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AIS+ - facilitating on board use of AIS Application-Specific Messages

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In May 2010 the International Maritime Organization approved 17 AIS Application-Specific Messages (ASM) for international use. To facilitate and speed up the process of taking them into operational use, VTT together with the Baltic Sea Action Group and IBM, set up a project with the aim of implementing software to be used on board ships providing a User interface for utilising a subset of the new messages. To achieve the objectives, the software should be available free of charge and easy to take into use. Thus, development of the software called AIS+ started from existing Open Source software to which a user interface for ASMs was implemented. Preliminary versions were installed on trial ships and the implementation was continued based on user feedback. Connecting a PC with dedicated software to the AIS transponder proved to be a practical solution to enhance AIS messaging. Some user feedback has been obtained, and more extensive testing periods are planned, but the implementation of the full set of messages is pending on funding decisions.

Introduction

The Automatic Identification System (AIS) is a powerful tool for ship identification and tracking. However, AIS could be exploited more efficiently to improve the situational awareness both on board and ashore as well as reduce the manual workload. To respond to these challenges, the functionalities and information content of AIS have recently been augmented by defining new Application-Specific Messages (ASM) [1]. For these messages, also referred to as Binary addressed and broadcast messages (Message ID 6 and 8), multiple content structures can be defined using an Application identifier. The International Maritime Organization (IMO) published a circular with seven ASMs for international trial use in 2004 [2] and new circular in 2010 [3], revoking the old one from 1 January 2013, containing 17 messages. These messages could be used for communicating of area related information such as navigational warnings as well as weather information, ship reporting data, route information, traffic management etc.

So far, the usage of the international ASMs has been quite limited. The Number of persons onboard message is in moderately frequent use. Finland and Sweden broadcast real time weather information along their coasts and USA has also set up test beds where weather information and area notice messaging is tested. In addition, regional ASMs are in use in inland traffic in parts of Europe and Canada. One of the main barriers for a wider use of ASMs is that current bridge equipment in general cannot handle the new messages. Neither do the current performance standards for ECDIS and radars [4] take the display and user interface of new information into account. This makes equipment manufacturers cautious in updating their products. With a limited number of users, the authorities have neither updated their systems nor procedures to serve shipping using ASMs.

The AIS+ open source software strives to overcome the implementation barriers by providing shipping with an easy and low cost solution for taking the ASM services in use. With AIS+ the user can send and receive ASMs through an intuitive user interface. AIS+ is currently in use on a limited number of test ships, but the aim is to make it available for all ships free of charge in the future. It is hoped that AIS+ will motivate both authorities and manufacturers to speed up their implementation of ASMs.

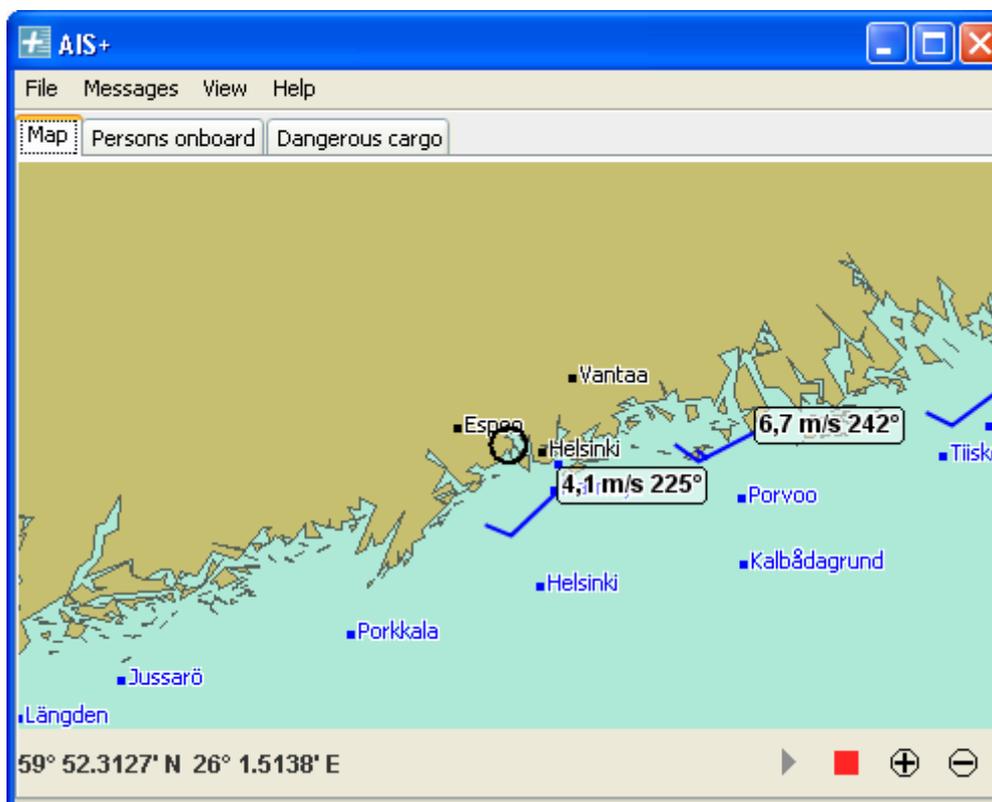
AIS+ Software

AIS+ is an application for receiving and sending AIS ASMs using a user-friendly user interface. The software can be run on a normal PC connected to the AIS transmitter through the Pilot plug. AIS+ reads AIS messages from the serial or USB port of the computer, decodes them and visualises the information content. It also codes user inputs into AIS ASM messages and sends them to the AIS transmitter for transmission. The ASMs currently implemented in AIS+ are: Meteorological and hydrological data (FI = 11), Area notice (FI = 22 and 23) (receiving), Number of persons on board (FI = 16), Dangerous cargo indication (FI = 25) and

Area notice (sending) [2], [3], all defined under the international designated area code (DAC = 1). In addition, AIS Addressed text messages (Message ID 6, FI = 0) can be sent. AIS+ contains public domain GSHHS (Global Self-consistent, Hierarchical, High-resolution Shoreline Database) coastline data for the whole world at five different granularity levels. It uses some components from the open source Freeais.org software that can be used to show AIS targets and their information.

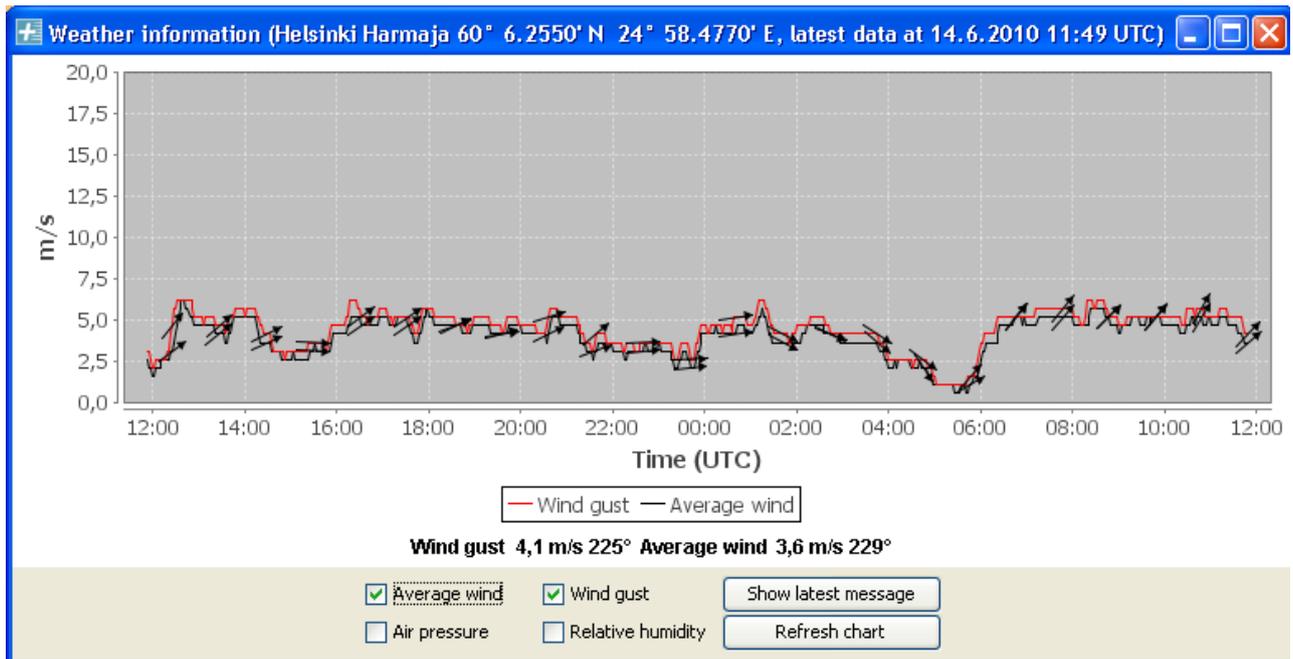
The hardware requirements for AIS+ are a normal PC with Windows operating system and a converter cable to the Pilot plug of the AIS transponder from the serial or USB port of the PC. The performance requirements for the PC are moderate and the program should run on any modern PC.

The main view of the AIS+ program is shown in the figure below. The map view shows the vessel's current own position with a black circle. The location information is retrieved from the vessels own position report AIS messages and the map by default follows the vessel. The snapshots in this document are from AIS+ attached to the AIS transponder at VTT's office in Espoo, so the location ashore is not a mistake. The map also shows major place-names and lighthouses depending on the zoom level of the map. The wind barbs with an attached wind speed and direction display show the current wind gust at available weather observation stations.



AIS+ main view

By clicking the wind information on the main display one can see the observation history at the weather station as shown in the figure below. The history data is logged by AIS+ from the real time observations received as ASMs. Currently the Finnish weather stations transmit average wind, wind gust, air pressure and relative humidity observations and the user can select which data is shown in the graph. The dialog shows the observation graphs for the last 24 hours. The latest received data for the other weather parameters defined in the met/hydro message (FI = 11) can also be viewed, but a graphical display of them is currently not implemented.



Weather information dialog

AIS+ can be used to create area notices consisting of a single geography type, i.e. circle, rectangle, sector, polyline or polygon. The area notice specification in the IMO circular [3] allows a combination of these in a single message but that is not currently implemented. The area notice creation dialog in the figure below shows the fields that can be filled for the area notice, depending on the selected area type. The area can be drawn on the map with a few clicks and for circles, rectangles and sectors the location parameters can also be tuned manually in the dialog.

Create area notice [X]

Area notice type: Broadcast Addressed to MMSI []

AIS channel: A

Send interval (minutes): 30

Notice description: 10: Caution Area: Divers down

Start date UTC: 7.10.2010 08:00

End date UTC: 7.10.2010 12:00

Message linkage ID: []

Select area type: Circle or point

Circle center coordinates:

Longitude: 24.9472

Latitude: 60.1081

Circle radius (0-4095): 750 m

Scale multiplicator: 1

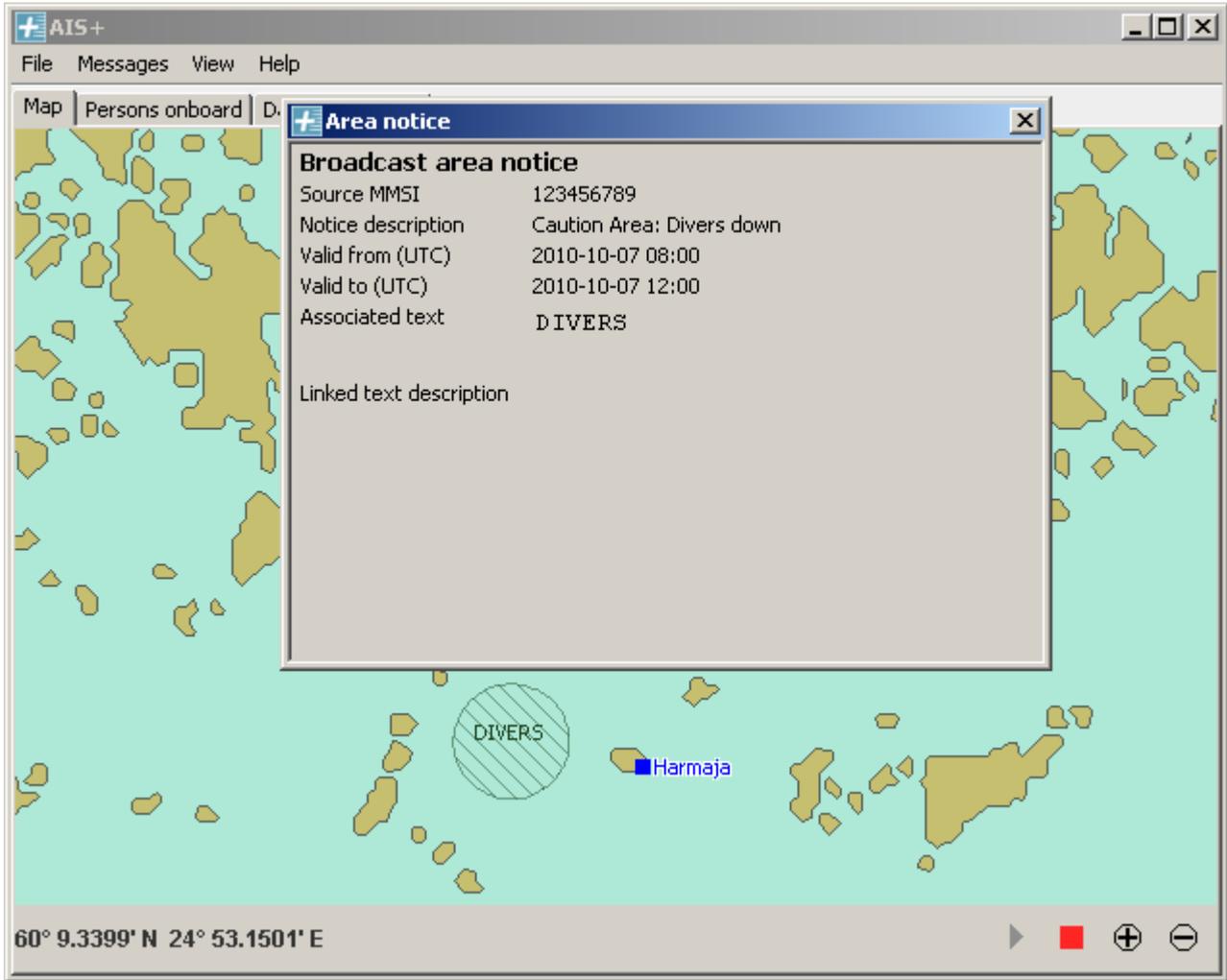
Associated text (120/126): DIVERS

Linked text description (161/161): []

OK Cancel

Area notice generation dialog

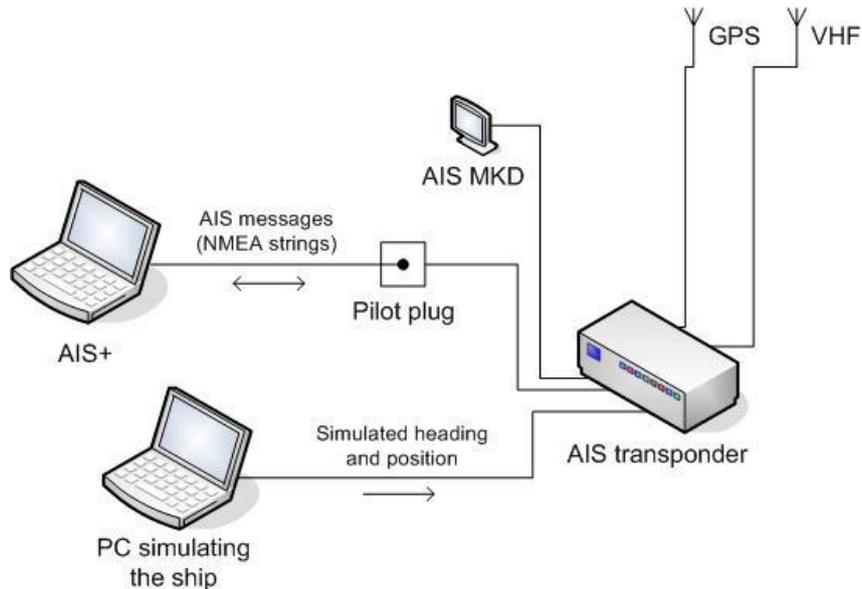
The resulting area notice is shown in the figure below with an opened area notice information dialog. Here the map is zoomed to the best coastline resolution (40 meters).



Area notice that is sent by the current vessel

Tests and user experience

For development and testing purposes, an AIS transponder was installed at VTT's office in Espoo. The installation included a Furuno FA-150 transponder with Minimum Keyboard Display (MKD), a Pilot plug as well as GPS and VHF antennas on the roof of the building, see the figure below. Further, a computer was needed to simulate the signals the transponder is expecting to receive from other instrumentation on board. The transponder would generate alarms if it did not receive heading and position data from the computer. A radio licence and MMSI number was acquired for the equipment, registered as a ship AIS transponder. The AIS office instalment proved very convenient and useful for testing development versions of AIS+ and verifying its functionality.



Test setting at VTT's office in Espoo

The first version of AIS+ was installed on two passenger ferries in January 2010 (m/s Gabriella and m/s Mariella). During spring 2010 the software was enhanced with additional functionality and a more visually pleasing map background was implemented. Feedback was obtained from navigation officers after two weeks of use in June 2010. The new map background was appreciated - most of the comments were related to how to present the weather information.

More observation points were asked for: especially in the vicinity of the port of Mariehamn, which is visited during each voyage of the ship between Helsinki and Stockholm. Also information from wave buoys was called for.

As long as the number of AIS+ users are not that many it was suggested that a list of ships with AIS+ could be shown to the user in order to guide the user when sending addressed messages - in this case related to area warnings. As there is a way of interrogating the capability of the receiving application, this could be used to make a list of receivers being able to handle data sent as ASMs. Note that the capability is given as a set of FI:s available. The interrogation is performed using IFM 3 Capability interrogation (DAC = 1, FI = 3) and the answer as IFM 4 Capability reply (DAC = 1, FI = 4), see [5]. This feature is not yet implemented in AIS+.

Finally weather *forecasts* were asked for. This kind of information is, however, not available as ASM messages. A possibility to respond to this request would be to transmit warnings about severe weather conditions as ASMs (e.g. Area notice FI = 22, Area type 23, Storm Front). This would, however, probably require manual work by the local met-office and a user interface to input this data.

Further test are planned to be conducted on board m/s Katariina, which is used as a training vessel by Kymenlaakso University of Applied Sciences located in the city of Kotka. The way of performing the test cases will depend on whether a dedicated AIS base station at the university building will be available or not. In case of absence of the base station, the tests will be limited to experiences of getting weather observations and trials regarding sending of Area notices.

If the plans to install a base station succeed, the crew on board the ship will create area messages and send these primarily as broadcast messages, then as addressed messages. Receiving of the messages will be tested by the base station and potentially also using inexpensive portable AIS receivers. A limitation for using AIS receivers is that they, in principal, cannot receive addressed messages due to lack of an own MMSI number. The tests will be repeated with the roles reversed following a detailed test plan, yet to be prepared. Feedback will be gathered regarding technical reliability and usability.

Conclusions and future development

Connecting a PC with dedicated AIS+ software to the AIS transponder has proved to be a practical solution to enhance AIS messaging. It provides a low-cost and convenient option for ships to take new features of AIS, such as ASMs, into use at an early stage. It is fairly straight-forward to further expand the features of AIS+ using the existing platform, if needed. The PC keyboard also facilitates data input, compared to the MKD and ECDIS user interfaces.

The users have found AIS+ easy to use. However, to motivate the ships to utilise ASMs, there must be enough services available. Only when the ship crews find ASMs to truly make their work easier, will the use increase. Hopefully the authorities will realise the potential of ASMs in making the communication with ships more efficient, upgrading the services provided to ships and contributing to safer seafaring. Concrete examples would be to upgrade the shore side capabilities to support ship reporting using ASMs as well as sending navigational warnings and current weather information using ASMs.

The focus on further efforts will be to encourage authorities to provide services through AIS ASM. This will be accomplished through limited trials showing both the technical capabilities and the user processes to utilise this communication means for the services and warnings. Also issues like how to handle multiple Presentation Interfaces (e.g. an ECDIS and AIS+) connected to an AIS transponder should be investigated and resolved.

The set of implemented ASMs in AIS+ is still very limited. This set will be enhanced depending on funding and user requests. Also ideas to enhance AIS+ to be used as a User Interface to input all Voyage related data to the AIS transponder, will be considered.

VTT has also plans to use AIS+ as a test bench for development of portrayal guidelines for ASM information. The AIS+ development can be followed on the web page www.aisplus.vtt.fi.

Acknowledgements

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