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| IALA Guideline |

DraFT G1111-4

Producing Requirements for AUTOMATIC IDENTIFICATION SYSTEMS (AIS) AND VHF DATA EXCHANGE SYSTEMS (VDES)

Functionality and Performance Specifications

Working paper, output from VTS 51

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

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|  | Edition 1.0  This document originates from IALA Guideline G1111 (ed 2015), which has been redeveloped as the G1111 series of guidelines concerning establishing functional & performance requirements for VTS Systems. Document revisions include document structure realignment and verification of currency and accuracy of the content. |  |
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|  |  |  |
|  |  |  |
|  |  |  |

1. INTRODUCTION 4

2. DEFINITIONS 5

3. References 5

4. Abbreviations 5

5. Operational Overview 6

6. Producing Functional and Performance requirements 7

7. Specific Design, Configuration, Installation and Maintenance Considerations 9

List of Tables

List of Figures

# INTRODUCTION

This Guideline presents a common source of information to assist VTS authorities in the understanding of AIS and VDES functionality and performance, supporting the design of AIS and VDES services and their contribution to the VTS traffic image (situational awareness) as well as guidance of how the VTS Authority should specify the associated functional and performance requirements.

The guideline considers the potential application of AIS and VDES in support of VTS services, which can include but are not necessarily limited to considerations relative to any of the maritime service portfolios as defined by the IMO e-Navigation Strategic Implementation Plan (SIP) (NCSR1/28/Annex 7).

Specific maritime security requirements possibly identified by the International Ship and Port Security code and other requirements from allied services may introduce additional challenges.

## 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 authority 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
* 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 and VDES**
* 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

# DEFINITIONS

## General Terms

For general terms used throughout this section refer to references [1] and [10].

## Definitions

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

# References

1. IALA Recommendation A‐124 ‐ On the AIS Service.
2. IALA Binary message register ‐ Collection of regional applications for AIS application Specific Messages of regional applications for AIS Binary Messages (http://www.iala‐aism.org/iala/files/newitems3.php).
3. IALA Guideline 1028 ‐ On the Universal Automatic Identification System (AIS).
4. IALA Recommendation V‐125 ‐ The use and presentation of symbology at a VTS Centre.
5. IALA Recommendation A.126 ‐ Use of AIS in Marine Aids to Navigation Services.
6. IALA Recommendation e‐NAV144 – On Harmonised Implementation of Application‐Specific Messages.
7. IMO SN.1/Circ.289 ‐ Guidance on the Use of AIS Application Specific Messages.
8. ITU‐R M.1371‐ Technical characteristics for an automatic identification system using time‐division multiple access in the VHF maritime mobile band.
9. IEC 62320 ‐ Maritime navigation and radiocommunication equipment and systems – Automatic identification system (AIS) – Part 1: AIS Base Stations – Minimum operational and performance requirements, methods of testing and required test results.
10. IALA Guideline 1117 – VHF Data Exchange System (VDES) Overview

# Abbreviations

Refer to IALA *G.1111 Establishing Functional and Performance Requirements for VTS systems* for an extensive list of abbreviations and acronyms covering the entire G1111 series.

# Operational Overview

This guideline considers application of AIS and VDES for VTS areas of responsibility and associated VTS duties. These areas and duties vary in the types of risks, vessels and their interactions, the required sensor ranges, and the types of services provided by the VTS provider.

**AIS (Automatic Identification System)**

AIS operates within the marine VHF band and has the same limitations as VHF communication. Secondly, an AIS reported position is primarily based on GNSS‐sourced positional data with associated capabilities and constraints.

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.

**VDES (VHF Data Exchange System)**

VDES also operates within and shares the marine VHF band of frequencies. With its increased data transmission capabilities, VDES is seen as an effective and efficient use of radio spectrum, building on the capabilities of AIS and addressing the increasing requirements for digital data transmission.

The VDES concept was originally proposed to address emerging indications of overload of the VHF Data Link (VDL) of AIS and simultaneously enable a wider, seamless data exchange for e-navigation, potentially supporting the modernization of GMDSS. As the purpose of e-navigation is to enhance berth-to-berth navigation and related services for safety and security at sea and protection of the marine environment, VTS providers may consider including VDES as a component within a VTS system to support the digital exchange of an expanded variety of information between both vessels and VTS providers and between vessels within and external to VTS areas.

The full system concept is described in IALA Guideline 1117, *VHF Data Exchange System.*

## Operational Requirements

AIS may provide timely, relevant and accurate information to VTS personnel 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.

VTS Authorities could consider recommending Class‐A devices for non‐SOLAS vessels that participate in VTS or provide support for VTS operations.

VDES is a technology that builds upon and supplements AIS communications, and as such may be used for not only VTS services, but also for other data communication including, but not limited to, Search and Rescue (SAR), Maritime Safety Information (MSI), and Ship Reporting. When available, the VDES satellite component (VDE-SAT) may be an effective means to extend the VDES to areas outside of coastal VHF coverage, and will provide a communication channel that is complementary to GMDSS and the terrestrial components of the VDES system.

The decision to implement VDES may include the following considerations:

* AIS system load;
* Services to be provided;
* Existing equipment (for existing sites);
* Antenna requirements, including interaction with other services;
* Power requirements; and
* Installation costs

The necessary functional and performance requirements may differ throughout the VTS service area. As such, setting the functional and performance requirements should be conducted precisely for each area to make sure the navigational risks are mitigated and VTS Operators can provide services smoothly.

The VTS Authority should identify the Operational Requirements that may impact the functional and performance Requirements of the AIS and VDES components within the VTS system.

These Operational Requirements result from:

* risk assessment and need analysis
* the identified operational areas within the area of interest
* the types of vessels operating within the area of interest
* the services intended to be provided by the VTS

# Producing Functional and Performance requirements

Producing functional and performance requirements for AIS and VDES systems is an interactive task involving iterations, including evaluation of achievable performance versus overall system cost.

The VDES Presentation Interface (PI) remains largely the same as the AIS PI but will include several new IEC 61162-1 messages to allow for the configuration of the VDES capability and facilitate the transfer of larger amounts of data.

The primary differences between AIS and the two new VDES technologies, ASM and VDE, are:

1. The Modulation and Coding Scheme (MCS).

2. The Radio Frequencies (RF) used the Radio Frequency bandwidth.

3. The data bandwidth.

## 4. The methods used by the Link Layer.Support to the VTS Traffic Image

### 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 maneuvering or not. For a class‐A transponder, the nominal position reporting rate is once every 10 seconds. For a high‐speed and/or maneuvering 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.

### Aids to Navigation

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

### 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 6 minute intervals or on request. The static data may be received by the VTS system and can be used to support VTMIS applications such a Port Information Management databases. 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.

## Information Exchange Between VTS and Mariner

### 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).

### Binary Messaging

In addition, AIS has facilities for sending and receiving binary messages (there are 4 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 [7] and the regional messages may be defined by appropriate authorities (see references [2] and [6] 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.

### Aids to Navigation

AIS base stations, as part of a VTS System, can be configured to broadcast synthetic and/or virtual aids to Navigation (AtoN). See definitions detailed in IALA Recommendation A.126 [5].

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.

## 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.

# Specific Design, Configuration, Installation and Maintenance Considerations

## 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.

## 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 [1].

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.

## 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.

## 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.

## 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 1 or 2 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.