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Proposal for DEFINING THE FUNCTIONAL CAPABILTIES of PHYSICAL AtoNS for MASS

# Summary

This document proposes further amendments to the functional capability definitions to (i) sharpen the focus of the exercise, (ii) decouple functional capabilities that are independent from each other, and (iii) define a set of core navigational information that can be broadcasted by an AtoN to support MASS operations.

## Purpose of the document

To propose a method for defining and classifying the functional capabilities of AtoNs.

## Related documents

1. IALA committee work programme (2023-2027)
2. ARM19-11.2.7 Liaison note
3. ARM19-12.1 Report of ARM19
4. IALA Recommendation R0126(A-126) The Use of the Automatic Identification System (AIS) in Marine Aid to Navigation Services
5. IALA Guideline G1098 The Application of AIS - AtoN on Buoys
6. ARM new AIS Guideline draft

# Background

With the advent of Maritime Autonomous Surface Ships (MASS), the role of Aids to Navigation (AtoNs) is likely to include increasing connectivity within, and participation with, data networks. To this end, the ARM MASS working group has been considering an input paper from China MSA on the potential categorisation of AtoN based on their ability to interactwith, and be used by, MASS. The proposal included six categories and sought to:

* Help with assessing the merits of, and planning for, various levels of interaction between AtoN and MASS (taking into account degree of risk and volume of traffic).
* Support the coastal State/Service provider with a risk assessment process (taking into account the degree of risk and volume of traffic).
* Provide a logical process for evaluating AtoN capabilities required that may support engineering solutions and financial planning.

In 2024, ARM19 considered a set of functional capability definitions for AtoNs to assist members/coastal States in defining design requirements, and submitted a liaison note to PAP to seek advice on whether there is merit for IALA to adopt the concept of having functional capability definitions. At the point of writing this paper, PAP’s assessment of ARM19’s request was not yet published on IALA’s website.

# Discussion

## FunCTIONAL CAPABILITY DEFINITIONS PROPOSED BY ARM19

The following definitions were proposed by ARM19.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Designation of Functional**  **Capability (FC)** | **Operational Mode** | **Functional Capability** | **Description** | **Degree** |
| FC1 | Non-Intelligent | Size, shape, structure, colour, topmark, light only. | Basic AtoN. | 1 |
| FC2 | Remotely Monitored. | As above plus the AtoN can be remotely monitored including operating status, position and energy levels. | Basic AtoN that is monitored remotely. This can include AIS and RACON for example. | 2 |
| FC3 | Remotely Monitored Plus | Remote monitoring allow management of operating status including lamp (emergency/normal), position and energy levels and characteristics. | Basic AtoN that can be monitored /controlled and managed remotely. | 2 |
| FC4 | Interactive | Telemetry allows monitoring and management of operating status including lamp, position and energy levels and characteristics. AtoN is capable of relaying digital services. | The AtoN is part of a data network that will promulgate information (for instance through S100 | 2 or 3 |
| FC5 | Intelligent | The AtoN is capable of sensing, processing and transmitting its own data. | The AtoN is fully integrated into digital services.  The AtoN is capable of providing real time information to vessels independently. | 4 |

The final column in the above table refers to the degrees of interaction with MASS as follows:

Degree 1 - Basic AtoN that cannot provide digital information to MASS

Degree 2 - AtoN can provide digital AtoN data (S100/200) to MASS

Degree 3 - AtoN can interact with additional digital data including hydrometeorological and traffic information etc.

Degree 4 - AtoN is capable of interacting through all the above digital data in real time.

## proposal

Singapore agrees with the principle of the above definitions of functional capabilities and would like to propose the following amendments to enhance it.

1. Scope the work to physical AtoNs

IALA defines AtoN as a device, system or service external to vessels, designed and operated to enhance safe and efficient navigation of individual vessels and/or vessel traffic. This ranges from physical AtoNs, virtual AtoNs, to Vessel Traffic Services. For this exercise, it is proposed to scope the work to only physical AtoNs (e.g. buoys, beacons, lighthouses) since these falls under the purview of the ARM Committee. The interaction of VTS with MASS should be considered by experts in the VTS Committee. There is no need to consider the functional capability of Virtual AtoNs since they are themselves a functional capability of an onshore broadcast system (i.e. it is an information that is being transmitted by another system).

1. Scope the functional capabilities to focus on MASS

It is proposed tighten the scope of the functional capabilities to focus on MASS. Accordingly, information that are not pertinent for MASS operations (e.g. energy levels of AtoNs) are proposed to be removed.

1. Scope the functional capabilities to known use cases of AtoN

Consideration was given to whether it would be useful to define a functional capability for potential future uses of AtoNs. For instance, in considering whether an AtoN should have the ability to interact with hydrometeorological and traffic information, it was noted that there are no known use cases for AtoNs that require those data. Until IALA defines new uses for AtoNs (e.g. send out warning signals when currents become stronger or traffic becomes dense), it would be premature to define an exhaustive list of functional capabilities for all potential future use cases of AtoNs.

1. Make the functional capabilities independent of each other

The classification table in ARM19-11.2.7 assumes that the levels of all the functional capabilities of AtoNs are corelated, i.e. a high level of functional capability in one aspect also means a high level of functional capability in other aspects. However, it is possible that different AtoNs may be equipped differently. For instance, an AtoN that is equipped to transmit information to MASS may not necessarily be equipped with hydrometeorological data sensors, nor does it necessarily mean that the competent AtoN authority responsible for that AtoN can monitor its battery or operating status. To this end, it is proposed to make each functional capability independent of each other.

The three proposed functional capabilities are for an AtoN are:

* Navigational **I**nformation Broadcasted (Abbreviated using letter “I”)
* **O**ther Information Broadcasted (Abbreviated using letter “O”)
* Data **T**ransmission Method to Vessel (Abbreviated using letter “T”)

1. Define a set of core Navigational Information that can be broadcasted by an AtoN to support MASS

Today, AtoNs broadcast their AtoN ID and position information. Without a pre-compiled list describing the AtoNs’ properties (e.g. shape, structure, colour, topmark, light), the AtoN ID and position information are not useful in helping a MASS navigate. When implemented, the S-100/S-200 standards would help bridge this gap since it includes information relating to the AtoN’s properties. The premise for this to work is that (i) the AtoN has to be charted, (ii) in the case of new AtoNs, that ships have the most updated electronic navigational charts (ENCs), and/or (iii) the AtoN authority is S-201 ready. However, these premises may not apply in all cases.

In addition to AtoN ID and position information, it is proposed that MASS-ready AtoNs also promulgate the following information describing the AtoN’s properties to help MASS interpret the significance of that AtoN even if it is not showing up on the ENC:

1. Charted Position (if available)
2. Shape
3. Structure
4. Colour
5. Topmark
6. Light characteristic[[1]](#footnote-1)
7. Operational status1
8. Define the Data Transmission Method

It is proposed to define a new functional capability on “Data Transmission Method” based on whether the information from the AtoN is transmitted directly or indirectly (e.g. as part of S-100/S-200) to the vessel. The distinction is useful in helping vessel owners understand the kind of technology required onboard the ship to receive the information.

With the above considerations, it is proposed that the functional capabilities of AtoNs be defined as per the table set out in **Table 1** below.

**Table 1:** Proposed Functional Capability definitions for AtoNs for MASS

|  |  |  |  |
| --- | --- | --- | --- |
| **Functional Capability of AtoNs for MASS** | | | |
| **Navigational Information Broadcasted (I)** | **Other Information Broadcasted (O)** | **Data Transmission Method to Vessel (T)** | |
| **I0**   * Nil. Basic AtoN with shape, structure, colour, topmark and light. | **O0**   * No additional information | **T0**   * No data transmission | |
| **I1**   * AtoN ID * Actual Position Info | **O1**   * Additional information (e.g. hydrometeorological information) broadcasted | **T1A**   * Information sent *directly* to vessel | **T1B**   * Information sent *indirectly* to vessel (i.e. AtoN is part of a data network that will promulgate the information e.g. S-100/S-200) |
| **I2**   * AtoN ID * Actual Position Info * Charted Position (if available) * Shape * Structure * Colour * Topmark * Light Characteristics * Operational status | **T2**   * Information sent both *directly* and *indirectly* to vessel | |

Interpreting the functional capabilities classification table

Instead of using a single number to define the characteristic of an AtoN’s ability to interact with MASS, the AtoN will be classified by a combination of letters and numbers that determines the functional capabilities of the AtoN’s interaction with MASS.

For instance, an AtoN that is

* equipped with RACON and AIS and directly transmitting information on AtoN ID and position to vessels
* equipped with a weather station with a SATCOM device and is transmitting weather data to a station onshore which then promulgates the data to vessels

would be classified as:

**I**1-**O**1-**T**2

**In employing the classification table, it is important the information broadcasted reach the vessel.** If the broadcasted data cannot reach the vessel for any reason (e.g. tidal stream data collected is meant for research purposes and not shared), then the AtoN is not considered to have that functional capability.

For instance, an AtoN that is

* equipped with RACON and AIS and is directly transmitting information on AtoN ID and position to vessels
* equipped with a weather station with a SATCOM device and is transmitting weather data to a station onshore
* but the weather data is not further promulgated to vessels

would be classified as:

**I**1- **O**0-**T**1A

Note that the functional capability for “Other information broadcasted” (O) is set at O0 instead of O1, and that the “Data transmission method” (T) is set at T1A instead of T2 since the *entire* functional capability of weather station is disregarded.

# Action requested of the Committee

The Committee is requested to:

1. consider the proposal in section 3.2.
2. take action as appropriate.

1. Light characteristics and Operational status may not be necessary for MASS since the other information suffice in helping the MASS interpret the significance of that AtoN. Nonetheless, it is left in so as not to pre-suppose any MASS technology. [↑](#footnote-ref-1)