Input paper: [[1]](#footnote-2) DTEC4-6.2.2.3.3

Input paper for the following Committee(s): check as appropriate Purpose of paper:

**□** ARM **□** ENG **□** PAP **X** Input

**X** DTEC **□** VTS **□** Information

Agenda item [[2]](#footnote-3) 6.2

Technical Domain / Task Number 2 DTEC-7.1.2

Author(s) / Submitter(s) Task Group DTEC-7.1.2

draft Discussion paper on MASS Compatible AtoNs

# Summary

This input document introduces a Discussion paper related to MASS compatible AtoNs. The Discussion paper suggests that IALA could consider defining some new terminology and concepts related to the expected development of MASS compatible AtoNs.

The suggested new concepts – using tentative – terminology are:

* MASS adapted AtoNs – designed to support various intermediate degrees of shipboard automation from traditionally operated vessels to autonomous vessels
* MASS supportive AtoNs – designed primarily to assist autonomous vessels

## Related documents

This document is an annex to input paper:

* DTEC4-6.2.2.3 Report on Task DTEC-7.1.2 Digitalization of waterways

draft Discussion Paper on MASS Compatible AtoNs

# MASS Compatible AtoNs

The IALA Maritime Buoyage System (R1001) notes that current applications, marks and signals exhibited by AtoN and described in the recommendation apply to all vessels including the vessels with various degrees of automation. However, the recommendation foresees the possibility in the future to also develop AtoNs that are tailored specifically for MASS.

This may imply, in the future, the provision of AtoNs which have some additional functionality to support vessels with higher degrees of automation or even the provision of AtoNs which are primarily designed to assist autonomous vessel operations.

IALA may want to consider defining new terminology and concepts related to the anticipated development of MASS compatible AtoNs. The identified types of MASS compatible AtoNs could, for example, be categorized using the tentative terminology shown below (Table 3).

1. Possible categorization of MASS compatible AtoNs.

|  |  |  |
| --- | --- | --- |
| Type of MASS compatible AtoN | Functionality | Primary target group |
| MASS adapted AtoN (TBC) | Provision of additional M2M AtoN information | Various intermediate degrees of shipboard automation from traditionally operated vessels to autonomous vessels |
| MASS supportive AtoN (TBC) | Emulating visual AtoN functionalities by other means e.g. radio transmissions | Assisted autonomous vessels |

## MASS adapted AtoNs

The traditionally human focused AtoNs could be upgraded to MASS adapted AtoNs by amending them with machine focused functionalities. This would mean that the traditional AtoN would be equipped with an additional Machine-to-Machine (M2M) interface directly communicating with shipboard equipment. These type of AtoNs, for example AIS AtoNs, are already being developed and deployed.

## MASS supportive AtoNs

It seems that so far, the development of autonomous vessels has mainly focused on securing the conditions for fully independent operation of the vessel based on its own navigational aids. Another possible option would be to in some extent rely on external assistance provided by aids to navigation specially designed for this purpose.

The principal idea of MASS supportive AtoNs would be to transform the functionality of traditional aids into different physical form. The traditional visual functionalities could be replaced (or amended) by radio transmissions that emulate the visual functionalities locally. For example, leading lights and sector lights could be substituted (amended) by directional and highly beam-focussed short-range radio transmissions. This MASS supportive AtoN infrastructure could provide a radio transmitted high-precision trajectory to the AtoN assisted autonomous vessels through the approach or waterway, i.e. an invisible high-precision vessel track or electronic tow path. MASS supportive AtoNs would be primarily designed to assist autonomous vessels but when standardized, could assist all traffic in the area alike, including traditionally operated vessels.

The following economical and safety aspects could be considered related to possible introduction of MASS supportive AtoNs:

* Reasonable expenditure constraint: In some cases, the required or desired level of autonomous operation cannot be accomplished reliably in the harsh environments of the maritime waterway domains within reasonable expenditure constraints.
* Expenditure trade-offs between shipboard navigational aids and shore-based AtoNs in an economy of scale: There may be an economical benefit to use many less independent autonomous vessels in combination with a smaller set of shore-provided supportive AtoNs instead of the same number of highly independent autonomous vessels equipped with expensive navigational aids in combination with existing AtoNs.
* Shore-based supportive AtoNs to reduce risks: Despite all good efforts, MASS related accidents may happen. This may turn the regulatory and public opinion against fully autonomous vessels. One way to avoid this would be the co-operative system approach, where MASS-supportive AtoNs would support autonomous vessels’ navigational aids by default. Such an approach would also be likely to qualify as a risk mitigation measure in any Formal Safety Assessment.
* MASS operation outside operational envelope – falling back to remote operation: Autonomous operations take place only within a pre-defined operational envelope. When situations (e.g. malfunction of vessels navigational aids) occur that cause the autonomous vessel to move outside its operational envelope, it will revert to a ROV as a first stage. Provision of MASS supportive AtoNs may help to keep the vessels within the operational envelope longer.

# References

1. IALA Recommendation R1001 The IALA Maritime Buoyage System (MBS), Edition 2.0 urn:mrn:iala:pub:r1001:ed2.0
2. Oltmann, Jan-Hendrik. 2023. 'What makes an AtoN >MASS-compatible<'. Proceedings of the 20th IALA Conference, Vol 2. Saint-Germain-en-Laye: IALA. 138-154.

1. Input document number, to be assigned by the Committee Secretary [↑](#footnote-ref-2)
2. Leave open if uncertain [↑](#footnote-ref-3)