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Working Party on the Standardization of Technical and Safety Requirements in Inland Navigation

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Establishment of common principles and technical requirements for pan-European River Information Services (RIS): Recommendation on Electronic Chart Display and Information System for Inland Navigation (Inland ECDIS) (Resolution No. 48)

Automatic Identification System (AIS) Aids to Navigation report messages in inland waterways

Transmitted by the European Commission

I. Mandate

1. This document is submitted in line with cluster 5: Inland Waterway Transport, paragraph 5.1 of the programme of work 2014–2015 (ECE/TRANS/2014/23) adopted by the Inland Transport Committee on 27 February 2014.

II. Note from the Chair of Vessel Tracking and Tracing Expert Group

2. Inland AIS is a communication system based on maritime AIS to automatically provide position, identity and other navigation data of a ship and to exchange safety related information between ships and between ship and shore. In maritime, AIS is also used to provide information for emphasizing classical aids to navigation for the marking of buoys, wrecks, wind farms, etc. Special AIS Aids to Navigation Report (AIS AtoN) message transfers the position and the meaning of the aids to navigation as well as information if the buoy is on the required position or not (off position).

3. A joint group of the VTT EG and IECDIS EG has drafted an information paper on AIS AtoN in Inland Waterways. This information paper aims to introduce the function of an AIS AtoN report and to discuss pros and cons of a potential use of AIS AtoN messages in inland navigation.

4. The information paper intends to start an initial policy discussion at EU RIS platform and river commissions whether or not it is worthwhile for the VTT and ECDIS Expert Groups to further investigate in a technical solution for Inland AIS Aids to Navigation report for a potential use in inland navigation. This discussion should also bear in mind that there is already an ongoing project on AIS AtoN in inland navigation sponsored by the European Union.

5. The Information paper on AIS AtoN in Inland Waterways as drafted by the joint group of the VTT EG and the IECDIS EG is reproduced below.

III. Introduction

6. Inland AIS is a communication system based on maritime AIS to automatically provide position, identity and other navigation data of a ship and to exchange safety related information between ships and between ship and shore.

7. In maritime, AIS is also used to provide information for emphasizing classical aids to navigation for the marking of buoys, wrecks, wind farms, etc. Special AIS Aids to Navigation Report message (AIS AtoN) transfers the position and the meaning of the aids to navigation as well as information if the buoy is on the required position or not (off position).

8. This AIS AtoN report message can be either transmitted by a specific AIS AtoN station mounted on a buoy, wind farm or lighthouse or by an AIS shore station.

9. Using the AIS AtoN report message it can represent a real buoy lying in the water or it may represent a position where no real buoy is present. This doing so as if there would be a buoy is called a virtual AtoN.

10. Ships, equipped with an appropriate display system like ECDIS, can display the information contained in the AIS AtoN report message, e.g. as a symbol on the chart at the reported position of the AtoN. This functionality still needs to be standardised and is not yet implemented in all ECDIS applications.

11. This information paper aims to introduce the function of an AIS AtoN report and to discuss pros and cons of a potential use of AIS AtoN messages in inland navigation.

12. The information paper intends to start an initial policy discussion at the EU RIS platform and river commissions whether or not it is worthwhile for the VTT and ECDIS Expert groups to further investigate in a technical solution for Inland AIS Aids to Navigation report for a potential use in inland navigation. This discussion should also bear in mind that there is already an ongoing project on AIS AtoN in inland navigation sponsored by the European Union.

IV. References

13. The content of this document is partially based on or refers to:

Document title	*Organization*	*Publication date*
Directive 2005/44/EC of the European Parliament and of the Council of 7 September 2005 on harmonised river information services (RIS) on inland waterways in the community	EU	7 September 2005
Commission Regulation (EC) No 415/2007 of 13 March 2007 concerning the technical specifications for vessel tracking and tracing systems referred to in Article 5 of Directive 2005/44/EC of the European Parliament and of the Council on harmonised river information services (RIS) on inland waterways in the Community	EU	13 March 2007
Commission implementation regulation (EU) No 689/2012 of 27 July 2012 amending Regulation No 415/2007 of 13 March 2007 concerning the technical specifications for vessel tracking and tracing systems referred to in Article 5 of Directive 2005/44/EC of the European Parliament and of the Council on harmonised river information services (RIS) on inland waterways in the Community	EU	27 July 2012
Commission Implementing Regulation (EU) No 909/2013 of 10 September 2013 on the technical specifications for the electronic chart display and information system for inland navigation (Inland ECDIS) referred to in Directive 2005/44/EC of the European Parliament and of the Council	EU	10 September 2013
IMO Resolution MSC.232(82), Appendix 3	IMO	
IEC 62388 Maritime navigation and radiocommunication equipment and systems - Shipborne radar	IEC	26 June 2013
IEC 62288 Maritime navigation and radiocommunication equipment and systems - Presentation of navigation-related information on shipborne navigational displays	IEC	July 2014
Recommendation ITU-R M.1371, "Technical characteristics for an automatic identification system using time-division multiple access in the VHF maritime mobile band"	ITU	April 2010
International Standard IEC 61993-2, Edition 2 “Maritime navigation and radio communication equipment and systems – Automatic Identification System, Part 2: Class A shipborne equipment of the universal automatic identification system (AIS)"	IEC	October 2012
International Standard IEC 61162-Serie, “Maritime navigation and radio communication equipment and systems - Digital interfaces"		
"Part 1: Single talker and multiple listeners”	IEC	November 2010
"Part 2: Single talker and multiple listeners, high speed transmission"		September 1998
UNECE Location code (RECOMMENDATION No. 16,)	UNECE	
UNECE Ship type code (RECOMMENDATION No. 28),	UNECE	
CCNR Technical clarifications on Inland AIS	CCNR	2008

V. Introduction to the use of AIS Aids to Navigation Reports

A. Use of AIS AtoN

14. The International Association of Maritime Aids to Navigation and Lighthouse Authorities (IALA) maintains an international harmonised buoying system which is also the basis of the information content of the maritime AIS AtoN report message.

15. IALA defines the use of AIS AtoN as follows (Recommendation A-126 on the use of AIS in maritime aids to navigation services):

- 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;
- Transmitting accurate positions of floating AtoN;
- Indicating if a floating AtoN is off position;
- Provide additional AtoN capability through the use of Virtual AIS AtoN, where installation of physical AtoN is technically or operationally difficult;
- Enable timely/temporary marking of new hazards (fixed or dynamic) using Virtual AIS AtoN.

B. Information provided by AIS AtoN

16. The maritime AIS Aids to Navigation Report message provides information about the AtoN in uses e.g. Type, name, position of the AtoN, off-position indicator, etc. (see Annex I).

17. This information is typically broadcasted with a reporting interval of 3 minutes and can be received within the VHF coverage range of the transmitting AIS AtoN station or AIS shore station.

18. In case any data sets are left blank by the user the application shall automatically use the default values as given by the Vessel Tracking and Tracing standard.

19. After configuration of all values it shall be possible to save the values and write them back into the Inland AIS station using the input sentences of IEC 61993-2 and the VTT standard.

C. Usability of maritime AIS AtoN message in inland navigation

20. The maritime AIS message 21 is based on the IALA buoyage system which is different from the buoyage system used in inland navigation (CEVNI buoyage system).

21. An Inland specific AtoN message for inland waterways needs to be defined and incorporated in the related standards (VTT and Inland ECDIS). Both standards have to be amended to enable a correct information and display of the AtoN.

22. A detailed comparison between the IALA and the CEVNI buoyage system can be found in Annex II.

VI. The various configurations of AIS-Aids to navigation

23. An AIS Aids to navigation can be implemented in three ways, which are described in the following paragraphs.

A. Real AIS Aids to navigation

24. A Real AIS AtoN Station is an AIS station located on an AtoN that physically exists.

25. For example the AIS AtoN station is mounted on a buoy and broadcast actual real time data about the position and the status (e.g. on/off position) of that buoy.

B. Synthetic AIS Aids to navigation

26. A Synthetic AIS AtoN is where the AtoN message is transmitted from a remote AIS station. There are two possibilities for the implementing such a synthetic AtoN.

C. Monitored Synthetic AIS AtoN

27. A 'Monitored Synthetic AIS AtoN' has a position sensor and a communication link between the AIS Station and the AtoN. The communication between the AtoN and AIS confirms the location and status of the AtoN.

D. Predicted Synthetic AIS AtoN

28. A 'Predicted Synthetic AIS AtoN' is not monitored to confirm its location or status. The use of Predicted Synthetic AIS AtoN broadcasts for fixed AtoN is acceptable as the location will not change, but the status of the AtoN cannot be verified.

E. Virtual AIS Aids to navigation

29. A 'Virtual AIS AtoN' is transmitted as AIS AtoN message for an AtoN that does not physically exist. When a Virtual AIS AtoN is used, the AtoN symbol or information would be available for presentation to a mariner on an electronic chart, even though there is no real AtoN such as a buoy or beacon. Such a message would typically be broadcasted by an AIS shore station or an AIS AtoN station.

VII. Analysis of the advantages and disadvantages of the different configurations

A Description of the method used

30. In this chapter advantages and disadvantages of the different types of AtoNs will be described in comparison to the real buoy without AIS AtoN station.

31. It has to be noted that all solutions that are using AIS AtoN information require certain equipment on board which may result in additional costs for the vessels in areas

without existing carriage requirements for AIS and electronic chart systems. Existing chart systems will need to be updated supporting this functionality.

B. Real buoy without AIS

32. The traditional way of marking the fairway with buoys without AIS is a well-known introduced system. It is easy to see and interpret under good visibility conditions and does not require any additional tools or equipment on board.

33. A real buoy with a radar reflector is typically visible on the radar screen while the type (colour) of the buoy cannot be unambiguously identified. Main disadvantage of such type of buoy is that deviations of the position cannot be automatically detected.

C. Real buoy with AIS AtoN station

34. Equipping a real buoy with AIS AtoN station provides unambiguous information about the type, name and real position of a buoy under all visibilities for all vessels equipped with AIS and electronic charts. Additionally an explicit off-position flag indicates major drifting of the buoy. It allows for detection of deviations of the position of the buoy for the administration which can be used to identify problems like drifting, theft or collisions with vessels.

35. In some cases it might happen that three different positions of the buoy are displayed to skippers (radar position, chart position and AIS position). This problem could be minimised by adaptations of the standards. Equipping a buoy with an AIS AtoN station causes extra costs for implementation and maintenance. Also each AIS AtoN station increases the load on the AIS VHF link.

D. Real buoy with monitored Synthetic AIS AtoN

36. Equipping a real buoy with a position sensor and a communication link to a remote AIS station provides unambiguous information about the type, name and real position of a buoy under all visibilities for all vessels equipped with AIS and electronic charts. Additionally an explicit off-position flag indicates major drifting of the buoy. It allows for detection of deviations of the position of the buoy for the administration which can be used to identify problems like drifting, theft or collisions with vessels.

37. The benefits for skippers are similar to a real buoy with an AIS AtoN station. In some cases it might happen that three different positions of the buoy are displayed to skippers (radar position, chart position and AIS position). This problem could be minimised by adaptations of the standards. Equipping a buoy with a position sensor and a communication link causes extra costs for implementation (less than AIS AtoN station) and maintenance (additional communication costs may occur). Also each synthetic AIS AtoN station increases the load on the AIS VHF link.

38. Given the additional communication link the risk of a malfunction of the AtoN transmissions is slightly higher than for a real buoy with AIS AtoN station.

E. Real buoy with predicted Synthetic AIS AtoN

39. Sending a predicted synthetic AIS AtoN message for a real buoy provides unambiguous information about the type, name and theoretic position of a buoy under all visibilities for all vessels equipped with AIS and electronic charts.

40. The transmission of predicted synthetic AIS AtoN messages causes no extra costs in areas where shore based AIS infrastructure is available.

41. Normally the position of buoy transmitted via AIS and the chart position are the same. Changes of the position of a buoy can be implemented faster in the AIS AtoN message than in the chart. In some cases it might happen that three different positions of the buoy are displayed to skippers (radar position, chart position and AIS position). This problem could be minimised by adaptations of the standards.

42. Because of the fact that the position information sent out via the AtoN message is not derived from an on-site measurement, it is not possible to automatically detect any deviations of the real position of the buoy.

43. Also each predicted synthetic AIS AtoN station increases the load on the AIS VHF link.

F. Virtual AIS Aids to navigation

44. Sending an AIS message for a virtual AtoN provides unambiguous information about the type, name and position of a virtual buoy under all visibilities for all vessels equipped with AIS and electronic charts. Theoretically it would also be possible to transmit a polygon for marking of the fairway instead of transmitting multiple virtual buoys.

45. Changes of the position of a buoy e.g. in cases of incidents can be implemented faster using a virtual AIS AtoN than in the chart or for a real buoy.

46. The transmission of an AIS message for a virtual AtoN causes no extra costs in areas where shore based AIS infrastructure is available. Still additional costs for guaranteeing the necessary system availability (resulting in redundancy) might occur.

47. However it has to be taken into account that this might cause additional workload for the people involved. But it may reduce the workload of other people.

48. Precondition for the use of virtual AIS AtoNs is the seamless availability of Inland AIS and Inland ECDIS with heading information on all vessels resulting in significant costs for the vessels. Vessels without such equipment will not be able to navigate accordingly. In case of failure of the shore based AIS system, the onboard AIS station or the Inland ECDIS display no information about virtual AtoNs will be available. It is a risk to transmit safety relevant information solely through AIS.

49. Also each virtual AIS AtoN increases the load on the AIS VHF link.

50. Finally the relevant police regulations had to be amended to allow replacing real buoys with virtual AIS AtoNs.

G. Tailor made solutions using virtual Aids to Navigation

51. Virtual AtoNs could be used to transmit specific information to a specific (limited) target group e.g. sea-going vessels with a big draught, special transports etc.

52. In this case only the target group would have to be equipped with AIS and Inland ECDIS in Navigation Mode. The necessary system infrastructure only needs to be implemented in the area of usage.

VIII. Conclusions and recommendations

53. The use of AIS AtoN messages in combination with real buoys may have benefits both for the skippers and administrations. However it has to be considered that not all vessels might be equipped to display AIS AtoNs. Further the availability and reliability of the AIS information cannot be guaranteed in all cases.

54. The usefulness of such a combined solution has to be investigated and decided case by case because it is depending on the local situation and conditions. Preconditions are the amendment of the standards as well as potential investments into the shore infrastructure and the onboard equipment.

55. The use of virtual AIS AtoNs as replacement for real buoys is not recommended because it doesn't seem feasible for the near future to equip the whole fleet including pleasure crafts with AIS and Inland ECDIS with heading devices. In addition experiences must be gained about the safety risk and reliability of the entire system.

56. Still local tailor made solutions using virtual Aids to Navigation might be implemented.

57. The Inland ECDIS EG and VTT EG want to encourage further pilot implementation and testing of AIS AtoN applications in order to gain practical experiences. Further the expert groups recommend developing proposals for amending existing standards to ensure harmonised and sound implementation of AIS AtoNs.

58. The Inland ECDIS EG and VTT EG strongly recommend waiting with implementation of AIS AtoN (apart from pilot projects) until common standards for inland navigation are available.

IX. Annex I – Use of AIS AtoN

59. The International Association of Maritime Aids to Navigation and Lighthouse Authorities (IALA) maintains an international harmonised buoying system which is also the basis of the information content of the AIS AtoN report message.

60. IALA defines the use of AIS AtoN as follows (Recommendation A-126 on the use of AIS in maritime aids to navigation services):

61. 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;
- Promulgation of Application Specific Messages including:
- 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.

- Provide additional AtoN capability through the use of Virtual AIS AtoN, where installation of physical AtoN is technically or operationally difficult;
- Enable timely/temporary marking of new hazards (fixed or dynamic) using Virtual AIS AtoN.

62. 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;
- Provide statistics on reliability of AtoN;
- Extend the coverage of AIS monitoring.

Information provided by AIS AtoN

63. The AIS Aids to Navigation Report message, technically called AIS Message 21 as defined in ITU-R M.1371, 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, Synthetic and Virtual AtoN identification;
- Dimension of the AtoN and reference positions; and
- Status of the AtoN systems.

64. This information is typically broadcast with a reporting interval of 3 minutes and can be received within the VHF coverage range of the transmitting AIS AtoN station or AIS shore station.

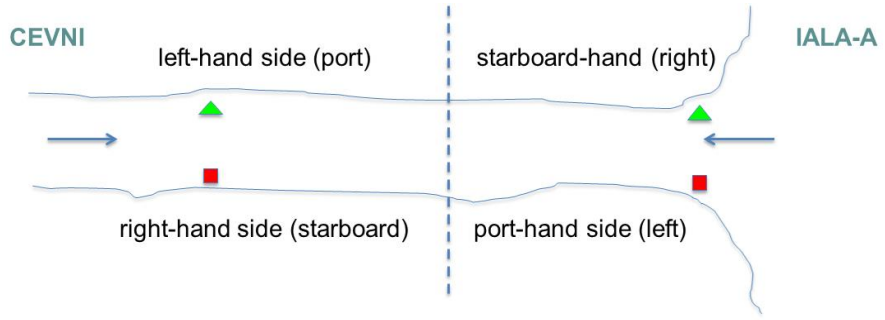
X. Annex II – Why is AtoN message 21 not sufficient for inland navigation?

65 The AIS message 21 is offering the values 24 and 25 to encode the buoys which are marking the fairway, but IALA areas are using different buoys then inland waterways:

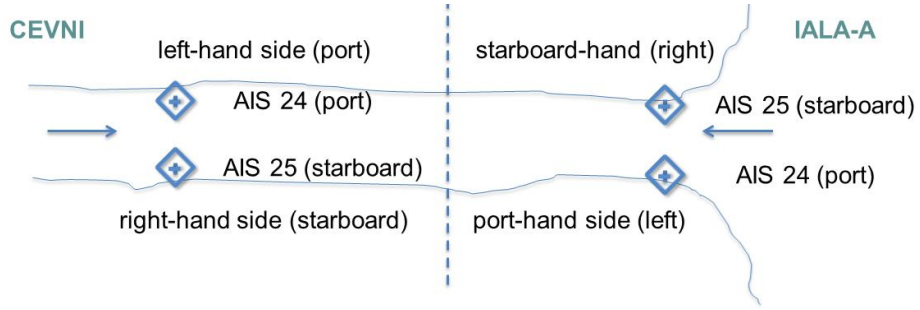
AIS message 21 Type of AtoN	IALA-A	CEVNI and Rhine Police Regulation
24 Port hand mark (left)	Red / square	Green / conical
25 Starboard hand mark (right)	Green / conical	Red /square

66. An Inland ECDIS is therefore not able to determine the correct display of the AtoN message and has to use a generic symbol. The type of the buoy can only be provided as textual description in the pick report.

67. In inland navigation the left-hand side and the right-hand side are determined by looking downstream. In maritime navigation starboard-hand and port-hand are determined by looking towards the entry into a harbour or an inland waterway when coming from the seaside. In the real world the green and red buoys are therefore always on the same side:

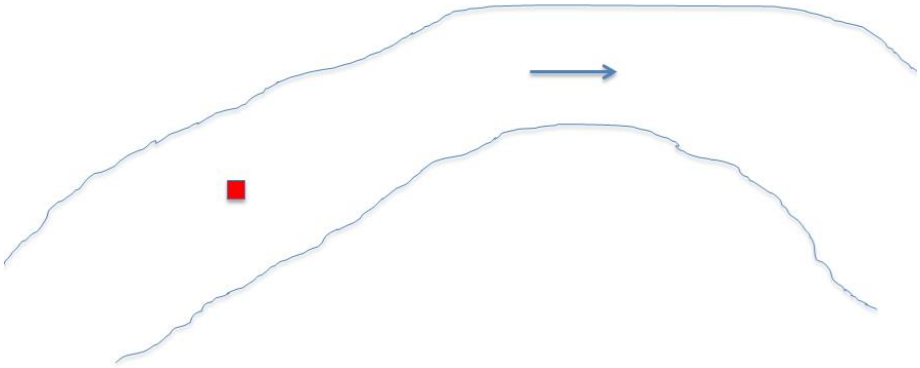


If the information about the buoys is provided by AtoN messages it is only possible to display generic symbols and the textual description:

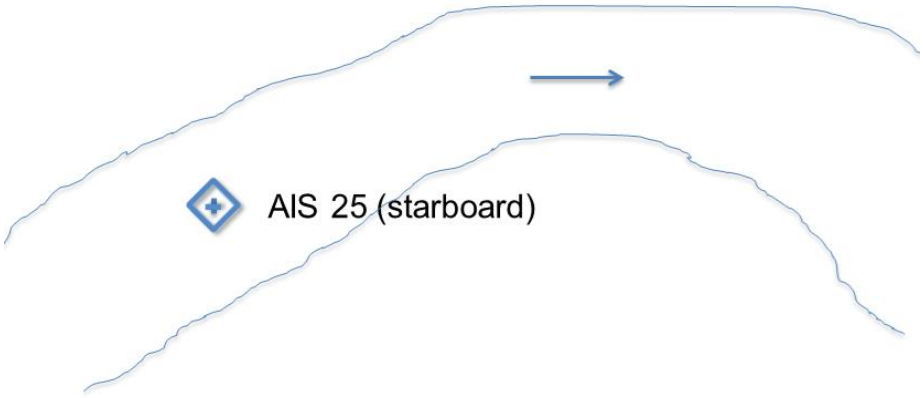


68. The skipper is therefore not able to decide on which side he has to pass the buoy if he does not know whether it is an IALA-A buoy or a CEVNI buoy. Neither the AtoN-symbolization nor the AtoN pick report is containing unambiguous information.

69. Real buoys are always unambiguous. Even if there is only one buoy in the middle of the fairway and the skipper does not know whether it is an IALA-A or a CEVNI buoy he knows on which side he has to pass the buoy:



But the information provided by the AtoN is not clear:



70. The CEVNI buoy “Bifurcation of the fairway” (without a preferred channel) cannot be encoded in the AtoN message. For the CEVNI buoys “Bifurcation of the fairway, preferable to pass on the right/left hand side” there is the same problem with right and left respectively red and green as for the buoys marking the sides of the fairway.

71. An Inland specific AtoN message is therefore needed to transmit clear information about buoys on inland waterways and the Inland ECDIS standard has to be amended to enable a correct display of the AtoN.