AISM Association of Internationale de Signalisation Maritime IALA International Association of Marine Aids to Navigation and Lighthouse Authorities

IALA Recommendation A-126

On

The Use of the Automatic Identification System (AIS) in Marine Aids to Navigation Services

Edition 1.3

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Document Revisions

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

Date	Page / Section Revised	Requirement for Revision
June 2007	Entire document	Release of IEC 62320-2 and of ITU-R M.1371-3
June 2008	Section 4.4	Improvement of sub-sections on power drain, off position, AtoN status bits, and addition of wreck marking.

IALA Recommendation on the use of the Automatic Identification Systems (AIS) in Marine Aids to Navigation Services

(Recommendation A-126)

THE COUNCIL

RECALLING that one of the aims of the Association is to foster safe, economic and efficient movement of vessels and the protection of the environment through the improvement and harmonisation of aids to navigation, vessel traffic services and other means world-wide.

NOTING Regulation V/19.2.4 of the 1974 SOLAS Convention, as amended, on the carriage of AIS equipment on board ships;

NOTING ALSO that studies carried out by IALA on shipborne identification systems have assisted in the development and adoption of:

- ITU Recommendation ITU-R M. 825 on the characteristics of a transponder system using DSC techniques for use with VTS and ship-to-ship identification;
- ITU Recommendation ITU-R M. 1371 on the Technical Characteristics for a Ship-borne Automatic Identification System (AIS) Using Time Division Multiple Access in the Maritime Mobile Band;
- IALA Technical Clarifications on ITU-R M.1371;
- IEC Standard 61993-2 Ed2: Class A Shipborne equipment of the Universal Automatic Identification System (AIS) - Operational and Performance requirements, methods of testing and required test results; and,
- IMO Recommendation on Performance Standards for a ship-borne Automatic Identification System (AIS), (MSC 74(69) Annex 3).
- IMO SN/Circular 217 on Interim Guidelines for the Presentation and Display of AIS Targets.
- IEC 62320-1 AIS Base Stations – Minimum operational and performance requirements – methods of test and required test results.
- IEC 62320-2 AIS AtoN stations - Minimum operational and performance requirements - methods of test and required test results.
- IMO SN Circ.236 - Guidance on the application of AIS binary messages.
- IEC 62287 Maritime radionavigation and communication equipment and systems – Class B shipborne equipment of the Automatic Identification System (AIS) using CSTDMA techniques – Operation and performance requirements, method of test and required test results.

NOTING FURTHER that IALA has adopted:

- Recommendation A-123 on the Provision of Shore Based Automatic Identification Systems (AIS);
- Recommendation A-124 on AIS Shore Stations and Networking Aspects Related to the AIS Service; and,
- The IALA NAVGUIDE, which includes a section on the use of AIS as an Aid to Navigation.

RECOGNISING that the use of AIS in VTS operations will assist in the development and maintenance of a traffic image, particularly with respect to the:

- Identification of vessels;
- Tracking of vessels;
- Simplification of information exchange; and,
- Provision of additional information to assist in vessel traffic management.

RECOGNISING ALSO that an AIS transponder could provide information and data that could:

- Be used as an aid to navigation;
- Complement existing aids to navigation;
- Monitor the performance of aids to navigation;
- Monitor the "on station" position of floating aids to navigation;
- Provide identity, state of "health" and other navigational information such as meteorological and hydrological data, if available, to ships and shore authorities; and

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- Be used to assess traffic type and pattern to assist in providing the appropriate level of service and mix of aids to navigation.

HAVING CONSIDERED the various applications of AIS that have been identified by IMO, ITU, IEC and IALA;

HAVING DECIDED that, in addition to the transfer of data from ship to ship, ship-to shore and shore-to ship, as identified by IMO, the Automatic Identification System is defined as a system for use as:

- A marine aid to navigation;
- A tool to assist in VTS operations; and
- A tool to assist aids to navigation service providers

RECOMMENDS that**:**

1. National Members, and other appropriate Authorities providing marine aids to navigation services, use appropriate AIS units as part of their marine aid to navigation services for

    a. the provision information and data to shipping, and

    b. monitoring and control purposes.

2. National Members, and other appropriate Authorities providing marine aids to navigation services, take into account the 'AIS Aids to Navigation Service' set out in the annex to this recommendation.

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Annex

AIS Aids to Navigation Service

Table of Contents

1 Background

Automatic Identification System (AIS) is an autonomous broadcast system, operating in the VHF maritime mobile band. It exchanges information such as vessel identification, position, course, speed, etc. between mobile and fixed stations. It handles multiple reports, using Time Division Multiple Access (TDMA) technology ensuring reliable and robust operation.

Chapter V of the 1974 SOLAS Convention (as amended) requires mandatory carriage of Automatic Identification System (AIS) equipment on all vessels constructed on or after 01 July 2002. Implementation for other types and sizes of SOLAS Convention vessels was required to be completed not later than 31 December 2004.

AIS as applied to aids to navigation (AtoN), improves and enhances services provided to mariners. The purpose of this document is to provide recommendations and guidance for the use of AIS in this field.

2 Introduction

The International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) define an AtoN as:

> *"a device or system external to vessels that is designed and operated to enhance the safe and efficient navigation of vessels and/or vessel traffic"*

The primary purpose of an AIS AtoN Station is to promote and enhance safety and efficiency of navigation by one or more of the following:

- Providing a positive and all-weather means of identification;
- Complementing existing services (e.g. racons) from AtoN;
- Transmitting accurate positions of floating AtoN;
- Indicating if a floating AtoN is off position;
- Marking or delineating tracks, routes, areas, and limits (for example, areas to be avoided and Traffic Separation Schemes (TSS));
- Marking offshore structures (for example, wind turbines, wave and tidal energy devices, oil and gas platforms); and
- Providing weather, tidal, and sea state data.

A further set of benefits for the AtoN provider include the following:

- Monitoring the status of an AtoN;
- Tracking an AtoN that is off position;
- Identifying ships involved in collisions with AtoN;
- Gathering real-time information on the 'state of health' of an AtoN; and
- Remotely controlling changes in AtoN parameters.

2.1 Aids to Navigation Report

ITU-R M.1371 defines the "Aids to Navigation Report" (Message 21). AIS AtoN service enables AtoN providers to broadcast information on the:

- Type of AtoN;
- Name of the AtoN;
- Position of the AtoN;
- Position accuracy indicator;
- Type of position fixing device;
- On/Off position status;
- Real and Virtual AtoN identification;
- Dimension of the AtoN and reference positions; and
- Status of the AtoN systems.

2.2 Technical standard for AIS AtoN Stations

Technical standards for AIS AtoN are defined in IEC document IEC62320-2, AIS AtoN stations - Minimum operational and performance requirements - methods of test and required test results.

There are three classifications of an AIS AtoN station, with different functionality. They are summarised below and are fully described in IEC 62320-2.

2.2.1 Type 1 AIS AtoN Station

The Type 1 AIS AtoN Station is a transmit-only station, operating in FATDMA mode. Hence the slots used by the Type 1 AIS AtoN Station need to be reserved.

This is the simplest type of AIS AtoN station, likely to have low cost and power consumption.

2.2.2 Type 2 AIS AtoN Station

The Type 2 AIS AtoN Station is similar to a Type 1, but has, in addition, an AIS receiver of limited capability operating on a single AIS channel. This receiver allows the Type 2 Station to be remotely configured and controlled via the AIS VDL.

2.2.3 Type 3 AIS AtoN Station

The Type 3 AIS AtoN Station is more complex than the Type 1 and Type 2, and contains two AIS receiving processes that allow it to participate fully on the AIS VDL. This means that in addition to FATDMA, the Type 3 station can function in RATDMA mode.

The Type 3 station is therefore capable of:

- Autonomous operation, not requiring slot reservations;

- Receiving and relaying AIS messages, including control and configuration messages for itself or for other AIS AtoN stations in a chain. See IEC 62320-2 for more details of chaining;

- Relaying AIS messages related to search and rescue; and

- indirect synchronisation, using its receiving processes.

3 Supplementary AIS AtoN Messages

In addition to Aids to Navigation Report, Message 21, an AIS AtoN may also transmit Messages 6, 8, 12, 14, 25 and other appropriate messages.

Message 6

Message 6, Addressed Binary Message, can be employed by an AIS AtoN for sending AtoN status reports to the competent authority responsible for the AtoN. Examples of useful data are battery data, lantern status data, and solar power system charging current. The benefits for the competent authority are knowledge of equipment status, opportunity for preventative maintenance, early notification of faults, and ultimately increased availability. Such performance information can be fed back into the design process for AtoN systems.

Message 8

Message 8 is a broadcast binary message. IMO has published a limited list of Message 8 formats for international use (SN Circ/236). Competent authorities are free to use other Message 8 formats on a regional basis.

As an example, among the list of IMO Message 8 formats is Application 1 Meteorological and Hydrological Data. Sensors on the AtoN provide this data to the AIS AtoN Station, which in turn broadcasts this Message 8.

Message 12

An example of the use of a Message 12, Addressed Safety Related Message, by an AIS AtoN could be where a Type 3 AIS AtoN receives an AIS SART message, and relays this, as a Message 12, to the SAR authority.

Message 14

Message 14 is a Broadcast Safety Related Message. As with the Message 12 example, an AIS SART message could be re-broadcast by an AIS AtoN.

Message 25

Message 25 is a single slot binary message that can for example be used to send encrypted configuration data. See IEC 62320-2 for further details.

Message 26

Message 26 is multiple slot binary message that uses SOTDMA.

A Type 3 AIS AtoN station may also transmit Messages 7 and 13.

IALA maintains a register of binary applications that use messages 6, 8, 25 and 26.

AIS may be applied to both floating and fixed AtoNs, and more than one AIS message format may be transmitted as noted above. The competent authority for the AtoN has an obligation to verify the broadcast information and the correct operation of the AIS AtoN Station.

4 Implementation

4.1 Real, Synthetic, and Virtual AIS AtoN

An AIS AtoN can be implemented in three ways, Real, Synthetic, and Virtual.

4.1.1 Real" AIS AtoN

A "Real" AIS AtoN Station is located on the AtoN.

4.1.2 Synthetic AIS AtoN

For practical or economic reasons it may not be appropriate to fit an AIS to an AtoN. In this case, the 'Synthetic' AIS approach may be taken. There are 2 types of Synthetic AIS AtoN, "Monitored Synthetic AIS AtoN" and "Predicted Synthetic AIS AtoN".

4.1.2.1 Monitored Synthetic AIS AtoN

A "Monitored Synthetic AIS AtoN" is transmitted as a message 21 from an AIS Station that is located remotely from the AtoN. The AtoN physically exists and there is a communication link between the AIS Station and the AtoN. The communication between the AtoN and AIS shall confirm the location and status of the AtoN.

4.1.2.2 Predicted Synthetic AIS AtoN

A "Predicted Synthetic AIS AtoN" is transmitted as a Message 21 from an AIS Station that is located remotely from the AtoN. The AtoN physically exists but the AtoN is not monitored to confirm its location or status.

Only a Monitored Synthetic AIS AtoN ensures the integrity of the floating AtoN, therefore the use of a Predicted Synthetic AIS AtoN is not recommended for use on floating AtoN. Predicted Synthetic AIS AtoN broadcasts for fixed AtoN is acceptable as the location will not change, but the status of the AtoN is not verified.

4.1.3 Virtual AIS AtoN

A "Virtual AIS AtoN" is transmitted as a Message 21 for an AtoN that does not physically exist.

It may be appropriate to create a virtual AtoN, where no physical AtoN exists. In this case the symbol would appear on the display for a specified location, even though there is no physical AtoN. A nearby base station or AtoN station could broadcast this message. The flag in Message 21 would clearly identify this as a Virtual AIS AtoN.

An example of where Virtual AIS AtoN could be useful is the marking of hazards to navigation on a temporary basis (see IALA Recommendation 0-133, Emergency Wreck Marking), until more permanent AtoN can be established.

4.2 MMSI numbers for AIS AtoN

4.2.1 MMSI numbers for all AIS AtoN

Message 21 must include a Maritime Mobile Service Identity (MMSI) number. All AIS AtoN MMSI numbers, as defined in ITU-R M.585-3, are of format 99 followed by a three-digit MID followed by a four-digit unique identifier. The MID identifies the country that issues the VHF licence for the AIS AtoN Station. The four-digit unique identifier starts with 1 (99MID1XXX) for real and synthetic AtoN Stations and starts with 6 (99MID6XXX) for virtual AtoN Stations.

4.2.2 MMSI numbers for Synthetic and Virtual AIS AtoN

Each Synthetic and Virtual AIS AtoN must have a unique MMSI number. The Repeat Indicator in Message 21 is used to indicate that the message is broadcast from another location ie not the location given in the message 21.

4.3 Reporting intervals for AIS AtoN messages

4.3.1 Message 21

The reporting interval for Message 21 should be chosen so that a vessel receives an appropriate number of Messages 21 from coming into range of the AIS AtoN broadcast until reaching the AIS AtoN location. Three messages are considered the minimum.

Factors to take into account are:

- Vessel speed of approach;
- Topology, for examples vessels approaching from around a headland; and
- Nominal transmission range.

Ideally a short reporting interval would be used, but in many cases the power consumption of the AIS AtoN will also influence the choice of reporting interval.

An example is of a high speed vessel approaching at 40 knots, from the open sea, and with a reception range of 20 nautical miles. In this case a reporting interval of 10 minutes would be sufficient to receive three messages.

A second example is of a vessel approaching from around a headland which masks the AIS signal, with the vessel doing 10 knots, and where the AIS AtoN appears at 2 miles range when the vessel clears the headland. In this case, a reporting interval of 4 minutes would be sufficient to receive three messages.

4.3.2 Reporting intervals for other messages

Reporting intervals for other messages should be based on operational requirements. Two examples follow:

Message 6 for AtoN monitoring.

This message need only be sent as often as the competent authority requires that data. However in practice power consumption by the AIS AtoN will be minimised if this message is sent just before or just after a Message 21. This is because most AIS AtoN devices will power down parts of their operating system between transmissions ("sleep mode"), and so sending Message 6 during a Message 21 wake-up portion of the sleep mode cycle does not add an extra wake-up period. Sending additional messages during the wake portion of the cycle has only a minimal effect on AIS AtoN device power consumption.

Message 8 for Meteorological and Hydrological data.

Again this should be coordinated with the wake-sleep cycle for Message 21. However by its nature, this message is required less frequently, so that a multiple of the Message 21 reporting interval would be appropriate. In situations where the Message 8 for Meteorological and Hydrological data is repeated by an AIS Base Station, the reporting interval at the AIS AtoN station might be reduced to 30 or 60 minutes, for example.

4.4 Factors affecting the power drain of an AIS AtoN station

The power drain of an AIS AtoN station is dependent on a number of factors which are usually available for setting via the unit configuration method. These are as follows.

- VDL access method – FATDMA will give substantially lower power drain than RATDMA
- FATDMA slot selection – If Mode B is used, then the Channel A and Channel B slots should be close together in time, to minimise the period for which processes in the AIS AtoN unit are active
- Reporting interval – an extended reporting interval will, of course, reduce power drain, but the interval should satisfy the guidance given in 4.3 above
- The AIS AtoN unit should be designed or configured to enter into a "sleep" mode when not active
- Repeating of the AIS AtoN messages by a local AIS base station, during the reporting interval of the AIS AtoN station, may allow the reporting interval of the AIS AtoN unit to be extended. For example, the AIS AtoN may have a 10 minute reporting interval, but the local AIS base station repeats the AIS AtoN message every frame, i.e. every minute. Consideration should be given to the coverage areas of the AIS AtoN unit and the base station to ensure that operational requirements are met.

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4.5 Repeating AIS SART messages

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AIS SART messages can be repeated by a Type 3 AIS AtoN Station.

4.6 AIS VDL channels for AIS AtoN messages – Reporting Modes

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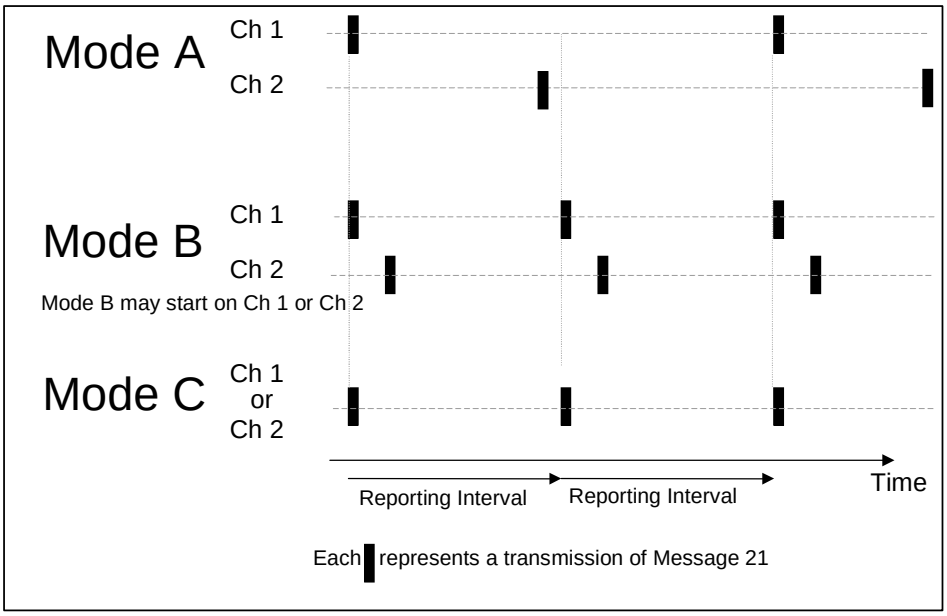
4.6.1 Reporting modes for Message 21

There are three reporting modes for Messages 21

- **Mode A** – Message 21 transmission alternates between Channel 1 and Channel 2 in a subsequent frame that is nominally one reporting interval later. Message 21 content is updated for each message, or
- **Mode B** – The same Message 21 transmitted on Channel 1 and Channel 2 in quick (nominally 4 seconds) succession. The first transmission of each Message 21 may be on either Channel 1 or Channel 2. The second transmission shall be on the other channel), or
- **Mode C** – Message 21 transmitted on a single channel, either Channel 1 or Channel 2. Message 21 content updated at each reporting interval.

Figure 1 – Reporting Modes for Message 21



The Type 1 and Type 2 AIS AtoN stations may transmit on a single AIS channel, either Channel A or Channel B, or on both channels. The Type 3 AIS AtoN station should transmit on both channels.

IALA recommends the use of Mode B for dual channel devices. Single channel devices must use Mode C.

4.6.2 Reporting modes for other messages

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Reporting modes for other messages should be based on operational requirements. Two examples follow.

Message 6 for AtoN monitoring

This application is essentially point to point transfer of monitoring data, and so a single channel, Mode C, may be sufficient.

Message 8 for Meteorological and Hydrological data

This application is likely to be intended for the benefit of shipping and so to increase the likelihood of reception, the use of Mode A or B is recommended.

4.7 Configuration of Message 21, Aids to Navigation Report

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Configuration of an AIS AtoN station, and of the essential Message 21, is described in IEC 62320-2.

4.7.1 Position monitoring for floating aids

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The AIS AtoN Station should transmit its current position as given by the Electronic Position Fixing System (EPFS) on the floating AtoN.

The position derived from an EPFS can be used in conjunction with the reference, or charted, position and a 'guard ring' to monitor the position of floating AtoNs and to generate an 'Off position' alarm which sets the off-position indicator bit in Message 21.

IEC 62320-2 does not prescribe any specific algorithm for computing off position for the purpose of setting the off-position flag in Message 21. This algorithm is left to the AIS AtoN manufacturer or competent authority to decide.

When selecting an off-position algorithm, consideration should be given to spurious position fixes from the EPFS. A single spurious position fix from the EPFS should not set the Off-position flag in Message 21.

The setting of the off position indicator in Message 21 should be the result of a determination of the AtoN position, based on multiple EFPS position fixes. ~~At least five sequential fixes should be used.~~ The EPFS should be operational long enough to obtain a stable and reliable position fix, considering the accuracy required to determine if the AtoN is inside or outside the guard ring. The specific algorithm used may be decided by the manufacturer. Two examples of algorithms are at Appendix 1

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The use of systems that augment the EPFS is recommended, to improve the accuracy and reliability of the position data.

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4.7.2 Name of AtoN

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When assigning the "Name of AtoN" field in Message 21, one or more of the following should be used:

a) Charted name;

b) National or international identification number;

c) Description of special characteristics. (This content is up to the service provider, but examples are light flash character, range in nautical miles, elevation in metres.)

The name can be up to 34 characters in length if the name extension field is used. Care should be taken when using long names as more than 20 characters may not be displayed on the MKD of some Class A equipped vessels.

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4.7.3 The "Dimension/reference for position AtoN field"

This field should indicate the "dimension/reference for position" parameter of the AtoN object itself and not the dimensions of the area in which a floating aid can move (guard zone) or dimensions of a "dangerous zone" around the AtoN.

For fixed AtoN, a numeric value should be used as noted in the table below. The orientations established by the dimensions A, B, C & D should face true north, south, west & east respectively. By setting A and C to zero, the reference point becomes the north-west corner.

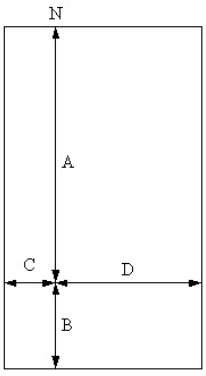
For floating aids larger than 2m x 2m, the dimensions of the AtoN should always be given as a circle, i.e. the dimensions should always be as follows: A=B=C=D>1. (This is due to the fact that an orientation of the floating aid is not transmitted.)

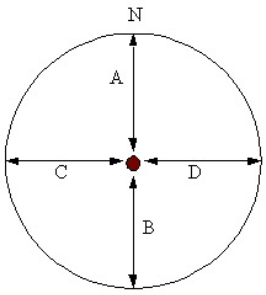
For floating objects smaller than or equal to 2m x 2m the values of the fields should be set to A=B=C=D=1.

When transmitting virtual AtoN information, i.e. the virtual AtoN flag is set to one (1), the dimension should be set to A=B=C=D=0 (=default). This should also be the case, when Type of AtoN is set to "reference point".

Off shore structures that are not fixed, such as rigs, should be considered as Code 31 type from Table 1. These structures shall have their "Dimension/reference for position" parameter as determined below.

Fixed off shore structures, Code 3 type from Table 1, shall have their "Dimension/reference for position" parameter as determined below. Hence, all off shore AtoNs and structures have the dimension determined in the same manner and the actual dimensions are contained in Message 21.





Dimension/reference for position, for a fixed AtoN	
	Numeric
A	0
B	2
C	0
D	1

Dimensions for a floating AtoN and both fixed and floating off shore structures (table 34bis Codes 3 and 31)	
A+B ≤ 2m	A=B=C=D=1
A+B > 2m	A=B=C=D>1

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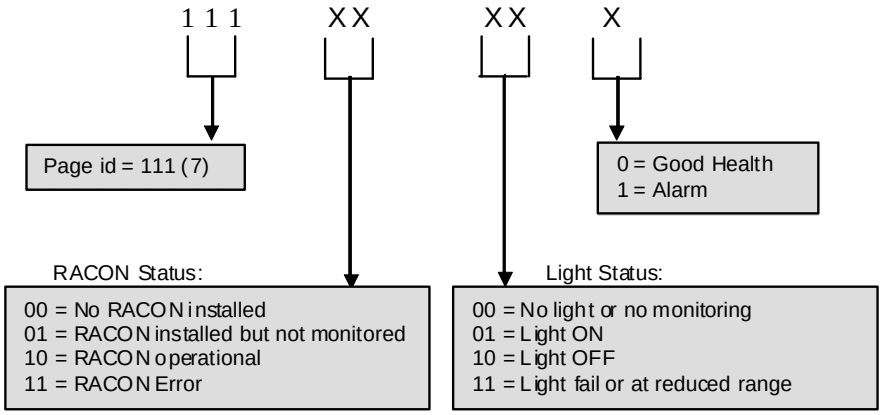
4.7.4 AtoN Status Bits

The diagram below represents the recommended use of these bits.



These bits shall be employed as follows:

The first three bits shall be use to define a Page ID. The Page ID can range from 0 to 7, allowing 8 pages. The first page (page 0) is not used for the Regional/International application and is defined as the default "not used" condition in Recommendation ITU-R M.1371. Page 7 (binary 111) is defined above. Pages 1 to 6 are reserved for future use. The future use is envisaged as being for monitoring of AtoN parameters such as voltages, currents, temperatures, etc.

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Page 7 shall be implemented in all types of AIS AtoN Stations. The final 5 data bits are defined as in the diagram above.

NOTE

- Manufacturer's default setting for the eight AtoN Status bits of Message 21 should be all zeros.
- One bit is used for alerting the competent authority that there is a problem at the AIS AtoN Station. This allows a competent authority to avoid using Message 6, if there is pressure on VDL slots, while still receiving some monitoring information every time Message 21 is sent by the AIS AtoN Station.
- Health flag alarm should be set to 1 to indicate a fault in or failure of the AtoN system or AIS AtoN station, at this location. Further indication of the fault or

failure detail can be achieved by use of additional pages within the eight AtoN Status bits, or addressed binary Message 6.

- By using only page 7 there is no need to toggle through the messages, only Message Id 7 has to be read thus allowing an immediate filtering.

- Main Light Status - For the main light, a fail is a situation where:
  - The light is off when it should be on
  - The flash character is incorrect (e.g. an optic drive failure)
  - The "Main light fail" may be set if the main light is operating at a reduced range (e.g. running on emergency, lower range, lanterns).

- Racon Status - For the Racon, a fail is a situation where the Racon unit signals a failure from an on-board built-in integrity test (BIIT). It may also signify a power failure for the Racon.

- AtoN Alarm Flag
  - The AtoN Alarm flag is un-set when all the AtoN devices are working correctly, and the mariner should be able to use the AtoN as expected.
  - The AtoN Alarm flag is set when any AtoN device has a failure, or is not working as expected. For example, if a sector light has failed, this should set the flag. If either the Racon of the main light has failed (or operating at reduced range in the case of the light), then this will also set the flag as well as the correct bit settings in the racon/main light bits. This allows a very simple indication of a problem on the AtoN without needing to decode the rest of the bits (e.g. useful for charting software to provide a quick method of determining the status of the AtoN).
  - The flag should not be set by failures that do not directly affect the use of the AtoN by the mariner. For example, a failure of the telemetry system should not be relayed to the mariner. Also, if the station's batteries are running low, this should not set the AtoN Alarm flag (unless it causes a failure of an AtoN device).

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4.7.5 Type of Aid to Navigation

The types of Aids to Navigation listed below are based on the IALA Maritime Buoyage System, where applicable.

There is potential for confusion when deciding whether an aid is lighted or unlighted. Competent authorities may wish to use the eight AtoN Status Bits of the message to indicate this.

TABLE 1

The nature and type of AtoN can be indicated with 32 different codes

	Code	Definition

	Code	Definition
	0	Default, Type of A to N not specified
	1	Reference point
	2	RACON
	3	Fixed structure off shore, such as oil platforms, wind farms. (Note: This code should identify an obstruction that is fitted with an Aid-to-Navigation AIS station.)
	4	Spare, Reserved for future use.
Fixed A to N	5	Light, without sectors
	6	Light, with sectors
	7	Leading Light Front
	8	Leading Light Rear
	9	Beacon, Cardinal N
	10	Beacon, Cardinal E
	11	Beacon, Cardinal S
	12	Beacon, Cardinal W
	13	Beacon, Port hand
	14	Beacon, Starboard hand
	15	Beacon, Preferred Channel port hand
	16	Beacon, Preferred Channel starboard hand
	17	Beacon, Isolated danger
	18	Beacon, Safe water
	19	Beacon, Special mark
Floating A to N	20	Cardinal Mark N
	21	Cardinal Mark E
	22	Cardinal Mark S
	23	Cardinal Mark W
	24	Port hand Mark
	25	Starboard hand Mark
	26	Preferred Channel Port hand
	27	Preferred Channel Starboard hand
	28	Isolated danger
	29	Safe Water
	30	Special Mark
	31	Light Vessel / LANBY/Rigs

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4.7.6 Type of Electronic Position Fixing Device

For fixed AtoN and virtual the surveyed position should be used. The accurate position enhances its function as a radar reference target.

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4.8 Marking of off-shore wind turbines.

Refer to IALA Recommendation 0-117, “The marking of off-shore wind farms”. The extremities of the wind farm should be identified by AIS. The use of synthetic AtoN AIS in this application would reduce the number of AIS AtoN Stations needed to mark a wind farm.

AIS may be used to mark only the most significant individual wind turbines of a wind farm, e.g. those wind turbines at a corner position, or at the change of direction of a line of wind turbines by utilising Message 21.

4.9 Marking of off-shore wave and tidal energy devices.

Refer to IALA Recommendation 0-131, "Marking of off-shore wave and tidal energy devices". The principles of section 4.7 above should be adopted.

4.10 Marking of wrecks

When an AIS AtoN station is used on an Emergency Wreck Marking Buoy, consideration should be given to the following points.

4.10.1 Radio licence for the AIS AtoN

In some countries AIS AtoN stations are considered as "fixed" stations (not mobile stations) under ITU radio regulations, however the location at which an Emergency Wreck Marking Buoy will be deployed is not known at the time that the application for a radio licence is made. The reason for this will need to be made clear to the radio licencing authority.

In addition, as the deploying location is unknown, it is not possible to allocate FATDMA slots in advance, so that the AIS AtoN station on the Emergency Wreck Marking Buoy will need to operate in RATDMA mode.

4.10.2 Power drain

Initially, at least, the AIS AtoN station on the Emergency Wreck Marking Buoy will be operating in RATDMA mode. Later, if the buoy remains on station for long enough, it may be possible to allocate FATDMA slots, and reconfigure the AIS AtoN. Power drain in RATDMA mode will likely be appreciably higher than when in FATDMA mode. If the buoy is on station for a short period, operating in RATDMA mode, it may be satisfactory for the on board battery to be gradually depleted. For longer period deployment, a change to FATDMA operation and/or a suitable larger power supply system will be needed.

4.10.3 Wreck marking with multiple AIS AtoN

If it is desirable to mark a wreck with two or more AIS AtoNs, then one can be a real AIS AtoN, which, in addition to its own Message 21, also broadcasts virtual or synthetic AIS AtoN messages for the other wreck markers, usually Cardinal marks.

4.10.4 Example of a specification for an AIS AtoN for wreck marking

Appendix 2 is an example , used by the United Kingdom General Lighthouse Authorities, of a specification for an AIS AtoN system for wreck marking. It has dual redundant AIS units for system resilience, and separate antennas for these units. Monitoring of the system by Message 6 is included.

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4.11 Chaining of AIS AtoN Stations

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A chain of AIS AtoN Stations allows for communication from an AIS Base Station to AIS AtoN Stations that are remotely located and unable to communicate directly with the Base Station. Encrypted messages are passed from station to station until the intended recipient is reached.

The concept requires an AIS AtoN Station to have knowledge of its neighbouring AIS AtoN Stations. Each AIS AtoN Station in the chain must know the entire chain to prevent unnecessary retransmission of the messages. See IEC 62320-2 for further details on chaining of AIS AtoN Stations.

5 References

Reference 1

ITU, Technical Characteristics for a Universal Automatic Identification System Using Time Division Multiple Access in the VHF Maritime Mobile Band, ITU-R M.1371. (The most recent edition should be used.)

Reference 2

IALA, Technical Clarifications on Recommendations ITU-R M.1371.

(The most recent edition should be used.)

Reference 3

IEC 62320-2 AIS AtoN stations - Minimum operational and performance requirements - methods of test and required test results

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Appendix 1 – Off Position Indicator, EFPS data algorithm.

Multiple EFPS fixes should be used to determine the setting of the off position indicator bit in Message 21. The algorithm used may be determined by the equipment manufacturer. The first example, contributed by the United Kingdom General Lighthouse Authorities follows. This is given as an example only and carries no endorsement from IALA. It may be that other algorithms are simpler or faster or just as effective. It is up to the competent authority to ensure that the algorithm used is suitable for the purpose. Note that with modern AIS AtoN units, the power drain of the GPS receiver may be a significant portion of the total power budget, so that an algorithm which requires that the GPS receiver be powered up for a long period may be undesirable.

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Example 1 - Algorithm used by United Kingdom General Lighthouse Authorities

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- The position monitoring system takes at least 5 position fixes, and determines if any is outside the guard ring radius. If none is outside, then the AtoN is deemed to be on-position, and the position monitoring system continues in its normal on-position mode (e.g. sleep for 10 minutes).
- If any of the positions is off-position, then the position monitoring system must take at least 100 position fixes. If 80% or more of the last 100 fixes are outside the guard ring radius, then the AtoN is deemed to be off-position.
- When in off-position mode, the position monitoring system constantly monitors the position. When 80% or more of the last 100 readings are inside the guard ring radius, then the AtoN is deemed to be back on-position.

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Example 2 – Untested algorithm to illustrate an alternative approach

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- The position monitoring system takes at least 5 position fixes, and calculates an average position. It then determines if this average position is outside the guard ring radius. If the average position is inside, then the AtoN is deemed to be on-position, and the position monitoring system continues in its normal on-position mode (e.g. sleep for the remainder of the reporting interval).
- If the average calculated position is off-position, then the position monitoring system must take at least 100 position fixes. The average position of the 100 position fixes is then calculated. If this 100 fix average is outside the guard ring radius, then the AtoN is deemed to be off-position.
- When in off-position mode, the position monitoring system constantly monitors the position. When the average of the last 100 readings is inside the guard ring radius, then the AtoN is deemed to be back on-position.
- The unit may then resume its normal on-position behaviour (e.g. sleep for the remainder of the reporting interval and resume behaviour of a minimum of 5 position fixes per reporting interval).

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Appendix 2 – Example of a specification for an AIS AtoN system for an Emergency Wreck Marking Buoy

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1 General

The GLA AIS AtoN enclosure shall be equipped with two AIS AtoN Units in compliance with IEC 62320-2 Type 3. Transmissions shall alternate between the AIS AtoN Units at the configurable reporting interval. Should one AIS AtoN Unit fail the other shall continue to transmit at its configured reporting interval. Loss of a single AIS AtoN Unit will in effect double the reporting interval.

In terms of the AIS licence the wreck marker AIS AtoN Unit is a fixed site and not a mobile vessel. However the location for deployment cannot be determined as such units are used in emergency situations to mark the location of a hazard to navigation. As a consequence at the time of deployment the VDL access scheme will be RATDMA. It shall be possible to change the VDL access scheme to FATDMA at any time after deployment if the FATDMA slot allocation becomes available for the location.

The AIS AtoN Unit shall transmit a proprietary AtoN status message 6 in addition to message 21 (AIS AtoN). The status message shall monitor the RACON, Light, Battery and ancillary equipment.

The wreck marker AIS AtoN Unit shall be capable of transmitting up to four virtual AIS AtoNs as cardinal marks around the wreck.

2 Specific Requirements

2.1 Power consumption

The power consumed by the AIS AtoN Units and the associated instrumentation is a matter of principal concern given the limited capacity of the 12 volt battery. The supplier shall state the power consumption of each component part of the system as well as the overall power consumption for reporting intervals of 1, 2, 3, 4, 5, 6, 10 and 15 minutes. Data shall be provided for both FATDMA and RATDMA operation.

The power consumption shall be verified by a witnessed Factory Acceptance Test (FAT). The power consumption for each reporting interval shall be measured over a period of at least 2 hours with all system components and ancillary equipment operating.

2.2 System resilience

Each of the two AIS AtoN Units shall have its own DGPS and GPS/VHF antennae such that a common mode of failure for the AIS part of the system is minimised. The other associated equipment and instrumentation may be shared by both AIS AtoN Units or may be dedicated to each AIS AtoN Unit at the suppliers discretion.

2.3 System control

Optionally the supplier may propose to control the system by a separate controller (PLC or data logger) or the AIS AtoN Units may control other system components. For example it would be advantageous to synchronise the sleep/wake cycle of the instrumentation with the sleep/wake cycle required by the reporting interval in order to minimise power consumption. The correct operation of the control system shall be verified during the FAT.

2.4 System testing

The system shall be tested at the suppliers works in a laboratory environment and at the GLA sites. Testing at both sites shall include;

- Power consumption
- Functional operation
- Verification of messages 6, and 21
- AIS synchronisation and timing
- Compliance with ITU-R M.1371-3
- Compliance with IEC 62320-2
- FATDMA
- RATDMA
- Monitoring of associated equipment

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2.5 Deployment

Following deployment the range and coverage shall be determined using a GLA Buoy Tender. The supplier shall provide a rate for providing engineering support during the range and coverage sea trials.

2.6 Enclosure

The dual redundant system shall be housed in the standard GLA AIS enclosure.

2.7 Monitoring

The AIS AtoN Units shall transmit monitoring information using the GLA message 6 as defined in Annex C.

2.8 Operating mode.

The default reporting mode is Mode B of IEC 62320-2 but the equipment shall be capable of being configured for Modes A and C also.
The system shall be capable of making a burst of transmissions on each channel in any period with a reporting interval of one minute for both AIS AtoN Units. The anticipated number of transmissions in a burst is ten but it shall be possible to configure any number between one and 20. The period of the burst shall be configurable between 6 and 20 seconds.

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