Document Revisions

***AISM***Association Internationale de Signalisation Maritime ***IALA***

International Association of Marine Aids to Navigation and Lighthouse Authorities

10, rue des Gaudines

78100 Saint Germain en Laye, France

Telephone: +33 1 34 51 70 01 Fax: +33 1 34 51 82 05

e-mail: [contact@iala-aism.org](mailto:contact@iala-aism.org) Internet: [www.iala-aism.org](http://www.iala-aism.org)

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**On**

**Communications in**

**Polar Areas**

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Communications in Polar Areas

# EXECUTIVE SUMMARY

.1 Purpose

The document seeks to establish guidelines for improved communication and dissemination of MSI *(Maritime Safety Information)* with ships operating in polar areas through enhanced communication systems.

The guidelines focus on the existing equipment as required by SOLAS for sea area A4, *which, according to SOLAS chapter IV are:*

* *VHF with DSC and distress alerting*
* *MF/HF radio installation*
* *SAR locating device,*
* *MSI through HF direct-printing telegraphy,*
* *Satellite EPIRB,*

.2 Summary

For ships operating in Sea Area A4, HF radio remains the only viable system for communicating distress and safety information and MSI, due to limitation of coverage of recognized satellite systems. In spite of this and the fact that SOLAS requires that e*ach Contracting Government undertakes to make available appropriate shore-based facilities for space and terrestrial radiocommunication services, including services in the bands between 4,000 kHz and 27,500 kHz* (SOLAS chapter IV, regulation 5), many Administrations have closed down their HF radio stations, due to low traffic.

There is a need to re-establish reliable communication to and from ships operating in polar areas for safety reasons.

As an alternative to HF, AIS and VHF, which is required to be carried on SOLAS convention, ships could use orbiting satellite systems as a tool for enhanced safety in polar areas. The future VDE (VHF Data Exchange) may become an efficient tool for communication and navigational safety in polar region as well as other areas.

Satellite systems, other than satellites in the Inmarsat system, may in the future be capable of fulfilling the requirements for distress and safety and MSI.

However, convention ships are not permitted to operate beyond the coverage of systems in which continuous alerting is available. Beyond the coverage of satellites in the Inmarsat system only HF is capable of fulfilling this obligation today.

Efficient, seamless and automated delivery of MSI should be a key objective of such communication in order to minimize distress situations. It should be noted that some urgent safety situations may require higher bandwidth solutions than available using AIS.

It is imperative to monitor all shipping traffic in polar areas to ensure their optimum safety.

**2 DEFINITIONS**

*Sea area A1* means an area within the radiotelephone coverage of at least one VHF coast station in which continuous DSC alerting is available, as may be defined by a Contracting Government.

*Sea area A2* means an area, excluding sea area A1, within the radiotelephone coverage of at least one MF coast station in which continuous DSC alerting is available, as may be defined by a Contracting Government.

*Sea area A3* means an area, excluding sea areas A1 and A2, within the coverage of an Inmarsat geostationary satellite in which continuous alerting is available.

*Sea area A4* means an area outside sea areas A1, A2 and A3.

“E-Navigation is the *harmonized* collection, integration, exchange, presentation and analysis of maritime information *onboard and ashore* by electronic means to enhance berth to berth navigation and related services, for safety and security at sea and protection of the marine environment.”

# discussions

According to the report from the e-Navigation Correspondence Group to MSC (COMSAR 15/11 – paragraph 9) efficient and reliable communication is crucial to ensure safe operations and interoperability on board and ashore and that an improved robust communication system for ships operating in polar and remote areas will be necessary for a future e-navigation concept.

IALA supports the opinion expressed by the e-Navigation Correspondence Group (IALA e-NAV11/10/1).

Whereas in most of the navigable ocean areas, the communications needs for distress and safety purposes can be met by existing terrestrial transmitters and communications satellites. In the Polar Regions; (i.e., above approximately 70 degrees North and below 70 degrees South) there is limited satellite communication capability for these purposes. Although geosynchronous satellites (e.g., Inmarsat) can provide communications capability in areas up to approximately 75 degrees, an effective and reliable means of communications is necessary for the remainder of the polar areas.

The GMDSS has introduced an international coordinated network of broadcasts of Maritime Safety Information (MSI), as defined in SOLAS IV Part A Regulation 2.9.

For the foreseeable future, HF remains the only available long range system that can provide for distress and safety communications and MSI services in areas beyond the coverage of satellite systems (i.e., geosynchronous) recognized for that purpose. This is also the opinion of IALA.

Although HF is a requirement of GMDSS, the operational challenges (e.g., changing propagation characteristics) and the inability to provide a high data rate (broadband) communications channel severely limits the usefulness of HF communications as it is organized today.

WRC-15 Agenda item 1.16 and Resolution 360 (WRC-12) will consider possible additional maritime communications that could service the polar regions with more robust HF capabilities; and also consider Radio Regulations modifications to enable new AIS terrestrial and satellite applications as well as additional or new applications for maritime radiocommunications within existing maritime mobile and mobile-satellite service allocations. This resolution specifically recognizes that IMO is developing a Polar Code. There is an expectation that the results of this Agenda Item will provide means for enhanced polar communications.

LRIT

Long-Range Identification and Tracking (LRIT) provides position updates normally every 6 hours. Ships operating in the polar regions should be required to transmit long-range identification and tracking information more frequently.

# COMMUNICATIONS IN THE POLAR REGIONS

Though there are no recognized satellite services as defined for Sea area A4, non-GMDSS satellites are available (or planned) and could be used, some of which are described in ANNEX A.

Various administrations have HF DSC stations for Sea Areas A3 and A4. A list of these stations can be found in the International Maritime Organization’s Master Plan of Shore-Based Facilities For The Global Maritime Distress And Safety System (GMDSS Master Plan); GMDSS.1/Circ.13 (23 May 2011). The actual coverage in the polar areas may be limited by such factors as propagation conditions, geographic location, radiated power and time of day.

# USE of ais (automatic identification system) and vde (vhf data exchange)

As noted above, some of the planned and existing satellites will have the capability to receive AIS transmissions. This capability would allow vessels to transmit short, low data rate safety related messages. In the future, use of an AIS transmission capability on these satellites may be an effective means to provide MSI (Maritime Safety Information) to vessels in the Polar areas. It should also be noted that WRC-15 will also consider enhanced AIS technology applications for enhanced maritime radiocommunications.

## USE OF VDE (VHF DATA EXCHANGE)

In the future some of the satellite providers may be capable of transferring VHF through their satellites. If the coverage includes polar areas, satellite VDE may become an efficient tool for enhanced safety to ships operating in these waters.

# Recommended actions

1. IALA recommends that **all ships independent of size, when** operating in polar areas, be provided with radio life-saving appliances, communication equipment and navigation equipment in accordance with SOLAS chapter III and IV and V.
2. IALA proposes the **development** of requirements for efficient, seamless and automated **exchange of digitized information** across all affected parties, including shorebased facilities.
3. IALA proposes and offers its assistance in the development of an implementation strategy and plan to address requirements for enhanced polar communications as outlined.
4. current and FUTURE SATELLITE COMMUNICATIONS SYSTEMS

Following is a non-exhaustive list of current and proposed satellite communications systems that will provide coverage to the polar areas. Note that military satellite systems have not been included.

**Antarctic Broadband Program**

The Antarctic Broadband Program is an Australian demonstration program that will use small-satellite technology to meet the data-transfer needs of the research community operating in the Antarctic area. This program plans to fly nanosatellites in Low Earth Orbit (LEO). At completion, this program plans for 24-hour coverage of the Antarctic Circle, providing over a terabyte of transfer capability per day at speeds comparable to that of ADSL.

**APRIZESAT**

AprizeSat (Argentina) is a constellation of small Low-Earth-Orbit satellites (64 satellites planned) to achieve a global communication system including data transmission and fixed and mobile asset tracking and monitoring (GMPCS). AprizeSat 3 and 4 feature an AIS (Automatic Identification System) receiver to gather position data from ships.

**ARGOS**

Argos is a global satellite-based location and data collection system dedicated to studying and protecting our planet's environment. Today, 6 Polar orbiting satellites flying at an orbit of 850 km allow any mobile object equipped with a compatible transmitter to be located across the world. It also offers the possibility of collecting data from measurement sensors connected to this transmitter.

The Argos system results from Franco-American cooperation involving CNES (French Space Agency), NOAA (National Oceanic and Atmospheric Administration), with support from NASA (National Aeronautics and Space Administration), Eumetsat (European meteorological organization) and soon ISRO ( Indian Space Research Organization)

**ARKTIKA**

Arktika (Russia and Canada) is a constellation of 6 satellites to provide imagery on hydrocarbon deposits, telecommunications and safe air traffic and commercial shipping.

**CASCADE**

Cascade (Canada) is planned to be a high capacity store-and-forward system for large data transfer. The data upload and download transmission speed would be 1.2 Gbps with 7 terabits onboard storage and revisit time every 90 minutes. The system is still in the planning stage with an expected initial operational date in 2016.

**COMM STELLATION**

COMMStellation (Canada) will comprise of 78 microsatellites in low earth orbit and networked with 20 ground stations to provide backhaul capacity. This system would provide internet connectivity to the polar areas.

**EXACTVIEW**

exactView (Canada) is a low Earth orbit communication satellite system that will consist of 8-10 satellites and are all equipped with AIS receivers. The satellite system currently operates 4 satellites in various polar orbiting planes with another 4-5 satellites planned throughout 2014.

**GONETS**

Gonets (Russia) is a low Earth orbit communication satellite system that will consist of 36 satellites in low earth orbit in 6-8 planes. These satellites will operate in a “store and forward” communications mode.

**Iridium NEXT**

Anticipated to begin launching in 2015, Iridium NEXT (USA) will maintain the existing Iridium constellation architecture of 66 cross-linked satellites in low-Earth orbit (LEO) and covering 100 percent of the globe. Iridium NEXT will substantially enhance and extend Iridium mobile communications services, delivering higher data speeds and use of IP technology.

**KOSMONET**

Kosmonet (Russia) will be a system of 48 cross-linked satellites that will provide high speed internet access and communications. This system is focused particularly in the Arctic/polar region. The project will not have a ground infrastructure; everything will be maintained in space.

**M3M SAT**

M3M Sat (Maritime Monitoring and Messaging MicroSatellite) (Canada) is a technology demonstration designed to test and provide operational Automatic Identification System (AIS) detection for the Canadian government. This system will contribute to commercial ship tracking services.

**PCW (Polar Communications and Weather)**

PCW (Canada) is a 2-satellite system in an HEO (Highly elliptical orbit) orbit. This system is designed to provide continuous weather observations of the Arctic Polar Region. It is a broadband communications system with service capabilities that include voice, videoconferencing, IP services for civil and government purposes. This system, once operational may not cover the European area of the Polar cap. The PCW system expects operations to begin around 2016.

**POLARSTAR**

PolarStar (Russia) is a system of satellites in a highly elliptical orbit (HEO) that will provide high speed Internet access, telephony, and TV. This system, once operational may not cover the European area of the Polar cap.

**SYSTEM SUMMARY**

A comparison table listing the systems and some of their characteristics is shown below.

Table 1. System Comparisons

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **SYSTEM** | **AVAILABLITY** | | **CAPABILITIES** | | | | **NOTES** |
|  | ***Now*** | ***Est. Future***  ***Date*** | ***Data*** | ***Voice*** | ***AIS*** |  |  |
| Anartic  Broadband |  | TBD | HDR |  |  |  | Presently a demonstration program |
| ARGOS | **✓** |  |  |  |  |  |  |
| AprizeSat |  | TBD | HDR |  | **✓** |  | Several satellites are in space  SIS will be on the future AprizeSat 3 - 6 |
| Arktika |  | TBD | HDR | **✓** |  |  |  |
| Cascade |  | 2016 | S&F  HDR |  |  |  |  |
| COMM Stellation |  | TBD | HDR |  |  |  |  |
| exactView | **✓** | 2014 | HDR |  | **✓** |  | Covers both Poles |
| Gonets | **✓** |  | S&F |  |  |  |  |
| Iridium | **✓** |  | LDR | **✓** |  |  | Covers both Poles |
| Iridium Next |  | 2015 | LDR | **✓** |  |  | Covers both poles |
| Kosmonet |  | TBD | HDR | **✓** |  |  | Focused at Arctic Polar Region |
| M3M Sat |  | 2013 | LDR |  | **✓** |  | AIS primary focus/LDR secondary |
| PCW |  | 2017 | HDR | **✓** |  |  | Primarily Arctic/ may not cover European area of Polar cap |
| PolarStar |  | 2016 | HDR |  |  |  |  |
|  |  |  |  |  |  |  |  |

LDR = Low Data Rate

HDR = High Data Rate

S&F = Store and Forward

TBD = To Be Determined

ANNEX 2  
Satellite Orbit Definitions

1. **Geostationary Earth Orbit (GEO)**

Geostationary Earth Orbit (GEO) is in a circular orbit 35,786 km (22,236 mi) above the Earth's equator and rotates at the same speed as the earth’s rotation. Because the Geostationary Earth Orbit satellite is over the equator, the typical communications coverage extends from approximately 70 degrees South to 70 degrees North. Depending on geographic location, the satellite coverage may extend further north and south. The only GEO satellites accepted by IMO as meeting the GMDSS requirements is the Inmarsat system.

1. **Geocentric orbit**

Geocentric orbit is an orbit around the Earth and are usually classified by the satellite’s altitude (i.e., Low Earth Orbit (LEO), Medium Earth orbit (MEO) and High Earth orbit (HEO)); the shape of the orbit (e.g., highly elliptical); and the area the orbit crosses (e.g., Polar orbit).

To provide effective, full-time communications over any given area, any LEO or MEO system will requires a constellation of satellites. Some orbits as the Highly Elliptical Orbit (HEO) can be designed so that the satellite covers a region of the earth for a large fraction of its orbital period. For example, two HEO satellites could provide polar coverage.

1. **Polar Coverage**

Two general types of satellite orbits that will provide Polar coverage: A constellation of satellites in low or medium earth orbit with sufficient number of satellites such that a satellite is in view at all times (e.g., Iridium) or a smaller number of satellites in a highly elliptical orbit (e.g., Molniya satellites used by Russia).

**Glossary of Terms**

AIS Automatic Identification System

**DSC Digital Selective Calling**

GEO Geo-stationary Orbit

**Galileo Global Navigation Satellite System (EU)**

**GLONASS Global Navigation Satellite System (Russia)**

**GNSS Global Navigation Satellite System**

**GPS**  **Global Positioning System (USA)**

**HDR High Data Rate**

**HEO Highly Elliptical Orbit**

HF High frequency (3 – 30 MHz)

**HST Hybrid satellite/Terrestrial System**

IGSO Inclined Geosynchronous Orbit

IMO International Maritime Organization

**ISL Inter-Satellite Links**

**LDR Low Data Rate**

LEO Low Earth Orbit

**M3MSAT maritime Monitoring and Messaging Microsatellite**

MEO Medium Earth orbit

**MMS Mobile Satellite Service**

MRCP Maritime Radio Communications Plan

**MSI Maritime Safety Information**

**NTS nano-satellite Tracking of Ships**

**PCW Polar Communications and Weather**

**S & F Store and Forward**

SBAS Satellite Based Augmentation System

**TBD To Be Determined**

**VSAT Very Small Aperture Terminal**