent of messages within four minutes. Reference sections 3.3 and subsections and 4.2 and subsections for more details on how prioritization is performed.

4.8.2 Generate notification of non-delivery immediately once the message is considered non-deliverable, for maritime distress alerts and distress messages not later than 4 minutes after reception of the alert or message.

This requirement is not applicable to the Iridium network. The Iridium network is not based on store-and-forward functionality with the satellite constellation. Delivery of all ship to shore and shore to ship communications is attempted immediately upon transmission to the system.

4.9 Facilities for broadcasting Maritime Safety Information

4.9.1 Satellite systems forming part of the GMDSS should technically be capable of offering facilities for broadcasting Maritime Safety Information (MSI) from MRCCs and authorized providers of MSI, such as Hydrographic Offices and Meteorological Offices, to ships at sea.

The Iridium network supports broadcast of Maritime Safety Information (MSI) from MRCCs and authorized providers of MSI to maritime mobile terminal aboard ships at sea. This functionality is described in section 3.1.5.

4.9.2 Such facilities for broadcast of MSI should provide for automatic, continuous and reliable reception on board ships and should, as a minimum, fulfill the requirements specified in sections 4.9.3 and 4.9.8 below.

The Iridium network supports automatic, continuous broadcast of MSI messages and reliable reception on board the vessel. The antenna for the maritime mobile terminal will be installed on the outside of the vessel with a clear view of the horizon in each direction, ensuring for very high reliability in successful delivery of broadcast messages. Additionally, the Iridium broadcast service provides for automatic, continuous and prioritized delivery of MSI messages. The Iridium broadcast service supports dynamically configurable message delivery options for specifying retry interval and number of repeated transmissions to maximize successful delivery.

Moreover, Iridium will provide to each MSI provider a system which can be connected to a computer such that the MSI provider can verify successful and timely delivery of their respective broadcast messages. This system will be capable of receiving MSI broadcasts and will be configured unique to each MSI provider such that they are able to receive broadcasts which they initiate.

4.9.3 The facilities should provide for recognition and processing of the four levels of priority specified in paragraph 3.3.1.

The Iridium broadcast service supports four levels of priority as specified in section 3.3.1. Reference sections 3.1.5 and 3.3.1 for more detail.

4.9.4 It should be possible to address the broadcast of MSI to all properly equipped ships within a specified area for at least the following types of areas:

4.9.4.1 the entire region covered by the satellite or system over which the transmission is made:

The Iridium broadcast service provides the MSI provider with the ability to specify the delivery area and priority for all MSI messages. A broadcast delivery area is specified using GPS coordinates for the boundary of the delivery area, which may be within the coverage area of one or more satellite vehicles, up to an including the entire coverage area of the Iridium constellation.

4.9.4.2 the NAVAREAs/METAREAS as established by the International Maritime Organization (IMO), the International Hydrographic Organization (IHO) and the World Meteorological Organization (WMO) respectively; and

The Iridium broadcast service supports delivery of Marine Safety Information (MSI) to all Iridium-based maritime mobile terminals within the NAVAREAs/METAREAs as established by the International Maritime Organization (IMO), the International Hydrographic Organization (IHO) and the World Meteorological Organization (WMO) respectively. Iridium will define unique area identifiers and delivery areas for the NAVAREAs and METAREAs based on the geographic boundaries as established by the IMO, IHO and WMO. The MSI provider can elect to specify the delivery area for a broadcast message using the unique NAVAREA or METAREA ID or define the delivery area by providing the GPS coordinates for the boundary of the delivery area.

4.9.4.3 a temporary area chosen and specified by the originator of the MSI message, including circular or rectangular user-specified areas appropriate for broadcast of distress alert relays and search and rescue coordinating communications.

The Iridium broadcast service supports the delivery of a broadcast message to an area specified by the message originator, including rectangular or circular regions. The MSI message originator can specify the delivery area for the message by providing a GPS position and radius for a circular delivery region, or a series of GPS coordinates defining the boundary of an orthogonal delivery area. The delivery area is specified for each message, enabling a temporary delivery area to be enabled in near-real time for each message, if needed.

4.9.5 The facilities should provide for transmission of at least the types of Maritime Safety Information required by SOLAS, as follows:

4.9.5.1 Search and rescue coordination information, including distress alert relays;

The Iridium broadcast service supports the delivery of digitized information in any format provided by the message originator. Therefore, the Iridium network supports the transmission of search and rescue coordination information including distress alert relays as required by SOLAS.

4.9.5.2 navigational warnings; and

The Iridium broadcast service fulfills the requirement to transmit Marine Safety Information (MSI) navigational warnings as required by SOLAS. See 4.9.5.1 for more detail.

4.9.5.3 meteorological warnings and forecasts.

The Iridium broadcast service fulfills the requirement to transmit Marine Safety Information (MSI) meteorological warnings and forecast as required by SOLAS. See 4.9.5.1 for more detail.

4.9.6 The facilities for broadcast of navigational and meteorological warnings should include possibilities for:

4.9.6.1 scheduling the broadcast at fixed times or transmitting messages as unscheduled broadcast transmissions; and

The Iridium broadcast service supports the scheduling of broadcast messages at fixed times or for immediate delivery of unscheduled broadcast transmissions. Using the secure web-based portal provided by Iridium to MSI providers, the MSI message originator will specify the delivery criteria for each message.

4.9.6.2 automatic repetition of the broadcast with time intervals and number of broadcast transmissions as specified by the MSI provider, or until cancelled by MSI provider.

The Iridium broadcast service supports the repetition of broadcast messages with time intervals and number of transmissions. Using the secure web-based portal provided by Iridium to MSI providers, the MSI message originator will specify the delivery criteria for each message. The criteria will include the number of repetitions for delivery of a message and the time interval between delivery attempts, if desired

4.9.7 The facilities should provide for marking MSI messages with a unique identity, enabling the shipborne equipment that receives these broadcasts to automatically ignore messages already received.

The Iridium broadcast service will uniquely identify each MSI broadcast message, and transfer that ID to the maritime mobile terminal receiving the message. The maritime mobile terminal will be configured to automatically ignore MSI messages which have been previously received based on the MSI message ID.

4.9.8 The broadcasting service should in addition provide facilities for broadcasts similar to NAVTEX to 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.

The Iridium broadcast service will provide the ability to deliver broadcast messages to coastal areas not covered by the International NAVTEX Service. This will include the identification characters defined in accordance with the International NAVTEX Service.

5 ADDITIONAL RECOMMENDED CAPABILITIES

5.1 Mobile satellite service providers are encouraged to:

5.1.1 route Automatic Location Identification (ALI) and Automatic Number Identification (ANI) in accordance with appropriate ITU-T Recommendations, with distress calls originating from MSS terminals routed directly to the RCCs responsible for voice and data calls;

Iridium will require an integrated GPS capability in each of the maritime mobile terminal. The intent is that this information will assist in identifying and automatically routing calls or messages to the responsible RCC, and also this information can be transferred to the RCC(s) for distress calls and messages. This functionality would effectively provide ALI information for the vessel.

The Iridium network will route ANI information to the responsible RCC through the transfer of the MMSI information, as described in sections 3.3.2.3.3, 3.7 and 3.8, for the maritime mobile terminal. The RCC will utilize the MMSI number for calling the vessel, so the MMSI information will act as the ANI information for the vessel.

5.1.2 automatically route information contained in registration databases in accordance with Resolution A.887(21), in a recognizable format and including the distress call to the responsible RCC, once means are established for doing so; and

The MMSI identification information for the maritime mobile terminal will be automatically routed to the responsible RCC for all distress calls.

5.1.3 be capable of retrieving maritime safety information in a timely manner from NAVAREA, METAREA, other relevant coordinators, and the International Ice Patrol Service, in a standard format and process established by those coordinators.

At present, the NAVAREA, METAREA, other relevant coordinators and the International Ice Patrol Service would have to send the MSI message to an Iridium gateway for delivery to a maritime mobile terminal. Iridium will evaluate the possibility to proactively retrieve maritime safety information from the relevant coordinators, in a standard format, for automatic delivery to the maritime mobile terminals in specified regions.

6 NOVEL TECHNIQUES

Satellite systems may be permitted to use novel techniques to provide any of the capabilities required by this resolution. Approval to use novel techniques for a period of up to 12 months may be given provisionally by IMO in order to allow early introduction and proper evaluation of the technique. Final recognition of a novel technique may be given by the Organization only after receiving a report allowing full technical and operational evaluation of the technique.

Iridium does not propose any novel techniques for compliance with the requirements to provide GMDSS communications at this time. Iridium reserves the right to propose additional techniques in the future for the purpose of providing or improving the efficiency or efficacy of GMDSS communications.

7 LEGACY SERVICES

7.1 All satellite-based systems and services for the GMDSS which were already approved and in use* before the entry into force of Resolution A.1001(25) are exempt from the requirements of sections 2.1, 2.2 and 2.3 of Resolution A.1001(25). These systems are:

7.1.1 Inmarsat-A

7.1.2 Inmarsat-B

7.1.3 Inmarsat-C

7.1.4 The International SafetyNET Service

This requirement is not applicable to the Iridium network.

7.2 The services identified in sections 7.1 are subject to the requirements of section 2.4.

This requirement is not applicable to the Iridium network.

8 GLOSSARY OF TERMS

API	Application Programming Interface, is a way for two computer applications to talk to each other in a common language that they both understand
GPS	The Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.
ISDN	Integrated Services for Digital Network. ISDN is a set of CCITT/ITU standards for digital transmission over ordinary telephone copper wire as well as over other media.
LEO	Low Earth Orbiting
LRIT	Long Range Identification and Tracking
MSI	Marine Safety Information
PSTN	The Public Switched Telephone Network is the aggregate of the world's circuit-switched telephone networks that are operated by national, regional, or local telephony operators, providing infrastructure and services for public telecommunication.
SBD	Short Burst Data. Iridium SBD is a simple and efficient network transport capability for transmitting short data messages between equipment and centralized host computer systems.
SNOC	The Iridium Satellite Network Operating Center is the nerve center of the Iridium space and ground network — providing 24/7 monitoring and control over all network elements, including satellites, ground sites, and interconnections.
SSAS	Ship Security and Alert System
Teleport	A center providing interconnections between different forms of telecommunications, especially. one that links satellites to ground-based communications
TPN	Teleport Network. The Iridium TPN consists of five (5) geographically diverse ground sites with multiple antennae at each site to provide link redundancy.
VPN	Virtual Private Network extends a private network across a public network, such as the Internet. It enables a computer to send and receive data across shared or public networks as if it is directly connected to the private network, while benefiting from the functionality, security and management policies of the private network.