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| IALA Guideline |

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ON THE USE OF [IMPLEMENTATION OF] AUTONOMOUS MARITIME RADIO DEVICES (AMRD) USING AIS TECHNOLOGY

Edition 1.0

Document date

Revisions to this IALA Document are to be noted in the table prior to the issue of a revised document.

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# Background

AIS is an autonomous and continuous broadcast system, operating in the VHF maritime mobile band. AIS can handle multiple reports at rapid update rates and uses Self-Organising Time Division Multiple Access (SOTDMA) technology to meet these high broadcast rates, ensuring reliable and robust operation. AIS is a global system and is used by ship, shore and satellite systems.

AIS allows automatic exchange of shipboard information from the vessel’s sensors, including static and voyage related data, between one vessel and another and between a vessel and a shore station(s). Its principal functions are to facilitate:

* Information exchange between vessels within VHF range of each other, increasing situational awareness.
* Information exchange between a vessel and a shore station, such as a VTS, to improve traffic management in congested waterways.
* Automatic reporting in areas of mandatory and voluntary reporting
* Exchange of safety related information between vessels, and between vessels and shore station(s).

Coastal authorities have noticed a significant increase in the use of non-standard AIS devices on AIS1 and AIS2.

Recognising the proliferation of non-standard AIS devices transmitting on AIS1 and AIS2, the WRC-15 to identified a need to study the issue and developed resolution 362 :

*Maritime radio devices which operate autonomously in the maritime environment, including but not limited to: devices on towed unpowered ships and barges, derelict ships, floating ice and wave-gliders, “man overboard” devices, diver locating, alerting and radiotelephony devices, fishing net marker buoys, oil spill tracking buoys, oceanographic and other drifting buoys.*

Within the Resolution it was further noted that:

*Such autonomous maritime radio devices are operating with automatic identification system (AIS) technology or digital selective calling (DSC) technology, or transmitting synthetic voice messages, or with a combination of those technologies, and have been developed for safety-related purposes, and their number is expected to increase*.

AMRD use a range of technologies and are used for a wide range of applications including the tracking of fishing nets, Unmanned Maritime Systems (UMS) also known as ‘drones’ and Fish Aggregation Devices (FAD) and the tracking of artisanal fishing craft. The technologies used are not limited to AIS, although this recommendation focuses on AMRD that use AIS technology (AIS-AMRD). The term AIS-AMRD is introduced to acknowledge the difference between AMRD that use AIS and AMRD that do not use AIS technology.

An AMRD is a mobile station; operating at sea and transmitting independently of a ship station or a coast station. Two groups of AMRDs are identified (ITU document 5B/411-E November 2017):

* Group A: AMRDs that enhance the safety of navigation,
* Group B: AMRDs that do not enhance the safety of navigation (AMRDs which deliver signals or information which do not concern the vessel can distract or mislead the navigator and degrade the safety of navigation).

AIS-AMRD that are non-compliant to ITU-R M.1371 are the most problematic, causing either random or periodic interference to the primary AIS users, lowering the overall traffic/vessel capacity of the channels and the reliability of the local AIS domain.

There are related definitions to consider:

An AtoN is a device, system or service, external to vessels, designed and operated to enhance safe and efficient navigation of individual vessels and/or vessel traffic. (IALA Dictionary)

A MAtoN shall be defined as a non‐fixed or un‐moored AtoN; but does not include a fixed or moored buoy that is adrift from station, temporary or otherwise. (IALA R1016)

The term “enhance safety of navigation” is derived from the International Convention for the Safety of Life at Sea (SOLAS), as amended. Within SOLAS, Chapter V is titled “Safety of navigation” and contains all relevant regulations. Any signal or information originated by an device, which reaches the navigator, may influence the safety of navigation. This includes AIS (signals should be shown on Radar and eventually also on the electronic display and information system) and VHF (working channels and Ch. 70). In any case the navigator has to decide how to proceed. In a positive case the safety of navigation will be enhanced. The term “safety of navigation” is used in SOLAS and other IMO documents, however there is no definition existing. The regulations listed in SOLAS Chapter V are relevant to achieve safety of navigation.

# INTRODUCTION

## The appeal of AIS frequencies and technology

AIS frequencies were allocated for the primary purpose of safety of navigation. The availability of low cost AIS units and components that enable the design and construction of AMRD has led to the proliferation of AMRD that use both AIS frequencies and components of the AIS protocol. Uses include the tracking of fishing gear and UMS.

For UMS, the appeal of AIS is also based on the combination of cost and usefulness. AIS allows the UMS to report their position not only to their owners, but also to others in the vicinity so they can be aware of their presence and avoid any collisions. Some more advanced UMSs are equipped with an autopilot feature that also uses AIS to assist in navigation through ship traffic. AIS binary message capability allows UMS operators to establish basic communications and monitoring links with the device. These messages can also provide a failover communication mechanism to retrieve the unit in case of failure of the main communications link.

The VHF Data Exchange Systems (VDES), as specified in ITU-R M. 2092, offers alternative modulation schemes, frequencies and mechanisms for maritime data communications in the maritime VHF band. As of 2018 these are not yet in wide spread use.

## The risks of AIS-AMRD for mariners

The proliferation of AIS-AMRD can pose a risk to mariners primarily due to:

1. Overloading of the AIS channels
2. AIS-AMRD appearing as Class B devices
3. AIS-AMRD not meeting the required technical and test specifications
4. Overcrowding navigational displays

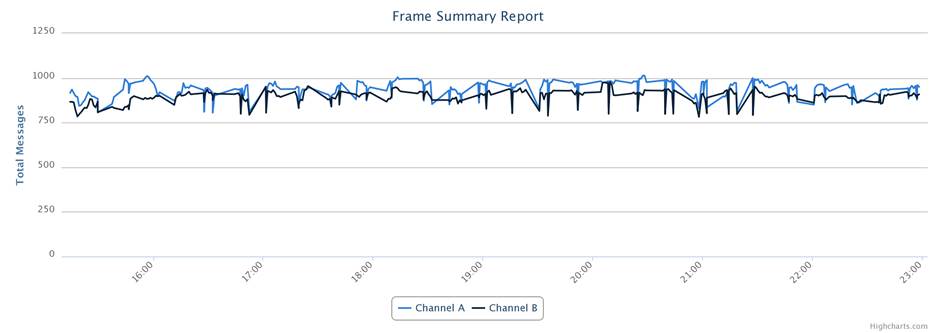
### AIS channel load

The number of devices reporting on AIS frequencies could easily exceed hundreds of units within a ship’s AIS coverage range of approximately 30 nautical miles. This overcrowding of the AIS frequencies reduces the number of slots available for ship position reports. While this will not completely inhibit AIS data transmission, this overcrowding will result in reduced AIS coverage range of the ship.

In this situation, any additional AIS traffic will degrade the navigational safety in the following manner: .

1. The CSTDMA devices may not transmit their position reports at all due to no empty slots being available.
2. The SOTDMA devices reuse occupied slots based on the distance from other AIS devices. This reduces the coverage range.

Figure 1 shows such channel loading statistics for the Victoria and Vancouver region in British Columbia, Canada, which is only considered a moderate AIS traffic area. At the level of channel loading Class-B CS device reporting behaviour is already diminished, and coverage range from a shore side perspective has been reduced compared to a system that is not loaded to the same extent.



1. Channel Loading Statistics Oct. 15, 2017, approaching 50% – Victoria/ Vancouver Canada

### AMRD appearing as Class B devices

AIS-AMRD often use the ITU-R M. 1371 message types 18, 24A and 24B to transmit their dynamic and static navigation data.

These AIS-AMRD are displayed as vessels fitted with Class B devices (see figure 2 and figure 3).

The symbology for maritime centric displays is described in IEC 62288. There is no provision in the maritime symbology lexicon to display AIS-AMRD. This means that any mariner and/or shore side Maritime Information System (MIS) operator is unable differentiate an AIS-AMRD from an AIS vessel. It is difficult to determine the risks posed by AIS-AMRD and the equipment to which they are attached.

### AMRD not meeting technical standards

ITU-R M.1371 provides the technical standard for AIS. In addition, IEC has developed testing standards for the AIS devices identified in ITU-R M.1371 to ensure protection of the radio spectrum used for AIS. Therefore, all devices that use AIS1 and AIS2 shall comply to ITU-R M. 1371.

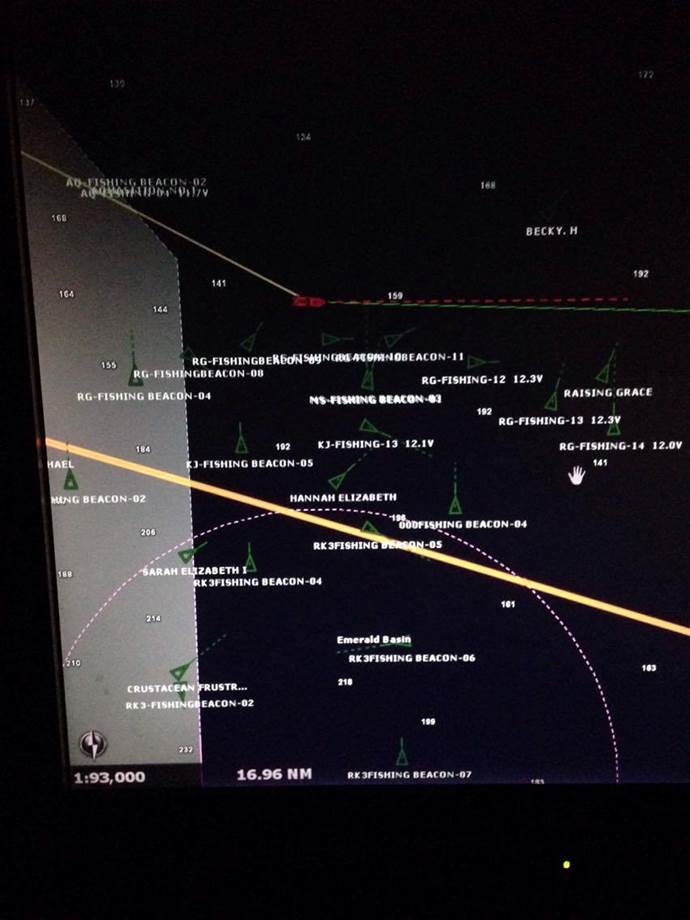
AIS-AMRD are not identified as AIS devices within the standards. AIS-AMRD are using some aspects of the existing standards, but not all. Of concern is the use of the ‘Vessel Name’ parameter to include dynamic information within the ‘Vessel Name’ parameter such as battery voltage and similar parameters (see figure 2).

### Screen over crowing of navigation display

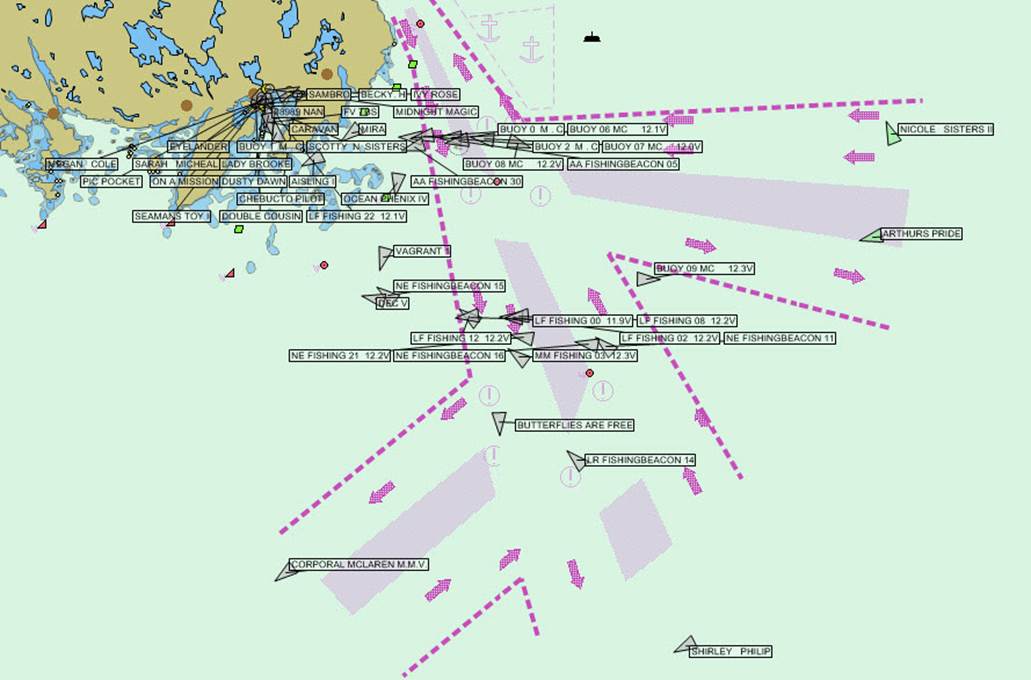
When AIS- AMRD report as AIS AtoNs or AIS Class-B devices, it is difficult to differentiate between AIS-AMRD and AIS AtoN or Class B AIS devices. Where differentiated symbology does not exist, it is difficult to distinguish the difference between AIS-AMRDs of group B (which are not directly linked to safety of navigation) from AMRDs of group A (directly related to safety of navigation). The AMRD information on the ECDIS or other display, although useful to the owner of the AMRD, becomes distracting and results in information overload to other users.

It is important that the mariner and the shore side MIS operator are able to clearly identify important information in the immediate area without spending time analysing irrelevant information, such as AIS-AMRD. Figures 2 and 3 show real-life examples of fishing nets AIS-AMRDs reporting as Class-B vessels and creating overcrowding on the RADAR screen and ECDIS.

This clearly illustrates that AIS-AMRDs create overcrowding and prevents the mariner from quickly identifying potential risks and returning their attention to looking outside the bridge as quickly as possible.



1. RADAR display of Vessels and AIS-AMRDs using the same symbol on AIS frequencies creating screen clutter, Canada



1. ECDIS Display of Vessels and AIS-AMRDs using the same symbol on AIS frequencies creating screen clutter, Canada

The use of AIS frequencies is convenient for the AIS-AMRD users but cannot be removed from mariner’s AIS/ECDIS/RADAR displays without removing all AIS AtoN or AIS Class-B information layer. This is not desirable from a safety perspective and is time consuming for the mariner and shore side MIS operator to individually assess each such report, and/or continually toggle display layers.

## The need for action

Without proper oversight, AIS-AMRD traffic will continue to have an increased impact to the performance, reliability of safety and security aspects of AIS channels. This has a negative impact on the services mandated by the 1974 SOLAS convention, including collision avoidance between moving vessels, avoidance of maritime hazards, and other MIS. In addition, AIS-AMRD have a negative impact on the ability to make effective use of AIS in support of Vessel Traffic Services (VTS).

# Recommendations on the use of AMRDs

When used appropriately, AIS-AMRD has potential for fostering innovation in the maritime domain. There are a number of approaches that can be taken to promote innovation while protecting existing systems such as AIS, including:

1. Operational approaches; recommendations
2. Short term technical approaches;
3. Potential medium and longer-term solutions to be considered

## Operational Approaches

The operational approaches which should be considered in order to mitigate the potential impact of AIS-AMRDs and address the immediate issues caused by AIS-AMRD include:

1. Ensure that all AIS-AMRD installed within the national and/or regional domain meet with the applicable technical and test standards.
2. Publish guidelines to the national and/or regional maritime environment under its control as to the technical standards, use and approval for use of AIS-AMRD within the authority’s domain.
3. Ensure that all AIS-AMRD are issued with and use the correct Maritime Mobile Service Identifier (MMSI) as detailed in the applicable technical standards and recommendations.
4. Implement a regulatory regime to manage the implementation of AIS-AMRD, and train appropriate persons to enforce the regime.

## Short term Technical Approaches

The list below offers some short-term technical approaches that should be considered to mitigate the potential impact of AIS-AMRDs and address the immediate issues caused by AIS-AMRDs.

1. Allow the use of message type 21 for AIS-AMRD (AIS AtoN). The AIS AtoN transponder can be of type 1, 2 or 3 depending on requirements. This allows an AtoN layer that can be deactivated from the mariner’s display, reducing the risk of confusion. Message 21 offers up to 34 characters for the name of the AtoN which will allow pertinent information to be available to mariners on the AMRDs.
2. Ensure the name of AIS-AMRD AtoN contained in message 21 commences with the word “DEVICE” followed by a space and then the type of device and the owner, name of ship or its acronym. For example, for an AIS-AMRD of type fishing net locator, owned by [Agency], the name of the AtoN contained in message 21 should be “DEVICE FISHING NET [Agency]” (23 characters).
3. Use a static name for AIS-AMRDs identification in message 21. Never use a name that would be dynamic in nature (such as voltage level of the battery) or other measurements that would cause the name of the device to change on a Mariner’s ECS or ECDIS.
4. AIS-AMRD should use binary messages on AIS 1 for transferring of telemetry data.
5. Use type of AtoN “0” (Default, Type of AtoN not specified) in message 21.
6. Always set their Virtual AtoN flag to report as a real AtoN (set to “0”).
7. Limit AIS-AMRDs reporting rate to once every 6 minutes or longer.
8. Limit AIS-AMRDs to position reports on AIS1 only. This ensures that AIS 2 is left unencumbered from the load of these devices while still maintaining compatibility with existing AIS transponders until migration off AIS frequencies.
9. Assign AIS-AMRD MMSIs in accordance with Recommendation ITU-R M.585-7, Annex 1, Section 4:
   1. The responsible administration should assign a nine-digit unique number in the format 9192M3I4D5X6X7X8X9 where the digits 3, 4 and 5 represent the MID and X is any figure from 0 to 9. The MID represents the administration having jurisdiction over the call identity for the navigational aid.
   2. The administration may use the sixth digit to differentiate between certain specific uses of the MMSI, as shown in the example applications below:
      1. 99MID1XXX Physical AIS AtoN
      2. 99MID6XXX Virtual AIS AtoN
   3. Noting that as per document SC.3/WP.3 No. 16 (2016), Working Party on the Standardization of Technical and Safety Requirements in Inland Navigation, Forty-eighth session, Geneva, 17–19 February 2016:
      1. It is proposed to determine the following MMSI format for AIS AtoN in inland waterways on which Code Européen des Voies de Navigation Intérieure (CEVNI) is applied:
         1. 99MID2XXX for physical AIS AtoN in inland waterways;
         2. 99MID7XXX for virtual AIS AtoN in inland waterways.
   4. Noting that MMSI 999 999 999 (and potentially 999 999 XXX for vessels in close proximity to each other) is used for identifying military vessels.

## Potential medium and long term technical considerations

IALA have developed a technical specification ITU-R M. 2092-0. VDES provides the maritime environment with a digital communications platform that offers increased data capacity than does the AIS technology.

# DEFINITIONS

[The definitions of terms used in this IALA Guideline can be found in the International Dictionary of Marine Aids to Navigation (IALA Dictionary) at <http://www.iala-aism.org/wiki/dictionary> and were checked as correct at the time of going to print. Where conflict arises, the IALA Dictionary should be considered as the authoritative source of definitions used in IALA documents.]

[Carry out the review / confirm any need to add new definitions to IALA Dictionary…]

# ACRONYMS

IMO International Maritime Organization (Acronym style)

[TBD]

# REFERENCES

References to include:

ITU related

IMO related

IALA related -

1. …. (Reference style)
2. ….
3. [if required]