IALA GUIDELINE

G1111-4
PRODUCING REQUIREMENTS FOR AIS

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DOCUMENT REVISION

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

Date	Details	Approval
December 2022	First issue. Major revision of Guideline G1111 sections, divided into sub-guidelines G1111-1 to G1111-9. Document revisions include previous section document structure realignment and verification of currency and accuracy of the content.	Council 76

CONTENTS

1. INTRODUCTION

This Guideline presents a common source of information to assist vessel traffic services (VTS) providers in the understanding of Automatic Identification System (AIS) supporting the design of an AIS service and its contribution to the VTS traffic image (situational awareness), as well as guidance on how the VTS provider should specify the associated functional and performance requirements.

1.1. THE IALA G1111 GUIDELINE SERIES

This Guideline is one of the G1111 series of guideline documents. The purpose of the G1111 series is to assist the VTS Provider in preparing the definition, specification, establishment, operation, and upgrades of a VTS system. The documents address the relationship between the operational requirements and VTS system performance (technical) requirements and how these reflect into system design and sub system requirements.

The G1111 series of guideline documents present system design, sensors, communications, processing, and acceptance, without inferring priority. The guideline documents are numbered and titled as follows:

- G1111 Establishing Functional & Performance Requirements for VTS Systems and Equipment
- G1111-1 Producing Requirements for the Core VTS System
- G1111-2 Producing Requirements for Voice Communications
- G1111-3 Producing Requirements for RADAR
- G1111-4 Producing Requirements for AIS
- G1111-5 Producing Requirements for Environment Monitoring Systems
- G1111-6 Producing Requirements for Electro Optical Systems
- G1111-7 Producing Requirements for Radio Direction Finders
- G1111-8 Producing Requirements for Long Range Sensors
- G1111-9 Framework for Acceptance of VTS Systems and Equipment

2. OPERATIONAL OVERVIEW

This Guideline considers application of AIS to VTS areas of responsibility. These areas may vary in the types of risks, vessels and their interactions as well as the required sensor ranges.

Automatic Identification System (AIS) are a sensor system that supports VTS and SAR operation by indicating the position of a vessel.

The necessary Functional and Performance requirements may differ throughout the geographical area of VTS responsibility and as such they should align to the risks being mitigated and to facilitate VTS operations:

- Features of VTS area, such as extent of area of responsibility and availability and distribution of Aids to Navigation.
- Radio environment such as noise floor, presence of other transmitters.

3. PRODUCING FUNCTIONAL AND PERFORMANCE REQUIREMENTS

The requirements should be based on the high level approach described in IALA Guideline *G1150 Establishing, Planning and Implementing VTS* [1]. This concluded that the feasibility study on risk should specify the risks within the interested area and the means to address or mitigate such risks.

3.1. AREA OF COVERAGE

The AIS coverage area needs to be consistent with the results of risk assessment and possible VTS responsibilities for SAR. Factors affecting the detection performance of AIS systems, including potential interference and propagation characteristics, should be taken into account as well as other sensors.

3.2. OBJECTIVE OF AIS

The objectives of AIS in VTS are:

- Automatically receive information from AIS-equipped vessels, including the ship's identity, ship type, position, course and speed over ground, navigational status and other safety-related information
- Monitor and track AIS-equipped vessels
- Exchange data with AIS-equipped vessels
- Support value added functions over the AIS infrastructure
- Manage AIS-based Aids to Navigation (including virtual and synthetic AtoN)
- Provision of vessel identification and location information to the VTS traffic image
- Provision of vessel manoeuvring and voyage related data to the VTS
- Provision of facilities to enable transmission of information between the VTS and the mariner

3.3. PHYSICAL IMPLEMENTATION OF VTS AIS

3.3.1. EQUIPMENT

The physical equipment options for a VTS Authority are as follows:

- AIS base station
- AIS limited base station
- AIS receiver
- AIS repeater
- AIS Marine Aid to Navigation (AtoN)

In all cases, careful consideration should be given as to whether the information is sufficient to support the required VTS operator (VTSO) tasks.

An AIS repeater may be used to extend the AIS coverage area of a VTS system.

AIS can be an integral part of an Aid to Navigation such that the AtoN position and other AtoN-related data can be transmitted over the AIS network and received by ships.

3.3.2. AIS LICENSING AND SITING

An AIS base station will need to be licensed by the appropriate national Radio Communications or Broadcast Authority in most countries. The licensing process will also determine any restrictions regarding the siting of the AIS base stations and their aerials. Potential AIS base station sites are determined based upon a cellular mapping of all base station sites (See section 7 of IALA Recommendation *R0124 The AIS Service (A-124*) [2]). AIS Cells are 30NM x 30NM square with a limit of two (2) base stations to each cell. One of the AIS base stations within a cell is configured to transmit its Fixed Access TDMA (FATDMA) information on one of the AIS VHF frequencies and the other base station is configured to transmit its FATDMA information on the other AIS VHF frequency. However, if an adjacent cell has less than 2 base stations (this can include a cell that is adjacent and inland), then additional base stations can be included by borrowing the allocation from the adjacent cell. The cell size also means that AIS VHF aerials should not be positioned higher than approximately 35m above sea level.

The limit of two base stations per cell is to ensure that the number of FATDMA slots is not excessive in any one geographic area. AIS base stations can transmit their own position so that the port appears on the ECDIS display of incoming vessels. However, the position transmission is repeated in a fixed slot on every AIS net cycle and, therefore, it consumes a fixed amount of the AIS bandwidth. If there are too many timeslots allocated for FATDMA, it reduces the availability of TDMA slots which are used by the AIS transponders on-board vessels for their normal position and ID transmissions.

It should also be noted that if the base station does not need to transmit its own position and, therefore, does not use FATDMA, then the number of base stations per cell can be increased.

Every AIS base station has a MMSI (Maritime Mobile Service Identity). Where a VTS system has multiple AIS base stations to cover a large VTS Area, each base station can be given the same virtual MMSI so that the whole VTS system appears with a single identity. The MMSI will normally be issued by the appropriate national Radio Communications or Maritime Authority when licensing the use of AIS frequencies.

3.4. OPERATIONAL REQUIREMENTS

AIS may provide timely, relevant and accurate information to VTSOs to support the compilation of the VTS traffic display. It provides automatic vessel position reports and movement information as it is received at base station sites. Where radar is installed as part of the VTS sensor suite, the AIS information should be correlated with the radar target data to ensure that each vessel within the VTS area is represented by a single track on the VTS traffic display. AIS also provides supporting information about the ship and its current voyage that may be integrated with other port operations.

The provision of information from the VTS to the mariner and vice versa is supported by AIS through the use of short text messaging and the global and regional binary messages within the AIS protocol.

3.5. FUNCTIONAL REQUIREMENTS

3.5.1. SUPPORT TO THE VTS TRAFFIC IMAGE

3.5.1.1. Target tracking

The Automatic Identification System (AIS) provides identification and position to enable the VTSO to monitor and track vessels within the VTS Area. AIS transmissions consist of bursts of digital data “packets” from individual stations, according to a pre-determined time sequence. AIS data consists of shipboard information such as position, time, course over ground (COG), speed over ground (SOG) and heading.

The AIS position reporting rate is dynamic and will change, depending on the speed of the reporting vessel and whether the vessel is manoeuvring or not. For a class-A transponder, the nominal position reporting rate is once every 10 seconds. For a high-speed and/or manoeuvring vessel, this rate may increase up to once every 2 seconds. Conversely, for a vessel, moored or at anchor, the position report rate may drop to once every 3 minutes.

Although the standard position reporting intervals are normally sufficient, an AIS Base station may be used to temporarily increase the position report rate of targets of interest. AIS may enhance situational awareness for the VTSO by improving the detection of vessels that are obscured from line of sight associated with other sensors. As a cooperative means of identification and detection, the AIS element of a VTS will receive data from any vessel that is equipped with a transponder even in severe sea and rain clutter conditions.

3.5.1.2. Marine Aids to Navigation

AIS Marine Aids to Navigation (AtoN) (including real and virtual AtoN) will be presented to the VTSO through the traffic image.

3.5.1.3. Voyage-related data

AIS provides facilities for mariners to enter details of their voyage, ETA and cargo etc. This static data is part of the standard AIS transmissions at six minute intervals or on request. The static data may be received by the VTS system and can be used to support Voyage traffic management information system (VTMIS) applications such a port information management database. Note, however, that, due to the absence of any commonly agreed procedure to update this data, it may not be present, be outdated or simply incorrect.

3.5.2. INFORMATION EXCHANGE BETWEEN VTS AND MARINER

3.5.2.1. Text messaging

A VTS Authority could use AIS to send free-format text messages to a vessel at sea. Such messages are intended to be for safety-related purposes. When received, AIS text messages will appear on the Minimum Keyboard Display (MKD) of the on board AIS system and could also be displayed on other systems such as ECS/ECDIS. Note, however, that AIS text messages are not a replacement for voice communication; a VTSO should not assume that AIS text messages were received and read on-board.

AIS text messages can be addressed either to a specified destination (MMSI) or broadcast to all ships in the area. The content should be relevant to the safety of navigation, e.g., an iceberg sighted or a buoy not on station. Such messages are limited to a maximum of 156 characters for an addressed message and 161 characters for a broadcast message. Although unregulated, AIS messages should be kept as short as possible (preferable less than 48 characters for an addressed message and less than 53 characters for a broadcast message).

3.5.2.2. Binary messaging

In addition, AIS has facilities for sending and receiving binary messages (there are four types of binary messages within the AIS protocol) and these can be used for supporting and 'value added' applications. Binary messages are specified as "global" or "regional", where the global messages are in accordance with reference [3] and the regional messages may be defined by appropriate authorities (see references [4] and [5] for further details).

The AIS infrastructure and protocol provides facilities to enable application developers to produce new functionality and capability though the use of the binary messaging features. All such developments and message sets should be consistent with the purpose of AIS in respect to enhancing safety of life at sea.

It should be noted that the approval of the appropriate national authority may be required for the use of the AIS VHF data link for a supporting application. One example of a supporting application is the transmission of specific hydrographical data.

It is recommended that national authorities should monitor and coordinate the use of binary messaging within their area of responsibility to ensure that the necessary facilities for ship reporting via the VHF data Link (VDL) are not compromised.

3.5.2.3. Marine Aids to Navigation

AIS base stations, as part of a VTS System, can be configured to broadcast synthetic and/or virtual Marine Aids to Navigation (AtoN). See definitions detailed in *IALA Recommendation R0126 Use of AIS in Marine Aids to Navigation Services [6]*.

AIS may be integrated with a physical AtoN for monitoring and control purposes and, also, in such a way that other data sources, hosted on the AtoN, can be managed through the main VTS Traffic Display. A physical AIS AtoN could be configured to transmit further virtual or synthetic AtoN.

3.5.3. ASSIGNED MODE

VTS may use the AIS Service capability to change the reporting mode (from autonomous to assigned mode, for example) of selected shipboard AIS units. This will enable the ship station to operate according to a specific transmission schedule, as determined by the VTS Authority.

3.6. SPECIFIC DESIGN, CONFIGURATION, INSTALLATION AND MAINTENANCE CONSIDERATIONS

3.6.1. INTERFERENCE

AIS may be susceptible to interference from adjacent channels. When siting AIS base stations, due consideration should be given to frequency allocations adjacent to AIS channels to avoid possible service disruption.

3.6.2. COVERAGE ASPECTS

In general, AIS design coverage ranges should approximate VHF voice communication ranges. However, actual vessel traffic density or geographic considerations (i.e., mountains or other VHF occlusions) may determine the need for additional base stations.

When estimating the size of the operational coverage (operational cell) for shore facilities, an important consideration is the traffic load – number of mobile AIS stations within the area.

For example, calculations in one port have indicated that an AIS base station could accommodate less than 300 active AIS units.

For further information refer to Reference [2].

Where the VTS Area extends beyond the coverage of a single AIS base station, the recommended approach is to extend the VTS Network with additional base stations or to connect to a separate AIS network, such that the required coverage is achieved. Where it is not possible to extend the VTS network, AIS repeaters could be used.

A repeater provides a simple means of extending the AIS coverage, however, at a cost of halving the capacity of the system! For this reason, AIS repeaters are not recommended for use in areas of high traffic density.

3.6.3. AIS OVERLOAD CONDITIONS.

With the growth of the number of vessels, equipped with AIS, and the available bandwidth of AIS, there are more and more areas where AIS reception is degraded due to overload conditions. Possible consequences include decreased effective reporting rates of vessels, causing problems for data fusing, and Class-B transponders cannot report due to lack of time slots.

This may lead to a stale or incomplete vessel traffic image without notification to the VTSO, and vessels may not see each other when reliant on the use of Class-B transponders, especially in areas where there is limited or no radar coverage.

3.6.4. DATA INTEGRITY

AIS position information is, in principle, obtained through GNSS. There is a possibility of GNSS-sourced positional data being corrupted due to (satellite) equipment faults and intentional or unintentional interference (of the satellite-originated signals). Where possible, safeguards should be considered within the VTS system to assess the integrity of positional data when two or more sources of such data are available. Note, that corruption of position data may result from an incorrect time stamp.

3.6.5. INSTALLATION AND MAINTENANCE

VTS is a shore based operation and as such it should use AIS physical equipment intended for on-shore use. VTS should therefore not use the physical (mobile Class A or Class B) transponder equipment intended for installation on a vessel.

The outdoor installations for AIS systems should be specified taking the considerations in Section 1 into account. This should also consider maintenance access, lightning protection and wind load on antennas. The build-up of ice in some climates should also be a consideration.

The AIS base station equipment should be housed indoors and in a controlled environment, as would be used for other IT network components. AIS base stations are typically 19-inch rack mountable and therefore all network and power connections will normally reside within the 19-inch equipment rack. Installation should therefore be simple and uncomplicated. For remote sites, where access may take more than one or two hours, the concept of a duplicated / hot standby configuration should be considered.

Standard maintenance procedures should apply to the base station and network connectivity. However, for the outdoor aerial equipment, regular checks should be made to ensure that the aerials, and cable runs to the aerials, are not damaged.

4. DEFINITIONS

The definitions of terms used in this Guideline can be found in the *International Dictionary of Marine Aids to Navigation* (IALA 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.

5. REFERENCES

[1] IALA. Guideline G1150 Establishing, Planning and Implementing VTS.

[2] IALA. Recommendation R0124 The AIS Service.

[3] IMO. SN.1/Circ.289 - Guidance on the Use of AIS Application Specific Messages.

[4] IALA. Binary message register - Collection of regional applications for AIS application Specific Messages of regional applications for AIS Binary Messages.

[5] IALA. Recommendation R0144 Harmonised Implementation of Application-Specific Messages.

[6] IALA. Recommendation R0126 Use of AIS in Marine Aids to Navigation Services.