Document Revisions

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

International Association of Marine Aids to Navigation and Lighthouse Authorities

20ter, rue Schnapper

78100 Saint Germain en Laye, France

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

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

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**On**

**an Overview of AIS**

**Edition 1**

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An overview of AIS

# Introduction

The issue of correlating a ship’s identity and its position in coastal waters and port approaches has been frustrating shore authorities for some time. It has long been realised that an automatic reporting device fitted to vessels would contribute greatly to the safety of navigation and traffic management by exchanging information such as identity, position, time, course and speed between ship and shore regularly, automatically and autonomously.

Vessel Traffic Services (VTS) and ports had a requirement for clear and unambiguous identification of vessels within their area, while the ability to provide such information ship-ship was identified as a benefit for safety of navigation and collision avoidance.

Separately, the maritime community was developing the technology and rules for a VHF radio system which would enable ships to automatically communicate data with each other for the purpose of safe and efficient navigation. This was the Universal Automatic Identification System, now just known as AIS.

It quickly became clear to shore authorities that AIS also had the potential to support a wide range of maritime regulatory and traffic monitoring activities and assist with maritime security.

## Scope

This guideline provides an introduction to AIS at an overview level. It does not include technical details; rather it references relevant documentation where further information can be found.

Further information on AIS documentation is provided at Annex E and is available on the IALA website.[[1]](#footnote-1)

## What is AIS?

AIS is a communications system based on a protocol using the VHF maritime mobile band, for the exchange of navigation data. There are numerous AIS devices, known as stations, which use this protocol to communicate. AIS uses an open protocol and is not intended for secure communications.

These AIS stations are designed to operate without interaction by ship or shore personnel (autonomous and continuous) and can include ship stations, shore side base stations, AIS on aids to navigation and AIS for search and rescue purposes. There is a capability for interaction by ship or shore personnel for short safety related text messaging.

Stations may also be polled (interrogation) or commanded to transmit in a different manner – for example more frequently, or on a different frequency (assignment).

AIS enables the automatic exchange of shipboard information from the vessel’s sensors (dynamic data), as well as manually entered static and voyage related data[[2]](#footnote-2), between one vessel and another and between a vessel and a shore station(s).

AIS devices are required internationally on most commercial vessels as identified by the International Maritime Organization (IMO) in the Safety of Life at Sea Convention (SOLAS), Chapter V. In addition, AIS is often required domestically on other vessels by some administrations.

The principal functions of AIS 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).

The development of AIS has expanded to include devices such as AIS for aids to navigation, AIS on search and rescue aircraft and AIS search and rescue transmitters[[3]](#footnote-3) (AIS SART). Further explanation of the different AIS stations is included in section 3.

## Purpose of AIS

The AIS improves the safety of navigation and protection of the environment by assisting in the effective navigation of ships and the operation of VTS, by satisfying the following functional requirements*[[4]](#footnote-4)*:

*.l in a ship-to-ship mode for collision avoidance;*

*.2 as a means for littoral States to obtain information about a ship and its cargo; and*

*.3 as a VTS tool, i.e. ship-to-shore (traffic management).*

AIS provides for increased situational awareness which enables effective response to emergencies such as search and rescue (SAR) as well as environmental pollution. Additionally, AIS can provide data to identify trends or improvements to the provision of services to enhance navigational safety.

### AIS and radar

AIS differs from radar in the respect that AIS uses an absolute external referencing system (EPFS) to determine position, whereas radar determines it’s position by relative measurements from the vessel or shore base to observed targets.

AIS supplements radar information through the automatic provision of:

* vessel identification, heading, course over ground (COG) and speed over ground (SOG);
* Improved vessel tracking (no target swap);
* Wider geographical coverage,
* Greater positional accuracy, dependent on the position input sensor;
* information in radar shadow area ('sees' around bends and behind islands);
* Near real time manoeuvring data;
* No loss of targets in sea, rain, and snow clutter.

It is important to be aware that not all ships are required to carry AIS and that it is permissible for the AIS to be switched off if the master believes that the continual operation of AIS might compromise the safety or security of his/her ship, or if security incidents are imminent.*[[5]](#footnote-5)*

If a vessel operating in a mandatory ship reporting systems does switch off its AIS, this should be reported to the competent authority.

It should be noted that some data is entered or updated manually and so there is potential for incorrect entry and for the entered data to become out of date. This includes data related to static information (e.g. ship identity, dimension) and voyage related data (e.g. navigational status).

## Development of AIS

AIS developed through the cooperative efforts of a number of different international organisations, including the IMO, the International Telecommunication Union (ITU), the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) and the International Electrotechnical Commission (IEC).

The development of AIS occurred after recognition of the need for a universal vessel tracking solution which could be interoperable and used world-wide to address VTS and ship reporting requirements.

A time-line which highlights the key elements in the development of AIS is included in ANNEX A.

### SOLAS Requirement

The AIS has been mandated as a shipboard carriage requirement for vessels under the revised Chapter V of the International Convention for the Safety of Life at Sea, 1974 (as amended) (SOLAS 74) section 19.2.4. The initial time line for carriage of AIS was amended at the diplomatic conference on Security in 2002, where the time frame for vessels constructed before 1 July 2002 was brought forward with completion by 31 December 2004. This meant that, while ships were able to be fitted with AIS by the date identified, the overall system was not yet developed and work continues as the versatility of AIS begins to be fully understood. As stated in SOLAS Chapter V, Regulation 19:

*2.4 All ships of 300 gross tonnage and upwards engaged on international voyages and cargo ships of 500 gross tonnage and upwards not engaged on international voyages and passenger ships irrespective of size shall be fitted with an automatic identification system (AIS), as follows:*

*.1 ships constructed on or after 1 July 2002;*

*.2 ships engaged on international voyages constructed before 1 July 2002:*

*.2.1 in the case of passenger ships, not later than 1 July 2003;*

*.2.2 in the case of tankers, not later than the first survey for safety equipment on or after 1 July 2003;*

*.2.3 in the case of ships, other than passenger ships and tankers, of 50,000 gross tonnage and upwards, not later than 1 July 2004;*

*.2.4 in the case of ships, other than passenger ships and tankers, of 300 gross tonnage and upwards but less than 50,000 gross tonnage, not later than the first safety equipment survey after 1 July 2004 or by 31 December 2004, whichever occurs earlier; and*

*.3 ships not engaged on international voyages constructed before 1 July 2002, not later than 1 July 2008.*

*.4 The Administration may exempt ships from the application of the requirements of this paragraph when such ships will be taken permanently out of service within two years after the implementation date specified in subparagraphs .2 and .3.*

*.5 AIS shall:*

*.1 provide automatically to appropriately equipped shore stations, other ships and aircraft information, including the ship's identity, type, position, course, speed, navigational status and other safety-related information;*

*.2 receive automatically such information from similarly fitted ships;*

*.3 monitor and track ships; and*

*.4 exchange data with shore-based facilities.*

*.6 The requirements of paragraph 2.4.5 shall not be applied to cases where international agreements, rules or standards provide for the protection of navigational information; and*

*.7 AIS shall be operated taking into account the guidelines adopted by the Organization.*

*Ships fitted with AIS shall maintain AIS in operation at all times except where international agreements, rules or standards provide for the protection of navigational information.*

Administrations also have scope under SOLAS V/1.4 to determine to what extent the provisions of the regulation will apply for:

*.1* *ships below 150 gross tonnage engaged on any voyages;*

*.2 ships below 500 gross tonnage not engaged on international voyages; and*

*.3 fishing vessels.*

Some Administrations have implemented, or are considering implementing, AIS requirements for other categories of vessels, including recreational craft.

AIS references are included in ANNEX E.

# How does it operate

AIS devices are very similar to mobile smart phones, in that both have the capability to do instant messaging either from phone to phone or to a group. How they differ is that in AIS devices instant messages are specifically-defined, autonomously generated and continuously sent at scheduled times (reporting rate) or when data changes. AIS, like many mobile phones, rely upon what is known as a time-division multiple access (TDMA) communications protocol. Which means the frequency (data link) used is divided into time defined slots which can only hold a set amount (packets) of data. The primary methods by which AIS devices access the link are:

1. Self-Organised (SOTDMA) is the basic access method for mobile stations. Stations plan their transmissions based on information collected from other stations. AIS stations using SOTDMA also pre-announce their own planned transmissions, so that other AIS stations are able to take their slot use into account when planning transmissions.
2. Random Access (RATDMA) is used by AIS stations to access the link for unscheduled transmissions.
3. Fixed Access (FATDMA) is used by AIS stations that have a requirement to transmit data at predetermined intervals, and involves the reservation of particular slots for their exclusive use.
4. Carrier Sense (CSTDMA) – known as ‘polite’ behaviour is used by some mobile stations which can access the link only when they find an unused slot.

Land mobile networks rely upon communication towers, often referred to as ‘cellular towers’ because their area of coverage is called a ‘cell’. When you experience a ‘dropped’ call on your mobile phone it is usually because you are outside the cell (coverage area) or because the cell has too many other users. What makes AIS unique and very different from a mobile phone network is the ability to ‘self-organise’. Simply, each AIS station is its own cell tower so its cell, or coverage area, moves with it. This is possible because the network is continuously self-organizing around the user, thus reducing the likelihood of ‘dropped call’ (undelivered AIS messages).

## Protocol for data transmission (language / sentences)

As indicated, AIS uses TDMA protocols. This is the ‘language’ used to communicate amongst stations using pre-defined messages (sentences) which are exchanged amongst users via two designated VHF frequencies[[6]](#footnote-6). The ensemble defined by the protocols, the frequencies and the messages is called the VHF data link (VDL). The VDL is similar to an internet email service where international compatibility is assured by a strict protocol, whatever the content of the message might be.

### Timing

As would be expected, proper time-division in TDMA is a critical part of the protocol and ultimate success of each transmission.

For AIS each minute of time (known as the ‘frame’) on each designated frequency is divided into 2250 slots, giving a total of 4500 for the two frequencies. Each frame of 2250 slots is repeated every minute. In order to ensure this is properly done, each and every AIS station is outfitted with a Global Navigation Satellite System (GNSS – such as a Global Positioning System (GPS) receiver which is relied upon for uniform precise timing. If GPS timing is lost, synchronisation is provided from other mobile units or AIS Base Stations.

## VHF data link

AIS stations transmit messages according to a defined access scheme on the VDL. These messages are sent via either of the two AIS frequencies - AIS 1 or AIS 2 – which are accurately synchronised using GNSS time information. If the GNSS timing information is not available, the system can operate using a secondary timing mechanism.

The AIS has been designed for short range, VHF coverage, normally referred to as ‘line of sight’. Shore based AIS base stations typically have high antenna positions and increased coverage area which may result in higher loading and possible data packet collisions. This may result in lost messages for the AIS base station, however the data would continue to be transmitted and received by the other AIS stations.

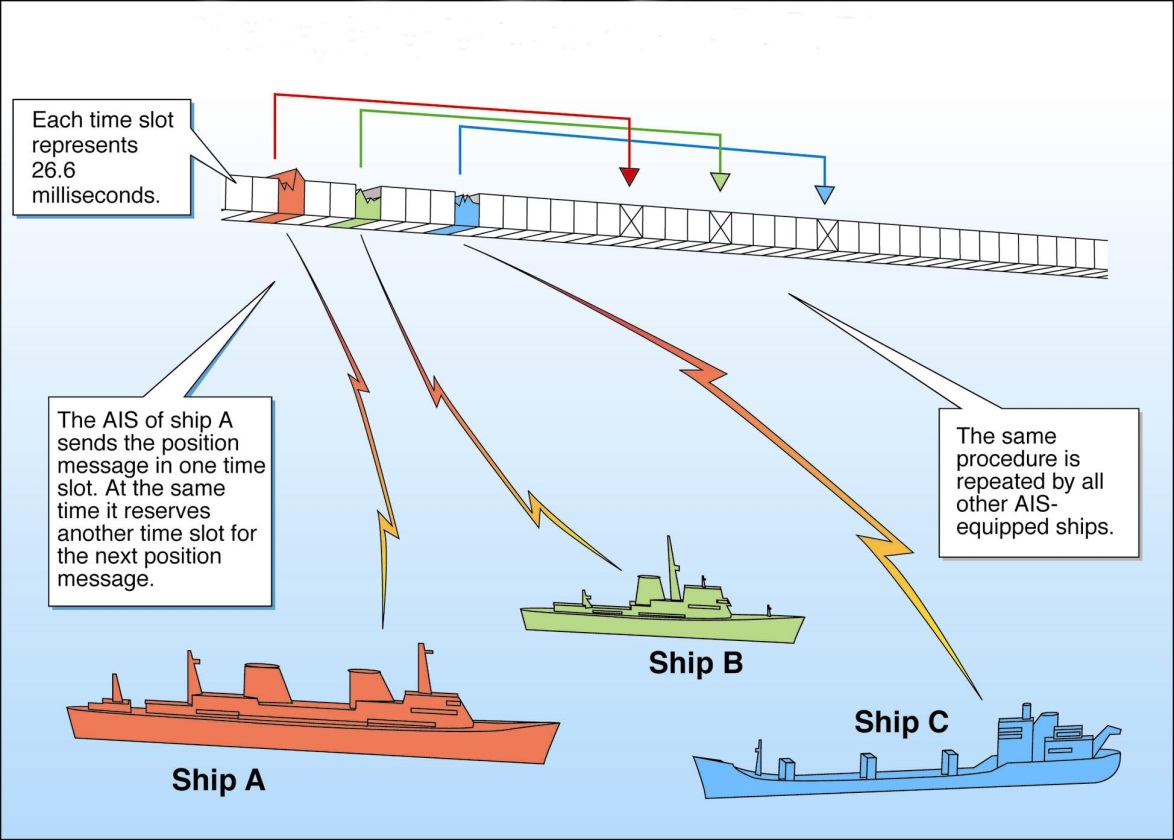
Although most AIS messages only use one (1) slot, some can occupy up to five (5) consecutive time slots. The greater the number of slots used by a message, the greater the potential for data packet collisions.

Administrations should organise the usage of the VDL by appropriate FATDMA[[7]](#footnote-7) reservations and consider the total load on the VDL before introducing additional services which rely on AIS.

The information exchanged via the VDL is safety related. The usage of the VDL should be monitored and controlled to safeguard its proper function and avoid overloading. IMO has highlighted this need in IMO Resolution MSC. 140(76):

*‘Administrations should take steps necessary to ensure the integrity of the radio channels used for AIS in their waters.’*

Even though there are potentially some scenarios in which data collisions may occur, the AIS is quite robust, and has been designed to work at high VDL loading.



1. Protocol for AIS data transmission

## Process for Data exchange

In addition to TDMA (which AIS uses to exchange information over VHF radio), AIS stations also use internationally adopted maritime digital interfaces and data sentences (IEC 61162 / NMEA-183 / IEC 62320) to exchange data amongst other devices, systems or networks. This facilitates the display and use of AIS information on board the vessel (e.g. on radar, ECDIS, chart-plotters) and ashore (e.g. VTS systems) which enables the use of AIS to meet specific needs (perform a service).

## Display of AIS data

AIS data can be displayed in different ways. SOLAS ships must carry a Minimum Keyboard and Display (MKD) which displays received AIS data in alphanumeric form.

On vessels with more capable displays than the MKD, the manner in which it is displayed depends on the type of data. AIS ship dynamic data is typically displayed as an icon on radar or ENC, see Figure 2. Safety messages are displayed as alphanumerics. Meteorological and hydrological data can be displayed in alphanumeric and / or in a graphical manner. AIS AtoN messages will be displayed as icons.

There are standards for the display of the target on a shipborne navigational display,[[8]](#footnote-8) but not for the display of any additional information. In this manner the symbol for the ship (isosceles triangle) will be common to all displays, but the presentation of the information available from the target (static, dynamic and voyage related) will not be. This is true for the display of other AIS stations. There is no standard for the display of AIS data on shore based display systems such as VTS.



1. Display of AIS

Since AIS operates on VHF it can see targets that are not visible on radar.

## AIS Service

The AIS can be considered a maritime safety-related information service. The purpose of the AIS Service is to allow its clients to interface with the different AIS stations that can be used by mariners or maritime administrations on the VHF Data Link (VDL).

The AIS service provides a functional interface for its clients to access the available data from AIS stations. The purpose of this interface is to:

* facilitate the integration of the information from AIS into other applications;
* isolate the client from the technical details of the AIS technology and the way the AIS Service has been configured and implemented;
* allow for a simple point of control of what AIS data is shared with each client.

## Messages

The data exchange using AIS is based on well-defined messages, occupying between one (1) and five (5) consecutive time slots and are listed in Table 1 below. The majority of the messages are concerned with the transfer of navigational information, however some messages are application specific or have system management functions, and are specifically described in the sections below.

### Standard messages

The standard messages used by AIS are given in the table below. These messages are approved by ITU for use by AIS. For further details see ITU-R M 1371.

1. Standard AIS messages

| Message ID | Name | Description |
| --- | --- | --- |
| 1 | Position report | Scheduled position report |
| 2 | Position report | Assigned scheduled position report; |
| 3 | Position report | Special position report, response to interrogation; (Class A shipborne mobile equipment) |
| 4 | Base station report | Position, UTC, date and current slot number of base station |
| 5 | Static and voyage related data | Scheduled static and voyage related vessel data report; (Class A shipborne mobile equipment) |
| 6 | Binary addressed message | Binary data for addressed communication |
| 7 | Binary acknowledgement | Acknowledgement of received addressed binary data |
| 8 | Binary broadcast message | Binary data for broadcast communication |
| 9 | Standard SAR aircraft position report | Position report for airborne stations involved in SAR operations, only |
| 10 | UTC / date inquiry | Request UTC and date |
| 11 | UTC / date response | Current UTC and date if available |
| 12 | Addressed safety related message | Safety related data for addressed communication |
| 13 | Safety related acknowledgement | Acknowledgement of received addressed safety related message |
| 14 | Safety related broadcast message | Safety related data for broadcast communication |
| 15 | Interrogation | Request for a specific message type (can result in multiple responses from one or several stations) |
| 16 | Assignment mode command | Assignment of a specific report behaviour by competent authority using a base station |
| 17 | DGNSS broadcast binary message | DGNSS corrections provided by a base station |
| 18 | Standard Class B equipment position report | Standard position report for Class B shipborne mobile equipment to be used instead of Messages 1, 2, 3 |
| 19 | Extended Class B equipment position report | Extended position report for class B shipborne mobile equipment; contains additional static information(8) |
| 20 | Data link management message | Reserve slots for base station(s) |
| 21 | Aids-to-navigation report | Position and status report for aids-to-navigation |
| 22 | Channel management | Management of channels and transceiver modes by a base station |
| 23 | Group assignment command | Assignment of a specific report behaviour by competent authority using a base station to a specific group of mobiles |
| 24 | Static data report | Additional data assigned to an MMSI  Part A: Name  Part B: Static Data |
| 25 | Single slot binary message | Short unscheduled binary data transmission (Broadcast or addressed) |
| 26 | Multiple slot binary message with Communi­cations State | Scheduled binary data transmission (Broadcast or addressed) |
| 27 | Long-range AIS broadcast message | Scheduled position report designed for satellite detection;  (Class A shipborne mobile station) |

### Application-Specific Messages

Messages 6, 8, 25 and 26 provide a structure which can accommodate data suited for a specific application (e.g. meteorological and hydrological data, notifying of dangerous cargo, identifying a zone or a route, indicating pilotage requirements, etc.).

In addition to the message number, these applications are identified using a numbering system based on a unique three digit code known as the ‘Designated Area Code’ (DAC) and a two digit ‘Function Identifier’ (FI). This coding allows the correct use of the message if the necessary application software is available. These messages are similar to applications on a mobile phone.

DAC 001, FI 00-09 identify international messages for technical purposes defined by ITU-R M.1371. DAC 001, FI 10-63 identify international messages defined and adopted by IMO, as described in SN.1/Circ. 289.

DAC 010-999 identify regional functional messages, which may also be designated and adopted for use by administrations. Administrations are encouraged to register regional functional messages with IALA, who maintain the registry accessible from their website[[9]](#footnote-9).

Prior to developing a regional functional message, administrations should verify if a message with identical content is already on the registry (in use). These messages may be used outside the region, but the ‘ownership’ and control of the messages belong to the administration responsible for AIS in the area indicated by the DAC. Administrations are encouraged to use existing messages as appropriate with their registered DAC and FI. However, any changes to the content of an existing message would require a change to the DAC and FI and should be registered with IALA.

### Management messages

Management messages are used to control the behaviour of AIS stations and the use of the VDL. This functionality is performed solely by AIS base stations which should be controlled by a Competent Authority.

#### UTC and date inquiry (msg. 10) / response (msg. 11)

Stations may request / provide universal time coordinated information as needed.

#### Interrogation (msg. 15)

AIS stations may poll or interrogate other stations to request information other than UTC and date.

#### Assignment command (msg. 16)

Assignments are used by base stations to control the reporting interval of a mobile station. Message 16 will define both the slot and the increment for a given mobile station.

#### DGNSS broadcast (msg. 17)

This message may be transmitted by a base station which is connected to a DGNSS reference source, and configured to provide DGNSS data to other stations. Use of message 17 will correct the internal AIS GNSS. The system has not been designed to interface to the vessel’s GNSS (external to the AIS GNSS). The transmission of the differential broadcast can provide for more accurate positioning information where the AIS unit has an internal GNSS. In addition, the DGNSS reference source will warn the mariner and authorities about failures in the GNSS signal.

#### Data link management (msg. 20)

This message can be used by base stations to pre-announce the fixed allocation schedule (FATDMA) for one or more base stations and should be repeated as often as required. This message is used to reserve slots for a base station, or other fixed stations, to use. The mobile units will not use these slots. It is important to refresh the reservation of these slots, within the timeout period provided within the message, so that mobile units that are planning transmissions in future frames do not see the slots as available and new mobiles to the area receive the reservations in a timely manner. In addition, it is also important that slot reservation is coordinated so that the VDL remains available for the primary purpose of AIS, collision avoidance.[[10]](#footnote-10)

#### Channel management (msg. 22)

Channel management provides the ability to ‘require’ ships within a defined area to transmit and receive AIS on frequencies other than the two international AIS frequencies (AIS1, AIS2).

This can be accomplished by sending a channel management message on the existing AIS frequencies or on DSC channel 70. The alternate channel(s) chosen must be free from other VHF traffic.

This channel management can be used where the existing AIS frequencies are not available for use, if there is interference on existing AIS frequencies or in areas of high activity on the VDL.

Channel management must be effectively coordinated with adjoining stations to ensure that situational awareness in the transition zones is not lost.[[11]](#footnote-11).

#### Group assignment (msg. 23)

Group Assignment provides the ability to ‘require’ ships within a defined area and criteria to change their operating mode. The Group Assignment Command is transmitted by a base station when operating as a controlling entity. This command can be applied to a mobile station within the defined region and as selected by a mobile’s ‘Ship and Cargo Type’ or by ‘Station type’. The following operating parameters of a mobile station may be commanded using this message:

* transmit/ receive mode;
* reporting interval;
* the duration of a quiet time.

# AIS Stations

AIS is not solely used on board ship and can be grouped by ‘class’ (shipborne) and function. Shipborne AIS devices, which contribute the most to the flow of AIS information, are classified as either Class A or B. There are, however, other types of AIS stations that provide pertinent information or are used to manage AIS data. See Table 2.

1. Overview of AIS stations

|  |  |
| --- | --- |
| AIS Station | Description of AIS Station |
| AIS Class A[[12]](#footnote-12) | Class A stations are shipborne units which meet and are required on most commercial ships by the International Maritime Organisation (IMO). |
| AIS Class B | Class B stations are also shipborne units which are mainly compatible and very similar with AIS Class A but do not meet IMO technical or carriage requirements – primarily because they differ in power output and reporting rate. This Class has two variants based on the access scheme used: Carrier-Sense and Self-Organizing. |
| AIS base station | Base stations are designed for use by Competent authorities to manage the VDL and enable effective ship to shore / shore to ship transmission of information. They are the core of any AIS Service and can be networked to provide broad VTS or Coastal Surveillance coverage and overall maritime domain awareness. |
| AIS aids to navigation (AtoN) | AIS AtoN stations extend the visual or audible range of a traditional aid and provide current position or status; or they can provide ‘aid’ where a tradition aid does not yet exist, known as a virtual AtoN. |
| AIS SART | Radar Search and Rescue Transponders (Radar SART) are part of the Global Maritime Distress and Safety System (GMDSS). AIS Search and Rescue Transmitters (AIS SART) can now be used in lieu of Radar SART. AIS SART provide much greater range than Radar SART. |
| AIS on Search and Rescue (SAR) Aircraft | AIS provides for a unique message intended for use by Search and Rescue Aircraft and to assist others in a SAR operation. |



1. AIS Stations

An indication of the data broadcast by each AIS station is provided in ANNEX C.

## Mobile

### Shipborne

In recognition of the different types of AIS stations, allowance has been made in the AIS Technical Standards (ITU-R M.1371) for both Class A and Class B Ship-borne Mobile Equipment. Class A equipment complies with the IMO AIS performance standards. While the Class B are compatible with Class A, they are not fully compliant with IMO requirements and report less frequently than Class A.

#### Class A

The shipborne AIS units rely on inputs from the ship’s GNSS equipment (i.e. GPS), the heading device and rate of turn indicator. The requirement to feed this information in AIS is identified in SOLAS (e.g. SOLAS V/19.2.5 requires a gyro compass, or other means to determine and display heading, is provided as input into AIS equipment).

Shipborne AIS units are also required to provide a number of interfaces to allow for integration of received information with a variety of onboard navigation equipment, including a minimum keyboard and display (MKD). This MKD is the mandated display tool for AIS Class A and provides for a minimum of three lines of data consisting of bearing, range and the name of a selected ship.

When the AIS Class A is installed, important static[[13]](#footnote-13) ship-related information is entered into the AIS memory unit; this includes identity (i.e. name, call sign, MMSI), length and beam, type of ship and the location of the position-fixing antenna. Subsequent changes to this data require password access.

#### Class B

Class B shipborne AIS stations are mainly compatible with other AIS stations, but do not meet IMO carriage requirements. There can be two different variants of Class B stations, with different access methods (self-organizing TDMA and carrier-sense TDMA). Class B shipborne AIS stations are typically installed on non-SOLAS work craft and pleasure craft.

Class B units are not user configurable. Because of this, the units must be configured by the manufacturer or their representative (sales person) prior to use.

There is no requirement from IMO for carriage, installation or display of AIS Class B, however there are national requirements in some countries.

1. Comparison table – AIS Class A and AIS Class B CSTDMA

| Shipboard AIS Comparison | Class A (SOLAS compliant) | Class B/CS |
| --- | --- | --- |
| Transmit Power | 12.5 watts (nominal) /  1watt[[14]](#footnote-14) (low-power) | 2 watts |
| Major Communication Access Scheme | Self-organizing (SOTDMA) | Carrier-sense (CSTDMA) polite to Class A’s |
| Position Source and external inputs | External GNSS, heading, rate of turn indication required; AIS internal GNSS | AIS internal GNSS; heading optional |
| Display / digital interfaces | Minimum keyboard display (MKD); multiple input-output ports and single output | Optional |
| Safety text messaging | Receive and transmit | Transmit optional, and only preconfigured. |

### AIS SART

A Search and rescue transponder (SART) is used in the final stages of the execution of a search to respond to the ‘locating’ element of the Global Maritime Distress and Safety System (GMDSS). An AIS SART is capable of transmitting messages that indicate the position (Msg 1) and safety information (Msg 14) of a unit in distress and is compatible with existing AIS installations[[15]](#footnote-15). The station will transmit a safety related text message, containing ‘ACTIVE SART’ during an emergency and ‘SART TEST’ when under test.

### AIS on SAR aircraft

AIS can be fitted to aircraft to support search and rescue and safety of navigation. The position report for AIS on SAR aircraft includes information on altitude.

## Fixed AIS stations

Fixed AIS stations refer shore stations or AIS aid to navigation stations on lighthouses or other fixed locations.

### AIS Base Stations

The AIS base station is a device that provides the physical link to the VHF data link. The base station requires a controlling system to take advantage of the benefits of AIS and manage the VDL.

### AIS Repeaters

AIS repeaters can be used to extend the range of other AIS stations. The repeater must be within the range (often referred to as the footprint) of the other station to enable consistent repeat capability.

### AIS Aid to Navigation

An AIS unit can be fitted to an aid to navigation (AtoN) to provide positive identification, position and status of the AtoN. AIS AtoN may be fixed (i.e. attached to a lighthouse) or floating (i.e. attached to a buoy).

AtoN AIS messages may be broadcast from an AtoN itself, or may be broadcast from another AIS unit (e.g. an AIS base station). When it is generated from another AIS station it is either a synthetic or a virtual AtoN.

* A synthetic AIS AtoN is an AtoN that physically exists at the position given in the message;
* A virtual AIS AtoN is an AtoN that does not physically exist at the position provided in the message.

An AIS AtoN station may transmit a Safety Related Message (e.g. AtoN is out of position or malfunctioning) and will also repeat any AIS SART message received. In addition, the stations can work in a chaining environment to extend the range of AIS.[[16]](#footnote-16)

## AIS Station Reporting Rate

AIS stations report at set rates, as indicated in the following tables. Table 4 provides reporting rates for AIS Class A. Table 5 provides reporting rates for other AIS stations.

A new message 27 has been developed to respond to the use of satellite detection of AIS. This message has a reporting interval of 6 minutes.

AIS SART transmissions occur in a burst of 8 messages in one minute.

In addition to the standard reporting frequency, the opportunity is available to poll vessels for updated information. A Competent Authority may use a base station to require mobile AIS devices to report more frequently.

1. Class A Ship-Borne Mobile Equipment Reporting Intervals

|  |  |
| --- | --- |
| **Ship's Dynamic Conditions** | **Nominal Reporting Interval** |
| Ship at anchor or moored or not moving faster than 3 knots | 3 minutes |
| Ship at anchor or moored or moving faster than 3 knots | 10 seconds |
| Ship 0-14 knots | 10 seconds |
| Ship 0-14 knots and changing course | 31/3 seconds |
| Ship 14-23 knots | 6 seconds |
| Ship 14-23 knots and changing course | 2 seconds |
| Ship > 23 knots | 2 seconds |
| Ship > 23 knots and changing course | 2 seconds |

1. Reporting intervals – other than Class A equipment

|  |  |
| --- | --- |
| **Platform Conditions** | **Nominal Reporting Interval** |
| Class B ‘SO’ moving < 2 knots | 3 minutes |
| Class B ‘SO’ moving 2-14 knots | 30 seconds |
| Class B ‘SO’ moving 14-23 knots | 15 seconds |
| Class B ‘SO’ moving >23 knots | 5 seconds |
| Class B ‘CS’ moving < 2 knots | 3 minutes |
| Class B ‘CS’ moving >2 knots | 30 seconds |
| Search and rescue aircraft (airborne mobile equipment) | 10 seconds |
| Aids to navigation | 3 minutes |
| AIS base station | 10 seconds |

# Basic AIS Service

The purpose and functions of the AIS can be expressed in terms of services provided to the recipient. The most fundamental ‘services’ of the AIS are called ‘Basic AIS Services’. The concept of ‘services’ make use of the information and features of the different AIS stations through the data transmitted over the VDL.

An AIS service can assist Administrations in meeting other IMO obligations such as providing a traffic image to assist VTS and addressing reporting requirements for traffic management schemes and ship reporting systems. It can assist in other shore-based safety-related services, including providing information to assist in the execution of a SAR operation. This AIS service consists of information delivery between ships and shore and vice versa.

Shore infrastructure for AIS normally includes a network connecting the different sources and users of AIS data within the area of responsibility of an Administration. The infrastructure can be as simple as a single AIS base station, with a way to display the data from the base station and a means to control / make use of the tools available in AIS (such as the messaging capability). The infrastructure can be thought of as a series of ‘layers’ that build up to provide control of the overall shore infrastructure. These layers include:

1. The Physical Shore Station (PSS) layer – consisting of one or more fixed AIS stations. (note – the PSS includes not only the actual AIS base station, but also all the connections, antenna, etc. required for the base station to actually operate).
2. The Logical Shore Station (LSS) layer – software that takes the AIS data from one or more PSS and delivers it, in a useable format, to the users of the AIS service. The LSS does not need to be co-located with the base station (the PSS).
3. The AIS Service Management (ASM) layer – the top layer of the system, where the system can be controlled. The ASM links to each base station, or group of base stations (PSS) through the software system (LSS) and controls the shore based AIS system. There is, however, a need to ensure reliable data transportation means between all association physical AIS shore stations.

The implementation of IALA guidelines for shore based AIS services allows for the creation of national, regional and international networks (e.g. Helcom, IALA-Net).

## Coverage considerations

AIS is designed to optimise close quarters ship to ship communications. When the VDL becomes congested ships should still be able to receive messages from those ships with the strongest signal (usually those ships that are in close proximity). Depending on the received coverage, shore stations may not necessarily receive messages from the strongest signal as some of these messages may actually collide with other messages.

When determining coverage area for AIS, shore authorities should take into account:

* traffic congestion;
* antenna design;
* antenna height and distance from the theoretical monitoring area;
* required availability for the application (e.g. VTS, coastal surveillance, traffic statistic analysis).

## AIS network

AIS data can be transferred over a fully transparent data transportation network (e.g. the internet). This process does not comprise any AIS-specific technology and can be integrated within an existing network.

## Redundancy

With increased reliance on reception of AIS data to support VTS, search and rescue and other uses, comes a need for high availability and reliability. This can be achieved through redundancy of system components.

# Use of AIS by IALA members

AIS can be an effective tool for use by shore authorities to assist in aids to navigation provision and planning as well as the transmission of application specific messages.

In determining the requirement for, and the most effective use of, AIS there is a need to ensure the integrity of the VHF data link to continue to meet the application of AIS for safety of navigation as well as security[[17]](#footnote-17). There is a requirement to monitor activity on the VDL and, if required, put in place measures to ensure that the messaging aspect of AIS is used effectively.

AIS can be an effective tool to assist aids to navigation authorities in a number of areas, as identified in the IALA Guideline 1050 on the management and monitoring of AIS information. For example, AIS can be used to:

* Display traffic on electronic navigational chart and radar display;
* Provide information to VTS centres;
* Monitor shipping routes including mandatory and recommended routes;
* Enable trend analysis of AIS data (number and sizes of different types of ships; use of routeing measures);
* Provide data for risk analysis;
* Provide data for long term planning;
* Provide data for marine accident investigation;
* Improve the effectiveness and efficiency of planning, management and maintenance of waterways including the provision of Aids-to-Navigation.

Additional information on the use of AIS by Authorities is provided in the latest edition of the following IALA documents:

* VTS Manual;
* Recommendation V-128 on operational and technical performance requirements for VTS (annex 3 – AIS);
* Recommendation A-126 on the use of AIS in marine aids to navigation services;
* Recommendation O-143 on virtual aids to navigation;
* Guideline 1062 on the establishment of AIS as an aid to navigation;
* Guideline 1081 on virtual aids to navigation.

# Future Developments

AIS is a versatile tool and, as experience is gained in the implementation and use of the various AIS stations, enhancements and other uses are being identified.

## e-Navigation

e-Navigation is an International Maritime Organization (IMO) led concept based on the harmonisation of marine navigation information and supporting shore services driven by user needs.

e-Navigation is currently defined as:

*e-Navigation is the harmonised 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.*

IMO is working together with IALA to facilitate the e-Navigation concept for the mariner and the authorities. In this IALA is recommending future developments for AIS and other areas.

## Satellite AIS

Recently, there has been a lot of promising developments for enhanced methods of detecting AIS by satellite. Satellite AIS can extend coverage globally, including ocean and remote coastal areas.

Satellite AIS is capable of receiving shipborne AIS today on existing frequencies. However, since these frequencies are shared with fixed and mobile stations, its ability to do so is affected by the very wide footprint of the satellite and the number of stations (fixed and mobile) within the footprint. The expanding use of the different AIS stations will require Msg 27 and new protected frequencies[[18]](#footnote-18) for more effective satellite detection of AIS. This is currently being pursued at ITU.

## Second Generation AIS

There is a vision for a future second generation AIS to also efficiently handle new applications as well as low volume data communications for e-Navigation. Considerations of this so called ‘AIS (V2.0)’ have started at IALA. Although they are still in the visionary or forming phase, some important features have been identified.

While the ‘AIS (V2.0)’ will have new and improved features for both the shipboard and the shore-side, the most important operational features are described in terms of a future AIS (V2.0) mobile station: building on the core functionalities of the present AIS shipboard mobile Class A station, and improving several technical features in detail, such as messaging capabilities and improved frequency channel agility.

The goal is for ‘AIS (V2.0) to be implemented at a harmonised, integrated and generally improved operational presentation interface, currently envisaged as another result of IMO’s e-Navigation concept.

## AIS in GMDSS

Although all AIS Class A devices have an integrated dedicated Digital Selective Calling receiver and, in initial devices, had the ability to transmit DSC telecommands, they do not have the full functionality of a DSC radio that is part of GMDSS. This may change in the future as IMO contemplates GMDSS modernisation. Until then, IMO has published guidance on the use of AIS Class A devices for distress purposes (IMO COMSAR.1/Circ. 46).

IMO has recognised AIS Search and Rescue Transmitters (SART) as being part of GMDSS and allow their use in lieu of Radar SART.

1. Time-line of the development of AIS

The following provides a chronological overview of the development of AIS from initial international discussions to implementation of the IMO SOLAS carriage requirements. AIS continues to evolve.

|  |  |
| --- | --- |
| Sept. 1994 | IMO, 40th session of the safety of navigation committee (NAV40) - UK reported successful results of trials of a VHF DSC-based system and proposed that, to enhance the implementation of mandatory reporting systems and to assist in collision avoidance, ships should be fitted with an automatic identification transponder. NAV agreed to develop functional and operational requirements, as well as performance standards, and invited members to submit proposals to NAV41. |
| Sept. 1995 | NAV41 - Various proposals submitted including the VHF DSC by the UK; UHF and Satcom for long-range (France), VHF DSC gateways (USA) and a ‘blended’ approach using DSC, VHF and Inmarsat C for long range by Finland and Sweden. DSC was identified as a common factor, and was favoured for the overall implementation. The proposal by Finland and Sweden garnered interest, and IALA was invited to study the system with a view to developing standards to forward to ITU-R. |
| July 1996 | The requirements for short and long-range systems were recognised. The Automatic Identification System (or AIS) was discussed and two designs were under consideration. VHF DSC was considered the most suitable for VTS requirements, but the concept of the system was growing, and VHF DSC was not considered the most suitable ship/ship collision avoidance, which would require an automatic broadcast system (as opposed to the concept of transponders which ‘squawk’ when requested to do so). The WG considered that a 2-step approach would enable early implementation of VHF/DSC, with later introduction of a system with more functionality when available. A liaison statement to ITU included 3 possible solutions: 2-Channel VHF Broadcast; 1200-baud gateway from DSC Ch 20; or UHF (using existing documentation in ITU-R M.825 – Characteristics of a transponder system using digital selective calling techniques for use with vessel traffic services and ship to ship identification. (dated 1992 with latest update 1998.)  The Finnish/Swedish proposal at that time, to use SOTDMA (Self-organising time division management access) was subject to patents, which raised some concerns over license fees. |
| December 1996 | IMO Maritime Safety Committee (MSC67) - considered proposals for early implementation of VHF DSC, and for the VHF and Broadcast system being developed in tandem. However, after considerable debate, the 2-step approach was eventually abandoned in favour of a single, universal AIS to meet all requirements, and this was referred to NAV43. |
| July 1997 | NAV43 - carriage requirements were discussed and performance standards agreed. During discussions in the Technical Working Group (WG) the debate on technology intensified. It was agreed between delegations that they would not oppose the current ITU-R characteristics for a transponder system using VHF DSC (the ITU-R M.825-2).  However, at the request of Germany, Finland, South Africa, Sweden and the USA, IALA undertook to host a meeting to discuss and agree on a common approach for the technical characteristics. It was at this meeting that all involved agreed on the 4S system, using SOTDMA.  ITU World Radiocommunication Conference allocates two AIS VHF Channels. |
| 1998 | MSC 74 – IMO adopted the performance standards in Resolution MSC.74(69) and includes the AIS within Draft SOLAS Chapter V, Regulation 19 with time-line for carriage requirements.  ITU adopts the AIS Technical Characteristics ITU-R M.1371. |
| 2001 | IEC approves AIS Test Performance Standard 61993-2.  IALA publishes the IALA Technical Clarifications of Recommendation ITU-R M. 1371-1. |
| 2002 | IALA publishes IALA Guidelines on AIS, Version 1.0.  IMO carriage requirement for AIS commences from 01 July 2002, with a phased in approach. |

1. Table of AIS stations with message type
2. AIS stations and the status of the messages as per ITU-R M.1371

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Class A** | **Class B ‘SO’  See note** | **Class B**  **‘CS’** | **AtoN Type 1** | **AtoN Type 2** | **AtoN Type 3** | **Base Station** | **Repeater** | **SART** | **SAR Aircraft** | **Limited Base Station** |
| **Message** |  |  |  |  |  |  |  |  |  |  |  |
| **1** | T/R |  | R\* |  |  |  |  |  | T | R |  |
| **2** | T/R |  | R\* |  |  |  |  |  |  | R |  |
| **3** | T/R/I |  | /R\* |  |  |  | I |  |  | R/I |  |
| **4** | R/I |  | R\* |  |  |  | T/I |  |  | I |  |
| **5** | T/I |  | R\* |  |  |  | I |  |  | T/R/I |  |
| **6** | T/R |  |  | T | T | T | T/R |  |  |  | T/R |
| **7** | T/R |  |  |  |  | T | T/R |  |  |  | T/R |
| **8** | T/R |  | R\* | T | T | T | T |  |  |  | T |
| **9** | R/I |  | R\* |  |  |  | I |  |  | T/R/I |  |
| **10** | T |  |  |  |  |  | R |  |  |  |  |
| **11** | T/R |  | R\* |  |  |  |  |  |  |  |  |
| **12** | T/R |  | R\* | T | T | T | T/R |  |  |  | T/R |
| **13** | T/R |  | T\* |  |  | T | T/R |  |  |  | T/R |
| **14** | T/R |  | T\*/R\* | T | T | T | T |  | T |  | T |
| **15** | R |  | R |  |  |  | T |  |  |  |  |
| **16** | R |  |  |  |  |  | T |  |  |  |  |
| **17** | R |  | R\* |  |  |  | T |  |  |  |  |
| **18** | R/I |  | T/R\* |  |  |  | I |  |  | I |  |
| **19** | R/I |  | T/R\* |  |  |  | I |  |  | I |  |
| **20** | R |  | R |  |  |  | T/R |  |  |  |  |
| **21** | R/I |  | R\* | T | T | T | T/I |  |  |  |  |
| **22** | R |  | R |  |  |  | T |  |  |  |  |
| **23** | R |  | R |  |  |  | T |  |  |  |  |
| **24** | T/R/I |  | R\*/T |  |  |  | I |  |  | T/I | T |
| **25** | T/R |  | R\* | T | T | T |  |  |  |  |  |
| **26** | T/R |  |  |  |  |  |  |  |  |  |  |
| **27** | T |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
| **Notes** |  |  |  |  |  |  |  |  |  |  |  |
| T | Transmits this message type. | | | |  |  |  |  |  | | |
| R | Receives and processes this message.  Type | | | | |  |  |  |  |  |  |
| I | Capability to make interrogation to other AIS stations. | | | | | | |  |  |  |  |
| \* | CS Class B standard IEC 62287 does not require a display unit, therefore the optional aspect indicated refers to functionality visible for the user. | | | | | | | | | |  |
| Note | SO Class B IEC standard is still to be developed. | | | | | | | | | |  |

1. Data Broadcast by AIS station type
2. Data broadcast by AIS station type

| **EXACT DATA BROADCASTED VIA AIS BY STATION TYPE (Messages Used)**  Note: Not all data may be portrayed on shipboard or shore-side display systems | | Class A (1,5) | Class B/SO (18,19, 24B) | Class B/CS (18,24A,24B) | Base Station (4,24A) | AIS SART (1) | SAR A/C (9,5) | AtoN (21) |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PARAMETER NAME** | **DESCRIPTION & FORMAT** |  |  |  |  |  |  |  |
| User ID | MMSI Number | X | X | X | X | X | X | X |
| Longitude | Longitude in 1/10 000 min (180º, East = positive (as per 2’s complement), West = negative (as per 2’s complement).  181= (6791AC0h) = not available = default) | X | X | X | X | X | X | X |
| Latitude | Latitude in 1/10 000 min (±90°, North = positive (as per 2’s complement), South = negative (as per 2’s complement). 91° (3412140h) = not available = default) | X | X | X | X | X | X | X |
| RAIM-Flag | RAIM (Receiver autonomous integrity monitoring) flag of electronic position fixing device; 0 = RAIM not in use = default; 1 = RAIM in use. See Table 47 in ITU-R M.1371-4. | X | X | X | X | X | X | X |
| Position Accuracy | The position accuracy (PA) flag should be determined in accordance with Table 47  1 = high (=<10 m)  0 = low (>10 m)  0 = default | X | X | X | X | X | X | X |
| Time Stamp | UTC second when the report was generated by the EPFS (0-59, or 60 if time stamp is not available, which should also be the default value, or 61 if positioning system is in manual input mode, or 62 if electronic position fixing system operates in estimated (dead reckoning) mode, or 63 if the positioning system is inoperative) | X | X | X |  | X | X | X |
| SOG | Speed over ground in 1/10 knot steps (0-102.2 knots) 1 023 = not available, 1 022 = 102.2 knots or higher | X | X | X |  | X | X |  |
| COG | Course over ground in 1/10° (0-3599). 3600 (E10h) = not available = default. 3 601- 4 095 should not be used | X | X | X |  | X | X |  |
| True Heading | Degrees (0-359) (511 indicates not available = default) | X | X | X |  | X |  |  |
| Type of Ship and/or Cargo Type | 0 = not available or no ship = default; 1-99 = as defined in § 3.3.2, Annex 8 in ITU-R M.1371-4; 100-199 = reserved, for regional use; 200-255 = reserved, for future use. Not applicable to SAR aircraft | X | X | X |  |  | X |  |
| Name | Maximum 20 characters 6 bit ASCII, as defined in Table 44 in ITU-R M.1371-4. ‘@@@@@@@@@@@@@@@@@@@@’ = not available = default. For SAR aircraft, it should be set to ‘SAR AIRCRAFT NNNNNNN’ where NNNNNNN equals the aircraft registration number  For AtoN stations there is an additional 14 characters allowed. | X | X | X | X |  | X | X |
| Assigned Mode Flag | 0 = Station operating in autonomous and continuous mode=default; 1 = Station operating in assigned mode |  | X |  |  |  | X | X |
| DTE | Data terminal equipment (DTE) ready (0 = available, 1 = not available = default) (see § 3.3.1, Annex 8 in ITU-R M.1371-4) | X | X |  |  |  | X |  |
| Call Sign | 7 × 6 bit ASCII characters, @@@@@@@ = not available = default | X | X | X |  |  | X |  |
| Special Maneuver Indicator | 0 = not available = default,1 = not engaged in special manoeuvre 2 = engaged in special manoeuvre (i.e.: regional passing arrangement on Inland Waterway) | X |  |  |  | X |  |  |
| Rate of Turn | 0 to +126 = turning right at up to 708 degrees per min or higher; 0 to -126 = turning left at up to 708 degrees per min or higher Values between 0 and 708 degrees per min coded by ROTAIS=4.733 SQRT(ROTsensor) degrees per min where ROT sensor is the Rate of Turn as input by an external Rate of Turn Indicator (TI). ROTAIS is rounded to the nearest integer value. +127 = turning right at more than 50 per 30s (No TI available) -127 = turning left at more than 50 per 30s (No TI available) -128 (80 hex) indicates no turn information available (default). ROT data should not be derived from COG information. | X |  |  |  |  |  |  |
| Navigational Status | 0 = under way using engine, 1 = at anchor, 2 = not under command, 3 = restricted manoeuvrability, 4 = constrained by her draught, 5 = moored, 6 = aground, 7 = engaged in fishing, 8 = under way sailing, 9 = reserved for future amendment of navigational status for ships carrying DG, HS, or MP, or IMO hazard or pollutant category C (HSC), 10 = reserved for future amendment of navigational status for ships carrying DG, HS or MP, or IMO hazard or pollutant category A (WIG);  11-13 = reserved for future use,  14 = AIS-SART (active),  15 = not defined = default (also used by AIS-SART under test) | X |  |  |  | X |  |  |
| Class B Unit Flag | 0 = Class B SOTDMA unit; 1 = Class B ‘CS’ unit |  | X | X |  |  |  |  |
| Class B Message 22 Flag | 0 = No frequency management via Message 22 , operating on AIS1, AIS2 only; 1 = Frequency management via Message 22 |  | X | X |  |  |  |  |
| Class B DSC Flag | 0 = Not equipped with DSC function 1 = Equipped with DSC function (dedicated or time-shared) |  | X | X |  |  |  |  |
| Class B Display Flag | 0 = No display available; not capable of displaying Message 12 and 14; 1 = Equipped with integrated display displaying Message 12 and 14 |  | X | X |  |  |  |  |
| Class B Band Flag | 0 = Capable of operating over the upper 525 kHz band of the marine band; 1 = Capable of operating over the whole marine band (irrelevant if ‘Class B Message 22 flag’ is 0) |  | X | X |  |  |  |  |
| Type of Electronic Position Fixing Device | 0 = undefined (default); 1 = global positioning system (GPS); 2 = GNSS (GLONASS); 3 = combined GPS/GLONASS; 4 = Loran-C; 5 = Chayka; 6 = integrated navigation system; 7 = surveyed; 8 = Galileo; 9 -14 = not used; 15 = internal GNSS | X | X |  | X |  | X | X |
| Overall Dimension / Reference for Position | Reference point for reported position. Also indicates the dimension of ship (m) (see Figure 41 and § 3.3.3, Annex 8 in ITU-R M.1371-4)  For SAR aircraft, the use of this field may be decided by the responsible administration. If used it should indicate the maximum dimensions of the craft. As default should A = B = C = D be set to ‘0’ | X | X | X |  |  | X | X |
| Vendor ID | Unique identification of the Unit by a number as defined by the manufacturer (option; ‘@@@@@@@’ = not available = default)  See Table 76A in ITU-R M.1371-4. |  | X | X |  |  |  |  |
| Maximum Present Static Draught | in 1/10 m, 255 = draught 25.5 m or greater, 0 = not available = default; in accordance with IMO Resolution A.851  Not applicable to SAR aircraft, should be set to 0 | X |  |  |  |  |  |  |
| IMO Number | 1-999999999; 0 = not available = default – Not applicable to SAR aircraft | X |  |  |  |  | X |  |
| ETA | Estimated time of arrival; MMDDHHMM UTC Bits 19-16: month; 1-12; 0 = not available = default Bits 15-11: day; 1-31; 0 = not available = default Bits 10-6: hour; 0-23; 24 = not available = default Bits 5-0: minute; 0-59; 60 = not available = default  For SAR aircraft, the use of this field may be decided by the responsible administration | X |  |  |  |  | X |  |
| Destination | Maximum 20 characters using 6-bit ASCII; @@@@@@@@@@@@@@@@@@@@ = not available  For SAR aircraft, the use of this field may be decided by the responsible administration | X |  |  |  |  | X |  |
| AIS Version Indicator | 0 = station compliant with Recommendation ITU-R M.1371-1; 1 = station compliant with Recommendation ITU-R M.1371-3; 2-3 = station compliant with future editions | X |  |  |  |  | X |  |
| UTC Year | 1-9999; 0 = UTC year not available = default |  |  |  | X |  |  |  |
| UTC Month | 1-12; 0 = UTC month not available = default; 13-15 not used |  |  |  | X |  |  |  |
| UTC Day | 1-31; 0 = UTC day not available = default |  |  |  | X |  |  |  |
| UTC Hour | 0-23; 24 = UTC hour not available = default; 25-31 not used |  |  |  | X |  |  |  |
| UTC Minute | 0-59; 60 = UTC minute not available = default; 61-63 not used |  |  |  | X |  |  |  |
| UTC Second | 0-59; 60 = UTC second not available = default; 61-63 not used |  |  |  | X |  |  |  |
| Altitude Sensor | 0 = GNSS; 1 = barometric source |  |  |  |  |  | X |  |
| Altitude (GNSS) | Altitude (derived from GNSS or barometric (see altitude sensor parameter below)) (m) (0-4 094 m) 4 095 = not available, 4 094 = 4 094 m or higher |  |  |  |  |  | X |  |
| Type of aids-to-navigation | 0 = not available = default; refer to appropriate definition set up by IALA |  |  |  |  |  |  | X |
| Off-position indicator | For floating AtoN, only: 0 = on position; 1 = off position |  |  |  |  |  |  | X |
| AtoN status | Reserved for the indication of the AtoN status; 00000000 = default |  |  |  |  |  |  | X |
| Virtual AtoN flag | 0 = default = real AtoN at indicated position; 1 = virtual AtoN, does not physically exist |  |  |  |  |  |  | X |

1. Acronyms

|  |  |
| --- | --- |
| AIS | Universal Shipborne Automatic Identification System |
| AIS 1 | 161.975 MHz (87b – 2087) |
| AIS 2 | 162.025 MHz (88b – 2088) |
| ASM | AIS Service Management |
| AtoN | Aid to Navigation |
| BAS | Basic AIS Services |
| CSTDMA | Carrier-sense Time Division Multiple Access |
| DAC | Designated Area Code |
| DGNSS | Differential Global Navigation Satellite Service |
| DSC | Digital Selective Calling |
| ECDIS | Electronic Chart Display and Information System |
| ECS | Electronic Chart System |
| FATDMA | Fixed Access Time Division Multiple Access |
| FI | Function Identifier |
| GMDSS | Global Maritime Distress and Safety System |
| GNSS | Global Navigation Satellite Service |
| GPS | Global Positioning System |
| Gyro | Gyrocompass |
| IALA | International Association of Marine Aids to Navigation and Lighthouse Authorities |
| IEC | International Electrotechnical Commission |
| IMO | International Maritime Organization |
| ITDMA | Incremental Time Division Multiple Access |
| ITU | International Telecommunications Union |
| ITU-R | International Telecommunications Union – Radiocommunications Sector |
| LSS | Logical AIS Shore Station |
| MID | Maritime Identification Digit |
| MKD | Minimum Keyboard and Display |
| MMSI | Maritime Mobile Service Identity |
| MSC | IMO Maritime Safety Committee |
| NMEA | National Marine Electronics Association |
| PI | Presentation Interface |
| PSS | Physical AIS Shore Station |
| RATDMA | Random Access Time Division Multiple Access |
| RCC | Rescue Coordination Centre |
| RF | Radio Frequency |
| ROT | Rate of Turn |
| Rx | Receiver / receive |
| SAR | Search and Rescue |
| SOG | Speed Over Ground |
| SOLAS | Safety Of Life At Sea |
| SOTDMA | Self Organising Time Division Multiple Access |
| TDMA | Time Division Multiple Access |
| Tx | Transmitter / transmit |
| UTC | Universal Time Coordinated |
| VDL | VHF Data Link |
| VHF | Very High Frequency |
| VTS | Vessel Traffic Services |
| WGS84 | World Geodetic Survey 1984 |
| WRC | World Radiocommunication Conference |

1. AIS Documentation Overview
2. AIS documentation matrix

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| IALA Documents | | | | | | | | | | | | |
| NAVGUIDE / Guideline #### – Overview of AIS | | | | | | | | | | | | |
| Guidelines 1028-1029 AIS as an e-Nav service | | | | Guideline 1059  Comparison of AIS stations | | | | | Guideline 1062 Establishment AIS as AtoN | | | Guideline xxx  Future guidelines |
| A-123  Provision of shore based AIS | | A-124  AIS Service | | | | | A-126  AIS in marine aids to navigation | | | | | A-yyy  Future recommendations |
| Annex  FATDMA  planning | Annex  …. | | | Annex  …. |
| Non IALA Documents | | | | | | | | | | | | |
| IEC 61993-2  Class A | IEC 62287-1/-2  Class B ‘CS’/’SO’ | | | | IEC 62320-1  Base station | | | IEC 62320-2  AtoN station | | IEC 61097-14  AIS-SART | | IEC zzz  Future standards |
| ITU-R documentation on AIS, e.g. ITU-R M.1371-4 | | | | | | | | | | | IALA Technical  Clarifications  on 1371-4 | |
| IMO documentation on AIS, e.g. AIS Performance standards | | | | | | | | | | | | |

1. AIS reference documentation

[corrections / updates / amendments welcomed]

| Organisation | Doc Number | Doc Name | Status | Key points | Comments |
| --- | --- | --- | --- | --- | --- |
| IMO | Res. MSC.74(69)  12 May 1998 | Adoption of new and amended Performance Standards | In Force | Annex 3 –performance standards for AIS. | Provides the basic elements of what AIS should do. Introduces key terms – autonomous and continuous, static, dynamic and voyage related information. |
| IMO | Res 917(22) 29 Nov 2001 | – Guidelines for the Onboard Operational Use of Shipborne  Automatic Identification Systems (AIS) | In Force (amendment Res. 956(23)) | Provides the objectives of AIS, Description of shipborne AIS, data sets, reporting rates, operation, limitations, use of AIS for collision avoidance, AIS in VTS / SAR and Aids to Navigation (AtoN). | Reporting rates identified – from 2 sec to 3 min, depending on speed and activity for dynamic info; every 6 min for static info (or on demand) |
| IMO | Res 956(23)  26 Feb 2004 | Amendments to the Guidelines for the Onboard Operational use of Shipborne AIS  (Resolution A.917(22)) | In Forces (amends Rec 917(22)) | Operation of Transceiver Unit – (para 21) Change includes security aspects – including option to turn off the AIS ‘or where security incidents are imminent’. | Includes requirement, in a Ship Report System, for the master to report the reason for the action. |
| IMO | MSC Res.99(73)  5 Dec 2000  Regulation 19, SOLAS | Adoption of Amendments to the International Convention for the Safety of Life at Sea, 1974, as amended | In Force / Amended by DipCon | Original implementation dates for AIS with incremental implementation starting 1 July 2002 and ending 1 July 2008. | Amended by **Diplomatic Conference on Security, 2002** - Original phased in implementation brought forward to completion by 1 July 2004. |
| IMO | Res. MSC. 140(76)  5 Dec 2002 | Recommendation for the Protection  of the AIS VHF Data Link (VDL) | In Force | Related to the introduction of AIS Class B.  Recognises the ‘compelling need to ensure the integrity of the VHF Data Link (VDL)’ and puts onus on administrations | To Note:  .1 Class B AIS devices, as well as any device which transmits on the radio channels AIS 1 or AIS 2, should meet the appropriate requirements of Recommendation ITU-R M.1371 (series);  .2 Class B AIS devices should be approved by the Administration;  .3 Administrations should take steps necessary to ensure the integrity of the radio channels used for AIS in their waters. |
| IMO | Res. MSC.246(83) 8 Oct 2007 | Adoption of performance standards for survival craft AIS search and rescue transmitters (AIS SART) for us in search and rescue operations. | In Force | Provides performance standards for the AIS SARTS. |  |
| IMO | MSC Circ.1062  16 Dec. 2002 | Maintenance and Administration of AIS Binary Messages | Superseded  Led to SN Circ. 236 | Notes the process for handing over responsibility for Binary Messages | Initially, IALA dealt with Binary Messages, in conjunction with ITU. |
| IMO | SN/Circ217  11 July 2001 | Interim Guidelines for the Presentation and Display of AIS Target Information | In Force | Presents the symbol - triangle – for AIS targets | For symbology, also note IALA Rec. V-125 (2003), and ISO 19018 (2004) |
| IMO | SN/Circ 227  6 January 2003 | Guidelines for the Installation of a Shipborne Automatic Identification System (AIS) | In Force (amended by SN/Circ.245) | Details on installation of AIS on board vessels, including interference with VHF, antenna installation, GNSS installation, installation of the unit on the bridge, static and dynamic data input, long range function,. | Issues have arisen with regards to the positioning of the antenna (interference); the quality of the GNSS feed; input of data. |
| IMO | SN/Circ 236  28 May 2004 | Guidance on the Application of AIS Binary Messages | In Force until 1 Jan 2013. | Provides information on the use of the 7 agreed AIS Binary Messages  Met/Hydro; Dangerous Cargo; Fairway closed; Tidal Window; Extended ship / voyage related data; Number of people on board; Pseudo AIS targets; | The display capability of AIS binary messages is not part of the mandatory functions of the MKD (Minimum Keyboard and Display). The display may require hardware additional to the AIS and dedicated software. After 1 Jan 2013 IMO SN.1/Circ. 289 is applied. |
| IMO | SN/Circ 245   15 Dec 2004 | Amendments to the Guidelines for the Installation of a Shipborne AIS (Sn/Circ.227) | In Force (amends SN/Circ 227) | Only change is the inclusion of an uninterrupted power source (UPS) for the AIS. |  |
| IMO | SN.1/Circ.289 | Guidance on the use of AIS application specific messages.  2 June 2010 | Comes into Force after 1 Jan 2013 | Will supersede SN/Circ.236. | There will be significant functionality available for the use of these messages. |
| IMO | COMSAR.1/Circ46 | AIS Safety-related messaging 4 Feb. 2009 | In Force | Notes issue of using pre-fabricated messages in AIS. | While some units can use pre-set safety related messages (such as can be used in GMDSS, DSC) the system was not designed for such use. |
|  | From IMO web site ([www.imo.org](http://www.imo.org)) | **Maritime security - AIS ship data** At its79th session in December 2004, the Maritime Safety Committee (MSC) agreed that, in relation to the issue of freely available automatic information system (AIS)-generated ship data on the world-wide web, the publication on the world-wide web or elsewhere of AIS data transmitted by ships could be detrimental to the safety and security of ships and port facilities and was undermining the efforts of the Organization and its Member States to enhance the safety of navigation and security in the international maritime transport sector.  The Committee condemned the regrettable publication on the world-wide web, or elsewhere, of AIS data transmitted by ships and urged Member Governments, subject to the provisions of their national laws, to discourage those who make available AIS data to others for publication on the world-wide web, or elsewhere from doing so.  In addition, the Committee condemned those who irresponsibly publish AIS data transmitted by ships on the world-wide web, or elsewhere, particularly if they offer services to the shipping and port industries. | | | |
| ITU | ITU-R M.1371 (series) / ITU-R M.1371-4 2010 | Technical Characteristics for an automatic identification system using time division multiple access in the VHF maritime mobile band | Version 4 published | Provides the overall technical basis for the working of AIS, including SOTDMA, RATDMA, FATDMA, ITDMA and CSTDMA | Continues to refer to IALA technical guidelines where technical changes may be published as interim measures (Technical Revisions)  Available on ITU website (for a fee of 52 Swiss Francs) <http://www.itu.int/rec/R-REC-M.1371/en> |
| IEC | 61993-2 / Dec. 2001 | Part 2:  Class A shipborne equipment of the universal automatic identification system (AIS) – Operational and performance requirements | In Force – under review | Provides the actual testing standard for the equipment. Equipment bought should note compliance with this standard.  As part of maintenance cycle, this document is being updated by the IEC AIS Working Group. | Note – 61993-1 is for Shipborne automatic transponder system installation using VHF digital selective calling (DSC) Techniques.  (Available from IEC website <http://webstore.iec.ch/webstore/webstore.nsf/artnum/028339> for 283 Swiss Francs) |
| IEC | 62287-1 / March 2006 | Class B Shipborne Equipment of the  Automatic Identification System (AIS) –Part 1: Carrier-sense time division multiple access  (CSTDMA) techniques | In Force | Provides the actual testing standard for equipment – equipment bought should note compliance with this standard.  Note Politeness factor to accommodate activity on the VDL. | For CSTDMA only. Work is underway for a similar testing standard for SOTDMA Class B units.  (Available from IEC webstie <http://webstore.iec.ch/webstore/webstore.nsf/artnum/035858> for 261 Swiss Francs - approx. 276 AUD) |
| IEC | 62320-1 | Part 1: AIS Base Stations - Minimum operational and performance requirements, methods of test and required test results | In Force | Provides the actual testing standard for equipment – equipment bought should note compliance with this standard.  Through implementation of the standard, some corrections have been identified, and a PAS (Publically available standard) is being developed. | Some presentation interface sentences were created for the AIS Base Station, which are being reviewed in the IEC process for inclusion into IEC 61162. Liaison work is underway to resolve PI sentence issues.  (Available from IEC webstie <http://webstore.iec.ch/webstore/webstore.nsf/artnum/037701> 272 Swiss Francs - approx. 280 AUD) |
| IEC | 62320-2 | Part 2: AIS fitted to aids to navigation (AtoN) - Minimum operational and performance requirements - methods of test and required test results | Final draft international standard (FDIS) reached 24-08-07. Publication expected in Jan. 2008. | Introduces concept of three types of AIS, with different functionality. When completed, equipment purchased should note compliance with the standard. | Once CDV is reached, comments will be accepted for 5 months, then the document reviewed and FDIS reached, with a further 5 months for comments.  Main difference between types of AIS AtoNs:  Type 1 – no receiver  Type 2 – receiver for control functions only  Type 3 – 2 receiving processes for autonomous mode |
| IEC | 62320-3 | Part 3: AIS Simplex Repeater | Initial development. | Will provide the testing for the AIS Repeater as identified in IALA A-124. | Development will continue as revisions to A-124 proceed. |

| Organisation | Doc Number | Doc Name | Status | Key points | Comments |
| --- | --- | --- | --- | --- | --- |
| IALA | Rec. A-123 / June 2007 | On the Provision of Shore Based Automatic Identification Systems (AIS) | In Force – Previous edition Dec. 2003 | A-123 provides high level indication of the need for AIS Base Stations. | The has recently been updated and continues to reflects the overall vision of AIS as presented in SOLAS, Chapter V. Additional reference for Symbology ISO 19018 (2004) <http://www.iala-aism.org/> |
| IALA | Rec. A-124 ed. 1.2 / Dec. 2003 | On Automatic Identification System (AIS) Shore Station and Networking Aspects relating to the AIS Service | In Force / under review | The initial concepts of AIS Base Stations, Repeaters and Limited Base Stations. Requires significant revision. | During the process of developing IEC 62320-1 many areas of A-123 have been identified for change, and there will be substantial revisions carried out.  Annex F on FATDMA planning added Dec. 2005, providing a process to assign slots for Base Stations and AIS AtoNs. <http://www.iala-aism.org/> |
| IALA | Rec. V-125 ed. 2 / Dec. 2004 | The Use and Presentation of symbology at a VTS Centre (include AIS) | In Force | Provides information on symbology for use at VTS Centres. | Edition 1 covered AIS aspects only, while Edition 2 provides a broader view for symbology. <http://www.iala-aism.org/> |
| IALA | Rec. A-126 / June 2007 | The use of Automatic Identification Systems (AIS) in Aids to Navigation | In Force / Previous edition Dec. 2003 | Initial information for using AIS as an AtoN | In developing IEC 62320-2 many areas of A-126 have been identified for change, and this document represents substantial changes to the initial edition. <http://www.iala-aism.org/> |
| IALA | Guideline 1026 / Dec. 2001 | On AIS as a VTS tool | In Force | Notes how AIS can assist in VTS. | The introduction of AIS in VTS is under review at IALA – an IALA questionnaire is being circulated to gather status of AIS in VTS and to update relevant documents. <http://www.iala-aism.org/> |
| IALA | Guideline 1028 ed. 1.3 / Dec. 2004 | On Automatic Identification (AIS) – Volume 1, Part 1 – Operational Issues | In Force Replaced Guideline 1019 on AIS | Provides information on the actual operation of AIS. | Quite detailed information on how AIS works. <http://www.iala-aism.org/> |
| IALA | Guideline 1029 ed. 1.1 / Dec 2002 | On Automatic Identification System (AIS) – Volume 1, Part 2 – Technical Issues | In Force / Replaced Guideline 1019 on AIS | Provides information on the technical aspects of AIS  Range formula provided.  A=2.5(Square root of H (coast station height) (in metres) + Square root of h(height of ship’s transmitting antenna – assumed to be 4m (in metres)) | Quite detailed technical information, very in-dept on the provision of shore based AIS.  <http://www.iala-aism.org/> |
| IALA | Guideline 1032 / June 2003 | On the aspects of Training of VTS Personnel relevant to the introduction of the Automatic Identification System | In Force | Notes the required training for VTS Personnel when AIS is introduced. | The introduction of AIS in VTS is under review at IALA – an IALA questionnaire is being circulated to gather status of AIS in VTS and to update relevant documents.  <http://www.iala-aism.org/> |
| IALA | Guideline 1050 / Dec. 2005 | On the Management and Monitoring of AIS Information | In Force | Notes the benefits to using AIS in planning and managing aids to navigation systems. | AIS can provide many organisational benefits, both in short term / real time and in long term analysis of data. <http://www.iala-aism.org/> |
| IALA | Technical Clarifications | Clarifications to ITU-R M.1371-1 | In Force | Created and maintained at the request of ITU. | <http://www.iala-aism.org/> |
| IALA | Plan Dec 2009 | Radio Communications Plan | In Force |  |  |
| IALA | Website | Portal for AIS, including an AIS FAQ. Go to [www.iala-aism.org](http://www.iala-aism.org) link on the left hand side – AIS – takes you to the portal. All IALA documents available from the IALA website for download – normally free of charge (go to Publications / then the type of publication required). | | | |

1. AIS frequently asked questions - http://www.iala-aism.org/web/pages/AIS/AISFAQs.pdf. [↑](#footnote-ref-1)
2. Dynamic data is data provided from sensors such as gyro compass, GNSS device or rate of turn indicator; static data refers to data that doesn’t change such as the length or beam of the vessel; voyage related data refers to items such as the vessel draft, port of destination or cargo. [↑](#footnote-ref-2)
3. Radar search and rescue transponders (SART) and AIS SART are included in the Global Maritime Distress and Safety System (GMDSS). Radar SART are activated by the radar pulse (hence ‘transponder’) while AIS SART transmit at set rates. [↑](#footnote-ref-3)
4. IMO Resolution MSC.74(69) Annex 3. [↑](#footnote-ref-4)
5. IMO Resolution A.917(22). [↑](#footnote-ref-5)
6. AIS1 (161.975 MHz) and AIS2 (162.025 MHz). [↑](#footnote-ref-6)
7. FATDMA slot allocation should be coordinated amongst administrations, reference IALA Recommendation A-124 (annex 14). [↑](#footnote-ref-7)
8. IEC 62288 – Presentation of navigation-related information on shipborne navigational displays. [↑](#footnote-ref-8)
9. Regional registry <http://vislab-ccom.unh.edu/~schwehr/ais/collection/> (also accessible from the IALA website at [www.iala-aism.org](http://www.iala-aism.org) under ‘services offered’). [↑](#footnote-ref-9)
10. Refer to IMO Resolution MSC140(76) Recommendation for the protection of the AIS VHF data link. [↑](#footnote-ref-10)
11. Refer to IALA Recommendation A-124 Annex 17. [↑](#footnote-ref-11)
12. Inland AIS as used in inland waterways is a derivative of Class A. [↑](#footnote-ref-12)
13. Static data refers to data that doesn’t change such as the length or breadth of the vessel. [↑](#footnote-ref-13)
14. While Class A initially had a low-power of 2 watts, this was amended in a subsequent edition of ITU-R M.1371-3. The main issue that this change addressed was the requirement for limitations in power as identified in the International Safety Guide for Oil Tankers and Terminals (ISGOTT), fifth edition. [↑](#footnote-ref-14)
15. IMO Resolution MSC.246(83). [↑](#footnote-ref-15)
16. Reference IALA Guideline 1062 on the establishment of AIS as an aid to navigation and IALA Recommendation A-126 on AIS as an AtoN. [↑](#footnote-ref-16)
17. IMO Resolution MSC(140) 76 refers. [↑](#footnote-ref-17)
18. Channels 75 and 76 are being proposed to the ITU World Radio Conference 2012 (WRC-12). [↑](#footnote-ref-18)