




## The Baltic AIS Trial - ADMINISTRATIVE FINAL REPORT

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Project responsibility Project manager Markus Porthin (former project managers: Sanna Sonninen, Jukka Sassi)	Report author Markus Porthin	
Client VTT Finnish Maritime Administration Finnish Environment Institute (SYKE) Swedish Maritime Administration Estonian Maritime Administration Ministry of Transport and Communications Finland	Client referral and/or contact person Sanna Sonninen (FMA) Meri Hietala (SYKE) Rolf Zetterberg (SMA) Alar Siht (EMA) Jari Gröhn (MINTC)	
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Signatures	Signatures	Signatures
		
Written by Markus Porthin Project Manager, Research Scientist	Reviewed by Jukka Sassi Research Engineer	Accepted by Heikki Kanner Technology Manager

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### 1. Objectives

The objective of the AISBaltic project is to (from the project plan):

- identify the information needs of Baltic Sea states maritime safety, security, environment and SAR authorities that may be fulfilled by the limited information available from AIS,
- define what modifications to static and voyage related information would be essential to fulfil the identified information needs,
- study the possibilities of using AIS binary messages as additional source of information and to critically analyse the present content of these messages to commonly define such message contents that provide for the requirements of the above mentioned authorities,
- identify a demonstrated need for information not presently included in any AIS information and, if such a need is obvious, agree on the format and content of a new binary message including this information,
- test the usability of binary messages in field tests at least in the Gulf of Finland (transmission tests are made between GOFREP Traffic Centre Helsinki Traffic and ships) but not necessarily limited to that area,
- discuss the project with IALA and HELCOM to gain information essential for the conducting of this work and to share the results achieved,
- produce a proposal to IMO NAV Sub-Committee in 2008 for amending AIS operation on the basis of the identified needs for modifications to AIS static and voyage related information, to the predefined binary messages and of the possible new binary message(s) and to report the results of the trial use of binary messages at the Baltic Sea,
- provide means to enhance the SAR, VTS / SRS and environment protection operations and enable more reliable and efficient information

exchange by e.g. reducing VHF radio traffic where practical and simultaneously increasing the information available to authorities and

- identify and document any additional results achieved in the project such as the enhanced use of AIS or the means onboard providing for efficient use of AIS and especially the use of binary messages.

## 2. Results

### 2.1. Full results

The project fulfilled all initial objectives set out in Chapter 1, with one exception: it was agreed by the Steering group that the project will, deviating from the original project plan, prepare an information paper for the 2008 IMO NAV meeting and submit the project's final proposals for amendments to AIS content in 2009.

A short summary of the project and its results can be found in Porthin, M., Karppinen, S. 2009 (see publication list and Appendix 2).

### 2.2. Reports

Reports to the International Maritime Organization (IMO) based on and prepared by the AISBALTIC project:

"The Baltic AIS trial (AISBALTIC) project", Submitted by Finland and Estonia, IMO, Sub-Committee on Safety of Navigation, 54<sup>th</sup> session, NAV 54/INF.8, 2008.

"Inclusion of five new AIS binary messages developed in the Baltic AIS trial (AISBALTIC) project", Submitted by Denmark, Estonia, Finland, Latvia, Lithuania, Poland and Sweden, IMO, Sub-Committee on Safety of Navigation, 55<sup>th</sup> session, NAV 55/14/2, 2009.

"Remarks on the use of AIS based on experience from the Baltic AIS trial (AISBALTIC) project", Submitted by Finland, IMO, Sub-Committee on Safety of Navigation, 55<sup>th</sup> session, NAV 55/INF.11, 2009.

Report to the International Maritime Organization (IMO) partly based on results from the AISBALTIC project:

"Report from the AIS Binary Messages Correspondence Group", Submitted by Sweden, IMO, Sub-Committee on Safety of Navigation, 55<sup>th</sup> session, NAV 55/14, 2009.

### 2.3. Publications

Porthin, M., Karppinen, S. 2009. "Safer Seafaring through Improved Information Exchange", Scientific activities in Safety & Security, VTT.

Porthin, M., Zetterberg, R. & Sonninen, S. 2010. "AIS Binary Messages – Developments in the Baltic and progress in IMO", approved to 17<sup>th</sup> Conference of the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA-AISM), Cape Town, South Africa.

### 3. Resources and organisation

#### Project Manager:

Markus Porthin

Former Project managers: Sanna Sonninen and Jukka Sassi

#### Other people involved in the project:

VTT: Sampo Karppinen

Other: The steering group as well as several experts from the Baltic Sea countries, HELCOM and EMSA.

#### Project Steering group:

Markus Porthin (VTT) (replaced Sanna Sonninen when she moved to FMA in fall 2007)

Sanna Sonninen (FMA) (replaced Kari Kosonen (FMA) when moving from VTT to FMA)

Rolf Bäckström (FMA), retired, replaced by Kaisu Heikonen

Meri Hietala (SYKE)

Rolf Zetterberg (SMA)

Alar Siht (EMA)

Jari Gröhn (MINTC)

Tom Lundell, (Finnish Coast Guard)

#### Subcontractors and purchased services:

Navielektro Ky: carrying out of binary message exchange tests, technical implementation

MeetingSupport, Denmark: use of group decision support system in workshops

#### 4. Scheduling and main events

27 February 2007	1 <sup>st</sup> Steering group meeting
26 March 2007	2 <sup>nd</sup> Steering group meeting
2 May 2007	3 <sup>rd</sup> Steering group meeting
18 June 2007	ThinkTank 1 workshop, Helsinki: Identification of maritime authorities' information needs
Fall 2007	Full-scale transmission tests of the IMO defined binary message applications between Maritime Traffic Centre in Helsinki and ships
22 October – 4 November 2007	ThinkTank 2 Internet workshop: Identification of maritime authorities' information needs, continued
3 – 10 December 2007	ThinkTank 3 Internet workshop: Prioritisation of information needs
17 December 2007	ThinkTank 4 workshop: Information needs to be compiled into new AIS messages
19 March 2008	4 <sup>th</sup> Steering group meeting
30 June – 4 July 2008	IMO, Sub-Committee on Safety of Navigation 54 <sup>th</sup> meeting, London
25 – 28 Aug 2008	Working group meetings in Espoo
27 – 31 July 2009	IMO, Sub-Committee on Safety of Navigation 55 <sup>th</sup> meeting, London
8 September 2009	Final Steering group meeting

#### 5. Problems and deviations from the plan

The Steering group agreed on 19 March, 2008 that the project will, deviating from the original project plan, prepare an information paper for the 2008 IMO NAV meeting and submit the project's final proposals for amendments to AIS content to IMO in 2009. Thus the project was prolonged until summer 2009. The deviation in the time schedule was due to a slower than anticipated process of collecting and processing the views of the Baltic Sea countries and compiling them into amendment proposals of the AIS system.

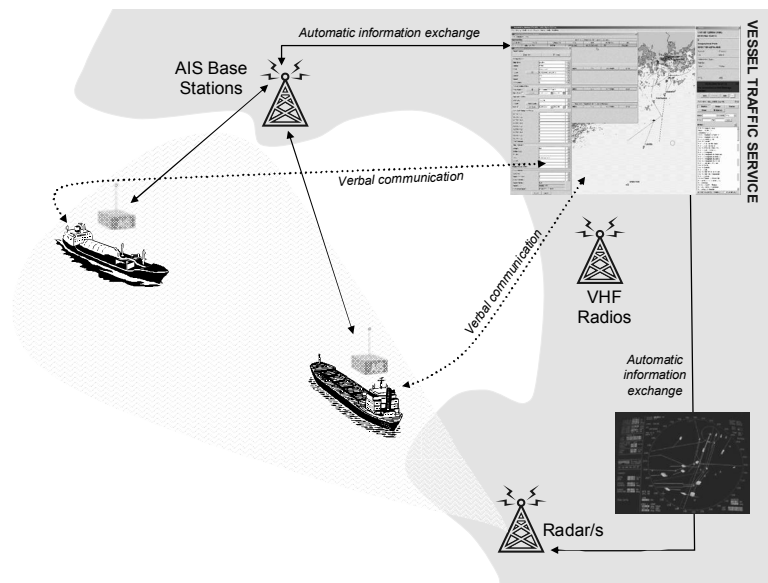
#### 6. Summary

The project fulfilled all main objectives excellently and gave an important contribution to the development of the marine Automatic Identification System (AIS).

## Appendices

1. Project plan
2. Porthin, M., Karppinen, S. 2009. "Safer Seafaring through Improved Information Exchange", Scientific activities in Safety & Security, VTT.

### PROJECT PLAN



**Project name: Baltic Sea AIS Trial**  
Project's short name: AISBaltic

Project number: 12977

## Contents

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### 1 Background

Automatic Identification System (AIS) is a system for ship identification and tracking that has the capability of both transmitting and receiving information. AIS can be considered as one of the most significant technical tools developed since the invention of radar. However, its information exchange capacity is limited and International Maritime Organization (IMO) administers the content of the AIS messages to avoid the overloading of the AIS frequencies. Various stakeholders have proposed additional needs to the present content of the AIS information and IMO shall in 2008 next open the discussion on the amendments to AIS operation.

Through AIS ships send static and voyage related ship-specific information to other ships and to land-based systems. Information on e.g. ship's identification (name, call sign, IMO number and MMSI number), position, destination, vessel type, etc. is exchanged. The introduction of AIS onboard ships was in many ways a remarkable improvement but the information provided with the system could be defined to better serve the needs of users both onboard and especially ashore.

In addition to the exchange of ship's static and voyage related information IMO has given a possibility for the application of binary messages. In IMO circular SN/Circ. 236<sup>1</sup> seven predefined binary messages are provided for test use. Use of these binary messages may enhance the use of AIS but the relevance of the information contained in these messages leaves lot to be desired.

This project originates from the need to reduce the workload caused on ships bridges and land based authorities by various demands for reporting and to improve the quality of information available. This can be achieved by reducing verbal communication i.e. VHF radio traffic and further the availability of the specific information needed by maritime, SAR and environmental authorities to enhance safety, security and protection of the environment.

Before the work described in this document is even started, several obvious benefits of enhanced quality of AIS information to ships and authorities can be foreseen. One significant positive effect to the safety of navigation is the increase of vessel traffic predictability. Predictability provides for better planning and time for countermeasures against escalating high risk situations. In addition to onboard decision-making, quality information on vessel traffic (ship types, cargoes, routes, incidents, etc.) received in good time enables providing safety related information and prerequisites for the development of new concepts for intelligent decision-making support systems, risk indicating calculations and strategic traffic planning just to mention a few. Information exchange must be

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<sup>1</sup> SN/Circ. 236 Guidance on the application of binary messages. IMO 28.5.2004.



developed before efforts can be placed on developing systems for automatic monitoring and analysing of the information and indicating of relevant observations.

## 2 Objectives and scope

### Lack of sufficient information, and availability of information with limited usability.

The present definition of ship’s static and voyage related information included in AIS is mainly the result of work done in the IMO Sub-Committee on Safety of Navigation (NAV) and serves its user well in many respect. The development of vessel traffic monitoring systems and of the international conventions has generated a need to amend this definition. For example the usability of AIS information related to cargo is rather poor. It has also been difficult for the officers onboard vessels to understand which of the available options (Fig. 1) for ship type second digit is the correct one for their vessel. The only variant in the present definition of cargo carried (Fig. 1) is the pollutant category indicator for noxious and liquid substances that is based on the definition found in the International Convention for the Prevention of Pollution from Ships (MARPOL) and in the International Bulk Chemical Code (IBC Code). Thus choosing of the ship type second digit is relevant only vessels with cargo classified to these pollution categories. A problem arises if the vessel carries dangerous cargoes not classified under MARPOL pollutant categories or cargoes classified under more than one pollutant category.

Identifiers Used by Ships to Report Their Type*	
First digit	Second digit
0 – Not used	0–All ships of this type
1 – Reserved for future use	1– Carrying DG, HS, or MP IMO hazard or pollutant category A
2 – WIG	2– Carrying DG, HS, or MP IMO hazard or pollutant category B
3 – See Table 12 below	3– Carrying DG, HS, or MP IMO hazard or pollutant category C
4 – HSC	4– Carrying DG, HS, or MP IMO hazard or pollutant category D
5 – See Table 12 below	5– reserved for future use
6– Passenger ships	6- reserved for future use
7– Cargo ships	7–reserved for future use
8– Tankers	8 – reserved for future use
9– Other types of ship	9 – No additional Information

\* This formatter requires two digits: The first is any digit from the column on the left, the second is any digit from the column on the right

DG = Dangerous Goods; HS = Harmful Substances; MP = Marine Pollutants

Figure 1 AIS ship type identifiers (IALA 2003<sup>2</sup>)(DG = dangerous goods, HS = harmful substances, MP = marine pollutant)

The revised version of MARPOL Annex II Regulations for the control of pollution by noxious liquid substances in bulk entering into force on the 1.1.2007 has induced another need to update the definition of cargo information in AIS. The revised annex includes a new four-category categorisation system (X, Y, Z & Other substances) for noxious and liquid substances and replaces the old A, B, C and D categorisation that is now used in AIS definition. New classes are not with the same content as the old are. Therefore, after

<sup>2</sup> IALA Guideline No. 1028 On The Automatic Identification (AIS) Volume 1, Part I, Operational Issues (Edition 1.3 December 2004)

1.1.2007 part of the definition of what substances are included to AIS ship type second digit is no longer valid.

Presumably, when the AIS information items would be discussed among relevant authorities, more needs for minor adjustments could be found. As an example the need for making the use of United Nations LOCODEs mandatory in the “next port of call” information can be mentioned. This need for improvement has been observed while making data enquiries from the Helsinki Commission (HELCOM) AIS database and from the GOFREP operation: as long as the information concerning port of destination is a free text field the name of a single port continues to be written in numerous ways.

The information available in AIS is very limited as shall continue to be so. To improve the amount and quality of information available for authorities from AIS, binary messages may be used. IMO gave in its circular (SN/Circ. 236) a possibility for the application of seven predefined binary messages:

1. Meteorological and hydrological data
2. Dangerous Cargo Indication
3. Fairway Closed
4. Tidal window
5. Extended ship static and voyage related data
6. Number of Persons onboard
7. Pseudo-AIS targets

The possibility of using AIS binary messages is welcomed as a means of collecting information required by the authorities almost automatically. In fact, if properly developed systems are available, automatic information acquisition from e.g. named area or defined limit is possible. This clearly enhances the use of AIS but the present predefined content of these messages seems to provide little added value to the present static and voyage related information.

In addition to the predefined messages, member governments may propose new binary messages to IMO. In this case, member governments should address a demonstrated operational need to the Sub-Committee on the Safety of Navigation (NAV) and provide a proposed format and content of the message.

Thus, the objective of the AISBaltic project is to

- identify the information needs of Baltic Sea states maritime safety, security, environment and SAR authorities that may be fulfilled by the limited information available from AIS,
- define what modifications to static and voyage related information would be essential to fulfil the identified information needs,
- study the possibilities of using AIS binary messages as additional source of information and to critically analyse the present content of these messages to commonly define such message contents that provide for the requirements of the above mentioned authorities,

- identify a demonstrated need for information not presently included in any AIS information and, if such a need is obvious, agree on the format and content of a new binary message including this information,
- test the usability of binary messages in field tests at least in the Gulf of Finland (transmission tests are made between GOFREP Traffic Centre Helsinki Traffic and ships) but not necessarily limited to that area,
- discuss the project with IALA and HELCOM to gain information essential for the conducting of this work and to share the results achieved,
- produce a proposal to IMO NAV Sub-Committee in 2008 for amending AIS operation on the basis of the identified needs for modifications to AIS static and voyage related information, to the predefined binary messages and of the possible new binary message(s) and to report the results of the trial use of binary messages at the Baltic Sea,
- provide means to enhance the SAR, VTS / SRS and environment protection operations and enable more reliable and efficient information exchange by e.g. reducing VHF radio traffic where practical and simultaneously increasing the information available to authorities and
- identify and document any additional results achieved in the project such as the enhanced use of AIS or the means onboard providing for efficient use of AIS and especially the use of binary messages.

When planning the testing of binary message exchange it should be remembered that the display capability of binary messages is not part of the mandatory AIS Minimum Keyboard and Display (MKD). If AIS is not equipped with this capability additional hardware to AIS and dedicated software may be needed<sup>3</sup>. In the transmission test of the AISBaltic projects this will not cause problems as all binary message information is produced with a dedicated lap-top computer that shall be connected to the AIS equipment Pilot plug onboard the vessels participating the trial.

The amount of transmissions needed and the possible need for acknowledgement of receipt shall also be evaluated during the testing of binary message transmission. The acknowledgement of receipt may be important in cases where communication with a vessel occurs in the areas where the reliability of receiving messages poor i.e. in the "Aloha-zone". In addition the suitability of the most common AIS user interfaces for a more extensive reporting is to be evaluated. It is very likely that a significantly better user interface is needed since at present the usability is generally very poor.

The operative means for ensuring the quality and correctness of the AIS information needs to be developed and implemented. The present situation is clearly unsatisfactory and means for solving this shall be assessed during the project. This project will compile the information needed by relevant authorities but also as a result of the work a critical evaluation on whether AIS is the correct means for the defined information exchange is documented.

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<sup>3</sup> SN/Circ. 236 Guidance on the application of binary messages, Annex 1 Guidance on AIS binary messages. IMO 28.5.2004.

### 3 Working plan

#### **Phase 1: January – May 2007**

In **the first phase** of the project a more detailed project plan is finalized by the project partners. Based on the documentation provided by IMO, IALA, IEC and ITU a description of the present state of AIS development and the possibilities for changes are determined. Information on the content of the ongoing related development work e.g. in Russia (use of alternate VHF frequencies) is looked into and possible needs for cooperation discussed. The views of the national maritime and environment authorities, coast guard (including search and rescue operations) and military on the needs for amending the AIS information available and the formats used is discussed and documented. This information is collected to create basic knowledge needed in the second phase of the project. Preparations for the trial tests of binary message exchange between ships and Helsinki Traffic/Helsinki VTS is also started during this phase. Discussions with shipping companies are started to reach cooperation agreements to ensure that sufficient number of vessels participate in the tests.

**The result of the first phase** is a detailed action plan and documented views of Finnish authorities on the needs for development. In addition, a presentation and an information sheet of the project are made. These documents can be distributed to the authorities of the Baltic Sea countries and Norway when they are invited to cooperate in this project. The project is presented to IALA and HELCOM to gain their support for the development and to obtain valuable information.

If the partners of this project agree that a preliminary questioning (e.g. web-based inquiry) needs to be conducted to gain sufficient information for ThinkTank-session held during the second phase, it shall be completed during the this phase.

#### **Phase 2: April – September 2007**

During **the second phase** material describing the project is delivered to the relevant authorities in all Baltic Sea countries and they are invited to participate in the project in a ThinkTank-session held for defining common views on the needs for AIS information modifications and new binary messages. The ThinkTank-session is conducted as an organized brainstorming and evaluation process with the help of a computer based group decision support system (GDSS). With this working method, it is possible to effectively collect, store and categorize the views of participants and produce summations as the work proceeds. The plans for binary message exchange testing and the required technical facilities are also produced during this phase. Vessels participating in the tests are chosen and information concerning their AIS equipment noted.

**The result of the second phase** is the material produced before and during the ThinkTank-session. This material is essential to be able to proceed with the work in the third phase.

#### **Phase 3: August 2007 – March 2008**

Testing of exchange of binary messages between vessels and Helsinki Traffic/Helsinki VTS is realized during **the third phase**. If any other country wishes to participate in the testing, they are welcomed and plans for testing are shared. The work concentrated on defining the modification needs to static and voyage related information, to predefined binary messages and on identifying needs for new binary messages continues. For this

purpose a second ThinkTank-session is organized. Preliminary results of the testing of exchange of binary messages are reported in this second session. The objective of this session is to reach an agreement on the AIS information modification needs. Based on the agreement, a proposal is prepared to IMO NAV Sub-Committee for amending AIS operation on the basis of the identified needs for modifications to AIS static and voyage related information, to the predefined binary messages and of the possible new binary message(s). Also the results of the trial use of binary messages at the Baltic Sea is reported to IALA, IMO and HELCOM.

**The results of the third phase** are a report of the testing of exchange of binary messages, a definition of the modification needs to AIS static and voyage related information and to the predefined binary messages and the need to implement new binary message(s). All additional observations related to AIS operation that are produced during the project are also reported. The proposal to IMO shall also be written during the third phase.

#### 4 Resources, organization and schedule

Project manager: VTT

Leading partner: Finnish Maritime Administration (FMA)

Partners: Frontier Guard, Finnish Environment Institute (SYKE), Estonian Maritime Administration and Swedish Maritime Administration

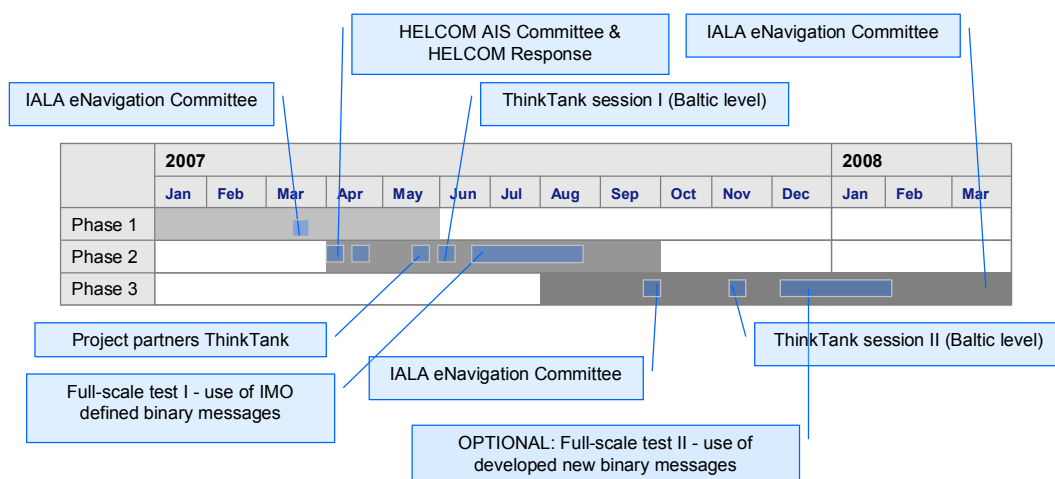
Steering committee members: FMA, Frontier Guard, SYKE, VTT, Estonian Maritime Administration and Swedish Maritime Administration

Sub-contractors: Navielektro Ky and Meetingsupport (GroupSystems, Denmark)

Special equipment and software: Navielektro Ky

#### Project schedule

Project Main milestones of the AISBaltic project:



## 5 Costs and Funding

### Costs of the project:

Phase 1: Work 1,75 working months = 24 500 € (possible web-based inquiry excluded)

Phase 2: Work 2,2 working months = 30 700€

Phase 3: Work 1,2 working months = 16 800€ (2007)

Work 1,8 working months = 25 000€ (2008)

Estimated additional costs from subcontracting during Phases 1 – 3 is 40 000€.

Subcontracting consists of carrying out of binary message exchange tests, technical implementation by Navielektro Ky and from the use of group decision support system (GDSS) in ThinkTank –session (GroupSystems Consulting Partner, Denmark).

Project funding:

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### Participant

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VTT

Finnish Maritime Administration

Finnish Environment Institute (SYKE)

Swedish Maritime Administration

Estonian Maritime Administration

LVM

# SAFER SEAFARING THROUGH IMPROVED INFORMATION EXCHANGE

Markus Porthin, Sampo Karppinen

*New messages for automatically exchanging information through the Automatic Identification System were developed to decrease the workload of navigators and improve the preparedness of the authorities, thus improving the level of maritime safety and the protection of the environment.*

## INTRODUCTION

The Automatic Identification System (AIS) has been developed to improve the safety and efficiency of the increasing marine traffic. AIS is a mandatory piece of navigational equipment for automatic data exchange between ships and with shore-based facilities, with the aim of assisting target tracking and simplifying information exchange (Figure 1). The Baltic AIS Trial project (AISBALTIC) was founded in 2007 as a part of the HELCOM Baltic Sea Action Plan to improve the information content in AIS [1].

## METHODS

The information transferred through AIS is arranged as a series of standardised messages. Because the VHF radio frequencies used in AIS data transmission have limited capacity, the content of the messages must be care-

fully chosen. In 2004, the International Maritime Organization (IMO) selected seven messages to extend the information content in AIS. In the AISBALTIC project, the technical usability of these messages was tested and their information content evaluated in field tests between the Helsinki GOFREP Traffic Centre and dedicated vessels in the Gulf of Finland (Figure 2).

In order to assess the need for changes in AIS, expert workshops were organised [2]. The operational information needs of the various authorities (for maritime safety, search and rescue, environment, prevention and control of pollution, and maritime security) representing the Baltic Sea countries, European Maritime Safety Agency (EMSA) and the European Commission, were collected. The most important needs were compared with the information presently available in AIS, and as a result, a series of new messages was compiled.

## RESULTS

According to the field tests, the IMO defined messages contain relevant information, albeit not in an optimal form. It was also noted that the older versions of navigational systems were not compatible with the messages.

As a result of the information need survey, five messages covering matters specifically lacking from the present AIS definitions were compiled [3,4]. Improvements to the current standard messages were also suggested [5]. The new messages improve the capability of ships to report their dangerous cargo. They also provide extended static and voyage related information, and transmit current information concerning specific areas or routes. Finally, one of the messages attaches additional free text information to other messages.

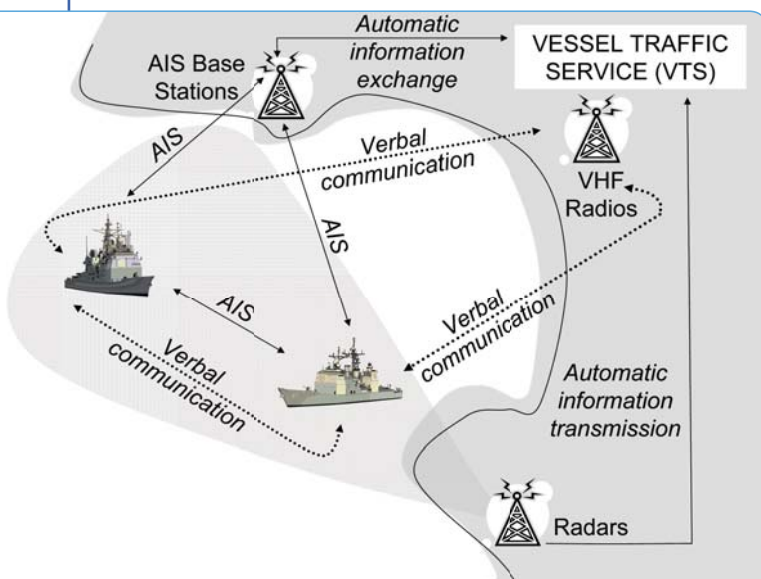


Figure 1. Example of communication between ships and shore-based facilities.

Figure 2. The field tests were realised by connecting a laptop computer to the onboard AIS equipment.

## DISCUSSION AND CONCLUSIONS

The five new messages compiled in the AISBALTIC project have been proposed as standardised international messages by the Baltic Sea countries [3]. The proposition submitted to IMO in 2009 is also supported internationally by countries such as USA, Japan, China, and Australia [4].

The new messages improve the preparedness of the authorities in case of an accident through more detailed information on ship types and dangerous cargo. Fulfilment of the reporting obligations of ships is also substantially facilitated, thus decreasing the need for VHF radio communication. The new area and route messages provide a fast and convenient way to transmit up-to-date information concerning, for example, search and rescue operations, caution areas or recommended routes. However, in order to fully benefit from the improvements current navigational equipment needs to be updated. Based on emerging user experience and practical knowledge, the information content in AIS is likely to be even further refined and optimised in the future.

## EXPLOITATION POTENTIAL

The proposed messages, if taken into international use, would decrease the workload of the navigators and improve the quality of up-to-date navigational and safety related information both on ships and ashore. They would effectively improve maritime safety and raise the level of protection of the marine environment.

## ACKNOWLEDGEMENTS

The authors wish to thank Sanna Sonninen and Rolf Zetterberg for their contributions to this work, and the shipping companies, the experts from the Baltic Sea countries, and the United States Radio Technical Commission for Maritime Services (RTCM) for participation and co-operation. The project was funded by the Finnish, Swedish and Estonian Maritime Administrations, the Ministry of Transport and Communications Finland, the Finnish Environment Institute, and VTT.



## REFERENCES

- [1] Porthin, M., Zetterberg, R. & Sonninen, S. 2010. "AIS Binary Messages – Developments in the Baltic and progress in IMO", approved to 17th Conference of the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA-AISM), Cape Town, South Africa.
- [2] "The Baltic AIS trial (AISBALTIC) project", Submitted by Finland and Estonia, IMO, Sub-Committee on Safety of Navigation, 54th session, NAV 54/INF.8, 2008.
- [3] "Inclusion of five new AIS binary messages developed in the Baltic AIS trial (AISBALTIC) project", Submitted by Denmark, Estonia, Finland, Latvia, Lithuania, Poland and Sweden, IMO, Sub-Committee on Safety of Navigation, 55th session, NAV 55/14/2, 2009.
- [4] "Report from the AIS Binary Messages Correspondence Group", Submitted by Sweden, IMO, Sub-Committee on Safety of Navigation, 55th session, NAV 55/14, 2009.
- [5] "Remarks on the use of AIS based on experience from the Baltic AIS trial (AISBALTIC) project", Submitted by Finland, IMO, Sub-Committee on Safety of Navigation, 55th session, NAV 55/INF.11, 2009.



## CONTACT

Markus Porthin  
 Research Scientist  
 markus.porthin@vtt.fi  
 Tel. +358 20 722 6883