



**DANISH MARITIME AUTHORITY**

**international**



**e-Navigation  
underway 2017**

**REPORT**

e-Navigation:

**A Showcase of Progress and Trends**

Copenhagen • Oslo • Copenhagen

**January 31<sup>st</sup> - February 2<sup>nd</sup>**



**IALA**

## INTERNATIONAL e-NAVIGATION UNDERWAY 2017

### CONFERENCE REPORT

#### Executive Summary



The seventh e-Navigation Underway International conference was held from 31<sup>st</sup> January to 2<sup>nd</sup> February, 2017 on board the DFDS ferry M/S PEARL SEAWAYS, during which time she sailed from Copenhagen to Oslo and then returned to Copenhagen. The theme for the conference was *e-Navigation: A Showcase of Progress and Trends*. The conference was attended by 154 delegates, representing 28 countries and 8 international organisations. The associated exhibition attracted 11 exhibitors, displaying the latest developments in e-navigation.

Following welcoming remarks from the conference chairman, Omar Frits Eriksson, and opening addresses from Francis Zachariae, Secretary-General of IALA, Troels Blicher Danielsen, Deputy Director General the Danish Maritime Authority and Kwang-yeol Park, Director General of the Ministry of Ocean and Fisheries in Korea, the key note speech was given by Mr Michael Bergmann, President of CIRM.

The Maritime Cloud concept was seen to be accepted and discussions were progressed on its implementation and management.

It was argued that e-Navigation is a concept not a box that can be purchased. The essence of e-navigation is that any supplier's equipment should be able to work interoperably with any other supplier's equipment. Considering the implementation of e-navigation, it was felt that "you cannot implement music and likewise you cannot implement e-navigation" – you can supply a song and you can supply an e-navigation service. e-Navigation is already established and operating, demonstrating that the business case for the available services has already been made and accepted. The benefits of e-navigation are evident through the benefits of the services provided.

A series of 28 presentations were given under the broad headings of general perspectives, a cluster of e-navigation projects, a selection of test beds, user perspectives, and specific technical solutions.

The conference generated five highlights.

- 1 There is a need to identify reliable business cases for e-navigation addressing the interests of various maritime stakeholders.
- 2 At least one national authority is considering e-navigation to address autonomous shipping in its coastal waters.
- 3 Cyber security continues to be an issue that needs to be addressed within e-navigation.
- 4 The list of 16 MSPs in the e-Navigation Strategy Implementation Plan requires further refinement and should be considered by all organisations involved including the IMO/IHO Harmonization Group on Data Modelling.
- 5 The Maritime Cloud requires a sound business case including cyber security, ownership and governance.

An invitation was issued to the 2017 e-Navigation Underway (North America) Conference to be held at the Sheraton Hotel, St. John's, Newfoundland, from 16<sup>th</sup> to 18<sup>th</sup> October 2017 in conjunction with the 2017 Ocean Innovation Conference. An invitation was issued to the first e-Navigation Underway – Asia-Pacific 2017 conference to be held at Jeju Island, Republic of Korea, from 18<sup>th</sup> to 20<sup>th</sup> June 2017.

The presentations from the sessions are provided on the IALA web site at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

# Table of Contents

<b>1</b>	<b>Introduction</b>	<b>5</b>
<b>2</b>	<b>Welcome Address</b>	<b>5</b>
<b>3</b>	<b>Opening of the conference</b>	<b>5</b>
<b>3.1</b>	Welcome by Mr Francis Zachariae – Secretary-General of the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA)	6
<b>3.2</b>	Welcome by Mr Troels Blicher Danielsen - Deputy Director General, Danish Maritime Authority	6
<b>3.3</b>	Welcome by Mr Kwang-youll Park – Director General of the Ministry of Ocean and Fisheries, Korea	6
<b>3.4</b>	Key Note Speech: From testbeds to Implementation – e-Navigation hits reality – Mr Michael Bergmann, President CIRM, Senior Advisor Viktoria Swedish ICT, Executive Advisor BM Bergmann-Marine	7
<b>3.5</b>	IALA’s work in e-Navigation – Mr Michael Card, Deputy Secretary-General, IALA	7
<b>3.6</b>	IALA webpage on testbeds – Seamus Doyle, IALA Committee Secretary	8
<b>3.7</b>	An update on cyber initiatives in the maritime industry - Lars Robert Pedersen, Deputy Secretary General, BIMCO	8
<b>3.8</b>	Progress and trends; the IHO perspective – Mr Gilles Bessero, Director, IHO	8
<b>3.9</b>	Status on the IMO e-navigation process – Mr John Erik Hagen, Regional director, Norwegian Coastal Administration	9
<b>3.10</b>	e-Navigation and Recent Developments in Portable Pilot Units – Capt Simon Pelletier, President, IMPA	9
<b>3.11</b>	e-Navigation - the implications for ports - Kevin Richardson, President, International Harbour Masters’ Association	10
<b>3.12</b>	e-Navigation from the end users perspective - Johan Gahnström, Senior Manager, Intertanko	10
<b>3.13</b>	e-Navigation – Who is paying for the Party? - Anders Brødje Manager, Bahamas Shipowners Association	10
<b>4</b>	<b>Theme 1 – General Perspectives</b>	<b>11</b>
<b>4.1</b>	Increased efficiencies through use of e-navigation Services and Smart Connected Ship	11
<b>4.2</b>	S-100: the underpinning of e-Navigation	12
<b>4.3</b>	New EU funding opportunities to support navigation and search and rescue	12
<b>5</b>	<b>Theme 2 – A Cluster of e-Navigation Projects</b>	<b>12</b>
<b>5.1</b>	The Maritime Cloud - underneath it all	12
<b>5.2</b>	STM going live – The STM test beds	13
<b>5.3</b>	EfficienSea2 – half way there	14
<b>5.4</b>	SMART-Navigation: an e-navigation project focusing on non-SOLAS ships as well as SOLAS ships	14
<b>6</b>	<b>Theme 3 - A Selection of Test Beds</b>	<b>15</b>
<b>6.1</b>	Route exchange in the SESAME Straits e-navigation test bed	15
<b>6.2</b>	Experiences gained from e-navigation test-bed in Finnish VTS's	15
<b>6.3</b>	Testbed for intelligent fairway smoothing path for autonomous vessels	16

---

6.4	Dublin Bay Digital Diamond	17
7	<b>Theme 4 - User Perspectives</b>	<b>18</b>
7.1	DanPilots perspective/ use of e-navigation	18
7.2	Display of e-navigation information	19
8	<b>Theme 5 – Specific Technical Solutions</b>	<b>19</b>
8.1	Location Sharing System Using AIS and RADAR TT Information on Cloud Server	19
8.2	New Funding Opportunities to Support Safety of Navigation: EGNOS and Galileo	20
8.3	Trials of e-radar/e-racon positioning system at Singapore Port	20
8.4	Automated Ship Reporting Testbed	21
8.5	FROM AIS TO IoT	21
8.6	CIRM-BIMCO pilot project on software maintenance	22
8.7	Hermitage – the first e-navigation testbed in Russia	22
8.8	Announcing e-Navigation Underway – North America 2017	23
8.9	Announcing e-Navigation Underway – Asia-Pacific 2017	23
8.10	Announcing the first combined IALA VTS / e-Navigation Symposium	24
8.11	Panel discussion	24
9	<b>Conference highlights</b>	<b>25</b>
9.1	Conference highlights	25
10	<b>Closing of the Conference</b>	<b>26</b>
11	<b>Exhibition</b>	<b>27</b>
11.1	Exhibitors	27
12	<b>Social Events</b>	<b>28</b>
12.1	Welcome Reception	28
12.2	Weather	28
12.3	Acknowledgments	28
<b>ANNEX A</b>	<b>Participants list</b>	<b>29</b>

# INTERNATIONAL e-NAVIGATION UNDERWAY 2017

## e-Navigation: A Showcase of Progress and Trends



### 1 INTRODUCTION

The seventh e-Navigation Underway International conference was held from 31<sup>st</sup> January to 2<sup>nd</sup> February, 2017 on board the DFDS ferry M/S PEARL SEAWAYS, during which time she sailed from Copenhagen to Oslo and then returned to Copenhagen. The theme for the conference was *e-Navigation: A Showcase of Progress and Trends*. The conference was attended by 154 delegates, representing 28 countries and 8 international organisations. The associated exhibition attracted 11 exhibitors, displaying the latest developments in e-navigation.



A list of participants is at 1ANNEX A.

### 2 WELCOME ADDRESS

Omar Frits Eriksson, Dean of the IALA World-Wide Academy, Conference Chair, welcomed all delegates to the 7<sup>th</sup> International e-Navigation Underway Conference between Copenhagen and Oslo, and hoped that all would enjoy the navigation between two of Scandinavia's beautiful capitals.



Remembering the 2010 idea that implementation of e-navigation should be an evolution rather than a revolution, he considered that e-navigation progress will be incremental and iterative.

He warmly welcomed Kwang-youl Park, Director General of Ministry of Ocean and Fisheries, Republic of Korea.

The theme for the 2017 Conference was e-Navigation: A Showcase of Progress and Trends. The focus was on showcasing the development of practical e-navigation solutions and testbeds, and discussing whether the necessary level of harmonisation required for e-navigation to be a success has been achieved. He anticipated that important international stakeholders will share their views and that practical solutions will be demonstrated to delegates.

### 3 OPENING OF THE CONFERENCE

Chaired by Omar Frits Eriksson, Dean IALA World-Wide Academy, and Conference Chair.



### **3.1 Welcome by Mr Francis Zachariae – Secretary-General of the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA)**

Mr Zachariae consider three questions relating to e-navigation.

Considering present trends, he noted that it is well accepted that e-navigation is not a project with an end-date but an evolution. Communication channels are available and are improving with technology such as satellite, VDES, etc. Maritime Connectivity is developing rapidly and is key to success. Maritime Cloud is at the center of connectivity. Regional solutions (test beds) are being developed, although a lack of international “leadership” is slowing progress. Shipping needs efficiency to stay competitive.



Mr Zachariae felt that a lot of progress has been made. The IMO Strategy Implementation Plan (SIP) is done. Much work is in progress on the MSP’s. Global interest is increasing. Industry is increasingly interested but sound business case is essential. There are testbeds everywhere but they need coordination. The PPU is a good example of e-navigation in action and the pilots are leaders in e-navigation implementation.

Considering challenges and solutions, Mr Zachariae felt that support of the IMO and other international organisations in attempting to make global solutions should lead to harmonisation and international standards. This is a present challenge.

He noted that this is the last year the Omar Frits Eriksson will chair e-Navigation Underway International due to his new role in IALA and he welcomed Hideki Noguchi and Jorge Arroyo as the new chair and vice chair of the ENAV Committee.

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

### **3.2 Welcome by Mr Troels Blicher Danielsen - Deputy Director General, Danish Maritime Authority**

Mr Blicher Danielsen welcomed all participants. Noting the rapid development of technology, he said that digital technology changes the way we work and cooperate. This creates the need for connectivity. Harmonisation and digitisation is a tool, not an end in itself. Better connectivity at sea is needed to support e-navigation.



e-Navigation will make shipping both safer and more efficient, but it must be market driven. The industry has to see the benefits to make the way it works more efficient.

Mr Blicher Danielsen also highlighted developments towards autonomous vessels. A variety of testbeds are ongoing in Northern Europe. He emphasised the need to consider workflows.

### **3.3 Welcome by Mr Kwang-youl Park – Director General of the Ministry of Ocean and Fisheries, Korea**

Mr Park offered his congratulations to this 7<sup>th</sup> e-Navigation Underway International conference and his appreciation for the gathering, sharing and harmonisation of the work of the international maritime communities.



e-Navigation remains the process of combating immature and uneven ground within maritime sectors. Thus, a foundation is needed, which can effectively and efficiently operate on any uneven surface.

In line with that foundation, another meaningful achievement is the establishment of a Co-ordinating Group for the co-ordination of the three present e-Navigation Underway conferences – International, North America and Asia-Pacific. The Co-ordinating Group will provide a substantial feedback forum for liaison between the e-Navigation Underway Conferences and the relevant international organisations, IMO member states, industry, and, most importantly, the users.

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

### **3.4 Key Note Speech: From testbeds to Implementation – e-Navigation hits reality – Mr Michael Bergmann, President CIRM, Senior Advisor Viktoria Swedish ICT, Executive Advisor BM Bergmann-Marine**

Mr Bergmann noted that e-navigation is now a concept that has been worked on over years. In a lot of regions, with support of quite a few maritime countries, test beds on various aspects of e-navigation have been executed. Based on those results, IMO has developed an overarching architecture, as well as a Strategy Implementation Plan (SIP).



At the beginning of the process the actors were faced with resistance as people didn't want to change or saw new technology as an evil development, eliminating mariners competence and thus not acceptable in the commercial market. Through test beds and constant work, this type of resistance has been dramatically reduced. But e-navigation stakeholders now face another set of arguments that are trying to derail the initiative. Those arguments circle around the talks about the length of implementation and e-navigation simply not getting any traction.

But those people who use these arguments to fight e-navigation do not realise that it already has moved from concept and test beds to reality. e-Navigation is already on board ships with modern integrated systems as well as in up-to-date VTS installations.

Mr Bergmann followed the path of e-navigation and focussed on the current status of implementation. He highlighted a few of the new initiatives, which bring further benefits and the e-navigation concept to reality.

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

### **3.5 IALA's work in e-Navigation – Mr Michael Card, Deputy Secretary-General, IALA**

Recalling Brian Wadsworth's vision of e-navigation in a paper dated 21st February 2005 and the subsequent establishment of the IALA eNAV Committee in September 2006, Mr Card noted that the 20<sup>th</sup> session of the present IALA ENAV Committee is in March 2017.



The work to modernise shore services, with an emphasis on connectivity and information transfer, is a continuous development, not a project with a completion date.

Communications is provided through free-to-air public services, and commercial services. The free-to-air services will include VDES for coastal and VTS services, conversion of 500 KHz stations to NAVDAT and possibly using existing DGPS stations for MSI broadcast. The Maritime Cloud is a good idea but it raises questions of ownership, management, cyber-security, and operating expenses.

Considering data modelling, IALA is actively working for MSI in the form of internationally recognised MSPs, not all of which need to be standardised, as long as they are recorded and understood by the bridge systems.

While not directly involved with GNSS provision, IALA will continue to work on terrestrial services for back-up and support of GNSS, especially R-Mode using 300KHz DGPS radio beacon transmitters as a very good potential terrestrial back-up system in coastal waters at acceptable cost.

There is continuing strong support for the FERNS organisation which coordinates Loran-C and Chaika services in the Far East area. A proposal to expand the role of FERNS is under consideration.

Considering VTS, Mr Card recalled the IALA Workshop in Indonesia in a February 2017 on standard voice communications phrases for VTS which are essential for future safe VTS operations but stressed the need for preparation for changes in VTS operations driven by a transition to digital information communications. IALA must also find a better mechanism for interaction between the IALA VTS and ENAV experts. He noted

that IALA will need to assist its members to prepare for commercial autonomous shipping, especially in VTS areas.

He described IALA work in streamlining of Recommendations and the introduction of Standards in 2018 as well as the planned transition to IGO status.

IALA is updating its Strategic Vision for the 2018-2022 work period and some changes in Committee structure for 2018-22 are likely.

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

### **3.6 IALA webpage on testbeds – Seamus Doyle, IALA Committee Secretary**

Mr Doyle described the benefits of providing e-navigation testbeds on the IALA website and the procedures for sharing testbed information in IALA Guideline 1107. He included a demonstration of the IALA website testbeds page.



The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

#### **3.6.1 Discussion**

In discussion it was noted that issues of permission to publish testbed data on the IALA website should be addressed through the leader/manager of the testbed.

### **3.7 An update on cyber initiatives in the maritime industry - Lars Robert Pedersen, Deputy Secretary General, BIMCO**

The industry's Guideline on Cyber Security on Board Ships was issued last year but is already being revised to include the ship to shore interface. e-Navigation may well increase the vulnerability of ships and ports to cyber attacks. Ports need to pay attention to cyber secure supply chains.



A BIMCO survey found that the majority of respondents (57%) are not really aware of the risk of cyber attacks. Only 21% of respondents said that they had been a victim of cyber attacks.

IT system failure is a major risk of shipboard cyber attacks and this was also identified by the survey while loss of corporate data was the second largest risk.

Mr Pedersen argued against mandatory guidelines and favoured the system management approach with sufficient flexibility to allow individual ships requirements and characteristics.

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

#### **3.7.1 Discussion**

Responding to a question regarding how to improve the uptake of guidelines by shipowners, Mr Pedersen stated that guidelines need to be voluntary and uptake driven by what is appropriate and necessary for the ship. A system management approach will ensure that ship owners/ managers responsible for data operations on ships will use relevant guidelines in the most appropriate way.

It was stated from the floor that the Maritime Cloud is one key enabler and there is a need from the IMO for a streamable S-100.

### **3.8 Progress and trends; the IHO perspective – Mr Gilles Bessero, Director, IHO**

Digital hydrographic services, radio-communications and their interaction form key elements of e-navigation. Therefore, as the intergovernmental organisation responsible





for coordinating the delivery of hydrographic services worldwide and developing the relevant standards and guidance, the International Hydrographic Organization (IHO) is a key partner in the development and implementation of e-navigation.

Mr Bessero explained what the IHO is and what the organisation has already done to support the development of e-navigation. He then focused on the views and activities of the IHO in relation to the development and implementation of the concept of Maritime Service Portfolios (MSPs). The issues that need to be addressed to transition from the current structure of hydrographic services inherited from the paper chart world to an e-navigation friendly structure were outlined. The expected role of the IMO-IHO Harmonization Group on Data Modelling was discussed from that perspective.

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

### **3.9 Status on the IMO e-navigation process – Mr John Erik Hagen, Regional director, Norwegian Coastal Administration**

Mr Hagen described the status of expected IMO outputs on three e-navigation solutions: New INS Modules (S1), Ship Reporting Guidelines (S2) and Harmonised Display (S4).



China has led the work on developing two new modules for the performance standards for Integrated Navigation System (INS): the Module on harmonisation of bridge design and the Module of information received via communications equipment.

Norway has carried out a successful testbed on automated and standardised ship reporting based on SafeSeaNet Norway, focusing on vessel arrival, ship security and border control. The data set received from the ship was automatically submitted into SSN Norway. Most of the messages were transmitted via AIS and ASM. A number of e-mail arrival reports from the ship were also submitted directly to MPA of Singapore. The testbed could be used as a basis for revising the guidelines and criteria for ship reporting systems.

Norway and the IHO have presented a first draft of the Guidelines for the harmonised display of navigation information received via communications equipment. However there are overlaps between work on S1 (two modules on INS), which requires a more coordinated approach. There is also a need to coordinate with other e-navigation work such as S-mode and MSP. The work should continue for the next two years.

In general, harmonisation and standardisation form the basis for the current IMO work on e-navigation.

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

### **3.10 e-Navigation and Recent Developments in Portable Pilot Units – Capt Simon Pelletier, President, IMPA**

Addressing e-navigation and recent developments in Portable Pilot Units (PPU), Capt. Pelletier discussed how PPUs came into being, how they evolved over time, and the latest trends regarding their use by pilots. He also commented on the evolution of e-navigation, and its relationship with marine pilotage. He described the risks of poor information fed to the PPU from ship systems.



#### **3.10.1 Discussion**

Responding to a question regarding the need for the PPU, it was stated that the standardised bridge is 10 years old and millions of dollars have been invested in PPU technology to great effect.

Type approval of PPU equipment will not suit the end user because users have different local requirements. No single PPU can meet the requirements of all users.

### 3.11 e-Navigation - the implications for ports - Kevin Richardson, President, International Harbour Masters' Association

In the IMO definition for e-navigation there is no mention of the word “ports”. This despite the fact that ports are an integral element in the logistics chain for global shipping trade. Ships load in a port, sail oceans and discharge their cargo in another port. In doing so the definition omits perhaps the most hazardous part of the whole journey, the passage into and out of a port. Latest statistics show that 60% of groundings and collisions happen in ports and port approaches. Capt Richardson examined the key elements of this ship/port interface and the e-navigation applications that apply throughout and how these may be used to reduce the likelihood of incidents. He also examined further concepts of e-navigation that may be applied in the future and what the impact of such innovations mean for the people who are responsible for safe and secure port operations.



The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

### 3.12 e-Navigation from the end users perspective - Johan Gahnström, Senior Manager, Intertanko

Having described the objective and structure of Intertanko, Capt Gahnström summarised tanker incidents based on Information taken from reports from Lloyd's Maritime Information Unit and The International Tanker Owners Pollution Federation. He considered the six e-navigation issues on the agenda of IMO and noted that work on S-mode outside of the IMO will need to be undertaken to be ready to provide meaningful submissions to the IMO NCSR Sub-Committee in 2018. He proposed revised performance standards for Integrated Navigation Systems (INS) in relation to harmonisation of bridge design, display of information and partly on using S-100 and other communications. He proposed a reporting system will support just-in-time operations for the port as well as enabling once-only pre-arrival information to the national competent authority, the so-called "single window" solution. He considered the revision of GMDSS and noted that this revised GMDSS is believed to be for new built ships only, and from around 2025 at the earliest. He observed that harmonised display of navigation information is at the core of e-navigation but raised concerns of what information is to be displayed on an ECDIS standards. He queried how much information can be added to an ECDIS with graphical layers, or information pop up, before it is not a useable tool for safe navigation. He noted the need to harmonise IMO MSPs and IHO S-100 Product Specifications, and queried who is driving e-navigation? IMO? IHO? IALA? And who should?



The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

### 3.13 e-Navigation – Who is paying for the Party? - Anders Brödje Manager, Bahamas Shipowners Association

Digitisation of shipping is crucial to keep up with developments within general logistics, and it is imminent. Developments within e-navigation has seen some histrionic advancements since first introduced to the IMO. Not only has the definition and scope of e-navigation come to be much enlarged through experience, but parallel technical developments within other domains have provided substantially different solutions in relation to what was envisaged some 10 to 15 years ago. As the notion of e-navigation has expanded, so has the implications for the implementation of developed solutions.



As ship owners, the Shipowner Association monitors progress within the domain carefully, and two of the more striking aspects of current developments is an almost total lack of overarching leadership, as well as a lack of a movement towards one agreed, coherent and worldwide solution. Both are risking the shipowners' will to implement future solutions, whether regulated or on a voluntary basis.

Further, any future implementation will come at a cost, and minimising such costs is decisive. Among the more obvious, are costs of needed or required equipment and installation. However, costs also involve socio-technical aspects, such as changes to operations, training of personnel, navigational risks, information handling, cyber risks, and changes to a historically sound contractual regime. These implications, and others, need to be appropriately addressed. e-Navigation cannot stop at being technical developments, its implications span much further afield. From the shipowners' perspective, the major question remains: Who is going to pay for the Party?

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

### 3.13.1 Discussion

In discussion, it was stated that the emphasis should be on SOLAS rather than shipowners to drive the implementation of e-navigation.

It was considered that there is no single compelling driver for e-navigation.

Shipowners are responding to a very large number of changing regulations and there is little time or resources for e-navigation. Nonetheless it was stated that some administrations find a high demand for e-navigation services and the biggest beneficiaries of e-navigation will be shipowners in the long term.

It was observed that in many cases, errors arise from system designers rather than users.

It was noted that a cost benefit analysis feasibility study has led to adoption of e-navigation by Korea.

## Themed Sessions

The themed sessions comprised 20 presentations related to general perspectives of e-navigation, e-navigation projects and test beds, stakeholder perspectives, e-navigation specific technical solutions, and other relevant topics.

### 4 THEME 1 – GENERAL PERSPECTIVES

The Session was chaired by Professor Axel Hahn, OFFIS – Institute for Information Technology.

#### 4.1 Increased efficiencies through use of e-navigation Services and Smart Connected Ship

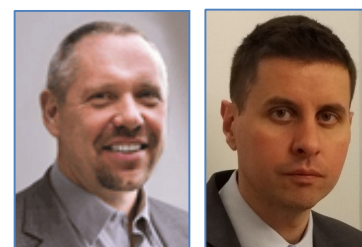
##### 4.1.1 Presenter and author

Mr Dmitry Rostopshin, Director, Transas, Russia.

Mr Anders Rydinger, Director, Transas, Sweden.

##### 4.1.2 Abstract

Validation of e-navigation technologies is an important step on the way to creating a common maritime data environment. Therefore implementation of e-navigation testbeds is critical for understanding user demands, the need for change of operational procedures, and the requirements for hardware and software components. A new e-navigation testbed will be established in Saint-Petersburg, Russia including a simulation environment and a real configuration. The testbed will be focused on connecting different stakeholders including vessels, VTS center, pilots and fleet operation in order to automate information exchange and provide decision support to users. The presenters provided details of the testbed implementation and results of first stage tests.



The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

### 4.1.3 Discussion

In discussion it was stated that, as in STM, broadband internet is used for general information while AIS is used for ship to ship and safety information.

## 4.2 S-100: the underpinning of e-Navigation

### 4.2.1 Presenter and author

Ms Julia Powell, Deputy Chief, NOAA, USA.

### 4.2.2 Abstract

The development of S-100, the IHO Universal Hydrographic Data Model, represents a major step forward in the standardisation of products for use in maritime applications. Based on the ISO 19000 set of standards for Geographic Information Systems, S-100 provides a framework for organisations to build different products that can be used by a wide variety of users from the commercial mariner to coastal zone managers, and is the data framework standard for e-navigation. Currently, mariners get various types of information needed to safely navigate from different sources – such as ENC's used on an ECDIS, MSI, tide tables, and sailing directions, etc. Current S-100 based products that are under development are S-101 for Electronic Navigational Charts (ENC), which will become the eventual replacement to S-57 ENC's, ocean forecast information, high resolution bathymetry, marine protected areas, and surface currents, among other things. By building different navigation products to the S-100 framework, navigation systems will be able to present the mariner with an integrated solution to make informed navigation decisions.



The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

### 4.2.3 Discussion

Responding to a query regarding the decision path in the work, it was stated that in the present draft interoperability is theoretical and an iterative approach to development of the guideline will be used, working with users at the appropriate time.

The present work is focussed on fixing the infrastructure issues due to limited resources.

## 4.3 New EU funding opportunities to support navigation and search and rescue

### 4.3.1 Presenter and author

Mr Yann Guichoux CEO, e-Odyn, France.

### 4.3.2 Abstract

AIS (Automatic Identification System) is a communications system that provides information on marine traffic. Using this system, e-Odyn was able to retrieve real time ocean surface currents information by analysing ships trajectories and behaviour. Noting that shipping companies spend €4 billion per year on fuel, Mr Guichoux presented some AIS derived ocean surface current features in the North Sea, the use of which can make routes more efficient.



## 5 THEME 2 – A CLUSTER OF E-NAVIGATION PROJECTS

The Session was chaired by Professor Axel Hahn, OFFIS – Institute for Information Technology.

### 5.1 The Maritime Cloud - underneath it all

#### 5.1.1 Presenters and authors

Mr Thomas Christensen, Project manager, Danish Maritime Authority, Denmark.

Mr André Bolles, R&D manager, OFFIS, Germany.

Mr Jin Park, Head of System Integration Management Team, KRISO, Korea.

### 5.1.2 Abstract

Developing a common framework for the future of e-navigation is of the utmost importance and it will take international cooperation to succeed. Such cooperation is exactly what is taking place in the Maritime Cloud Development Forum represented by the speakers. By collaborating between two major European projects STM Validation and EfficienSea2 and the ambitious Korean SMART-Project, the Maritime Cloud has the potential to become a global framework for e-navigation when implemented.



The speakers presented the significant progress with development of the Maritime Cloud, including 0.1 beta releases of the identity register and service registers - two components that will play key parts in making the Maritime Cloud a secure system for the implementation of future e-navigation solutions. It was also announced that the first endeavour at federalising existing registers – essentially allowing access to the Maritime Cloud for verified members of a specific organisation – had been a success.

The issues of governance and business models for the Maritime Cloud were considered. The speakers proposed the different ways in which the Maritime Cloud will provide value for the maritime world - ease and reduce cost of implementing services by defining standards, enhance cyber-security with the creation of secure connections between trusted parties, and boost access to all new solutions by providing a unified marketplace for services.

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

### 5.1.3 Discussion

In discussion it was noted that the Maritime Cloud is not a data storage cloud but an infrastructure to transmit data from one user to another. It is effectively a standard and the user pays for whatever communications medium that is used.

Considering the capability of the Maritime Cloud to accommodate users, it was stated that it is scalable and it is easy to add more users to the existing testbed.

## 5.2 STM going live – The STM test beds

### 5.2.1 Presenter and author

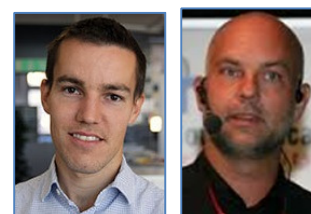
Authors: Mikael Lind, Viktoria Swedish ICT; Björn Andreasson, Swedish Maritime Administration, Mikael Hägg, Viktoria Swedish ICT/Swedish Maritime Administration.

Presenters: Mr Björn Andreasson, Swedish Maritime Administration, Sweden.

Mr Mikael Lind, Research Manager, RISE Viktoria

### 5.2.2 Abstract

The STM concept, implemented through Voyage Management, Port Collaborative Decision Making (PortCDM) and Flow Management, has been introduced by the EU TEN-T project MONALISA 2.0 and is now validated in the STM Validation Project, which is an EU CEF project. The introduction of STM puts focus on enabling safe, sustainable, and efficient sea transport with the scope of private and public service opportunities along the voyage, berth-to-berth. Furthermore, STM relates to existing practices and initiatives within the IMO's e-navigation and the EU's e-maritime.



The operational services in STM builds on the SeaSWIM (Sea System Wide Information Management) concept which adds information services and standardises payload formats compatible with, and building upon, the Maritime Cloud and its Service and Identity Registry.



The STM concept is now validated using field test beds including ship installation, shore centres, and ports as well as through simulations using the European Maritime Simulator Network (EMSN). Validation of Voyage Management will be executed in two main field test beds, one in the Mediterranean and one in the Nordic region. In the latter, STM services will aim for more efficient winter navigation and Search and Rescue (SAR). The PortCDM validation will take place by expanding the network of ports and Port CDM services developed in MONALISA 2.0 in the Nordic and Mediterranean regions. The contextual differences between port approaches will be collected and analysed, and will serve as a basis for the concept's refinement.

The testbeds illustrate a practical implementation of some of the operational services introduced in IMO's e-navigation's Maritime Service Portfolios (MSP).

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

### 5.2.3 Discussion

While ships from any part of the world can participate in the STM project, infrastructure outside of the EU area cannot be provided due to the project being EU funded.

## 5.3 EfficienSea2 – half way there

### 5.3.1 Presenter and author

Presenter: Mr Bjørn Borbye Pedersen, Director, Danish Maritime Authority, Denmark.

### 5.3.2 Abstract

Bjørn Borbye Pedersen, Director of e-Navigation at the Danish Maritime Authority, presented the results achieved by the EfficienSea2 project as the 32 partners are half way through their 3 years project. He explained how the EU-funded EfficienSea2 project works on developing the Maritime Cloud, platforms for services, communication channels and end user services in order to achieve connectivity in the maritime world. He gave the example of a new global standard for Navigational Warnings to show how different aspects of EfficienSea2 combine to make e-navigation a global reality.



The Danish Maritime Authority has developed a new editor, Niord, that can create navigational warnings using the draft IHO-standard S-124. In use, simply enter potential dangers into the open source editor developed in the project by the DMA, and they will automatically be made in a contemporary data format, that can be presented on geo-displays such as the project's display platform, BalticWeb. He listed a number of user benefits of the BalticWeb.

Mr Pedersen spoke of how EfficienSea2 is working actively to implement feedback from their midterm conference and of the highlights of the EfficienSea2 project still to come, such as the release of 10 operational services, field testing of VDES and further development of the Maritime Cloud.

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

## 5.4 SMART-Navigation: an e-navigation project focusing on non-SOLAS ships as well as SOLAS ships

### 5.4.1 Presenter and author

Dr Han Jin Lee, Project Manager, SMART-Navigation Project Office, KRISO, Korea.

### 5.4.2 Abstract

SMART-Navigation is an e-navigation project in progress in Korea. According to the statistics for marine accidents in Korea, about 80% are caused by human factors and about 70% of marine accidents involve small ships such as fishing boats. Hence the main feature of the SMART-Navigation project is to include e-navigation services not only for



SOLAS vessels being discussed in IMO but also non-SOLAS vessels as service targets.

There are about 70,000 registered fishing boats in Korean coastal waters. In order to secure the communications speed and bandwidth required to include all of these fishing vessels in service, expanding LTE communication maritime called LTE-Maritime is being considered. R&D teams in the project are developing services that SMART-Navigation will provide through the LTE-Maritime communication network for all ships. Dr Lee introduced the system architecture and services of the SMART-Navigation project.

#### 5.4.3 Discussion

Responding to queries regarding who operates the LTE-Maritime system, it was stated that the LTE-Maritime infrastructure is provided by the Korean government and small vessel users can access the system using devices such as smart phones.

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

## 6 THEME 3 - A SELECTION OF TEST BEDS

The Session was chaired by Kwangil Lee, Korea Research Institute of Ships and Ocean Engineering (KRISO), Korea.

### 6.1 Route exchange in the SESAME Straits e-navigation test bed

#### 6.1.1 Presenter and author

Mr Todd Schuett Project Manager, Kongsberg, Norway.

#### 6.1.2 Abstract

The concept of route exchange was first introduced in the Mona Lisa 2 project, which demonstrated the benefits of exchanging routes between ships. From this, the IEC 61174 standard was developed and approved. Through the SESAME Straits project and the STM Validation project, this concept of route exchange has been taken a step further by introducing the shore into the route exchange equation. With the introduction of the shore as part of route exchange, a number of issues become apparent.



Mr Schuett explored the technical, operational, and human factors challenges and opportunities that result from ship to shore route exchange or route sharing. Specifically, the paper focused on the challenges and opportunities related to:

- route format and communication,
- the expansion of the roles and duties of shore-based operators,
- the impact of global implementation,
- shared decision support services.

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

#### 6.1.3 Discussion

In discussion it was noted that it may be necessary to revise the IEC standard following testing.

### 6.2 Experiences gained from e-navigation test-bed in Finnish VTS's

#### 6.2.1 Presenter and author

Presenter: Mr Tuomas Martikainen, Senior officer, Finish Transport Agency, Finland.

#### 6.2.2 Abstract

The Finnish Transport Agency, in co-operation with other stakeholders in the Finnish maritime industry, is testing a service where vessels can share their electronic route plans with the maritime authorities. The test bed is also used for demonstrating a means for improved communication of the VTS service portfolio. The test-bed is currently in operational use in the Finnish coastal VTS centres with ships participating from several shipping companies having regular traffic to Finnish ports.



The ENSI (Enhanced Navigation Support Information) service is a test bed for a two-way electronic communication system aimed at increasing vessel traffic safety. Several accident investigations have shown that results from the on-board ECDIS safety check on planned route can be misunderstood or neglected. The ENSI service provides an additional external safety check carried out by maritime authorities. The safety of the route is cross checked and possible hazards along the planned route will be communicated to the navigator

In addition to route cross checking, several other e-navigation services are demonstrated in the system, including route weather, Navigational Warnings, ice navigation information, electronic Ship Reporting System reporting and pilot ordering services.

Feedback from the shipping companies participating in the tests has been encouraging. Even though the requirements for on-line communication are kept to minimum one of the challenges during the tests was the variation in ships IT environments and communication methods. Also further harmonisation on identification, authentication and security will be needed in the later phase.

Based on these experiences the next phase of the development is seen to be the integration of these services with other navigational equipment - either ECDIS's or other dedicated e-navigation displays that are connected with navigation systems. Further development of the ENSI service is done in close co-operation with other e-navigation projects such as EfficienSea2 and STM validation.

One of the services that have especially received positive feedback from mariners is information on ice routes. Currently VTS centers give recommend ice waypoints to ships mainly by using VHF radio. This is very time consuming and can easily lead to misunderstandings. Ships that are using the ENSI service can display recommended ice routes on maps and as a waypoint list.

Route exchange between ships, shore authorities or other stakeholders has proved to have many benefits: safety and efficiency can be improved even with a simple application. However further system and service development is needed in order to have the possibility of more ships participating in route sharing and on using other e-navigation services. As all parties have different user needs the development will need to be done in close co-operation with the industry, service providers and authorities.

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

### 6.2.3 Discussion

During discussion it was stated that the FTA does not intend to make route exchange equipment mandatory on ships.

## 6.3 Testbed for intelligent fairway smoothing path for autonomous vessels

### 6.3.1 Presenter and author

Presenter: Mr Jorma Timonen, Senior Officer, Finish Transport Agency, Finland.

### 6.3.2 Abstract

In 2017 the Finnish Transport Agency (FTA) will start a testbed which aims to improve navigators' situational awareness and effectiveness of marine transport by providing new e-navigation like services and navigational data to vessels. The testbed will be based on information collected by authorities and companies along selected fairways in Finnish waters. Collected information will be merged with valid models of the environment and displayed or integrated with the electronic navigational chart (ENC) on ECDIS.



Various sensors are already installed in the aids to navigation situated along the fairways. In this testbed FTA will study how collected data can be transferred to shore stations and vessels for further use, e.g. modelling of the current water level in relation to vessels draught. The vessel could also send requests to aids to navigation based on weather conditions and, for example, ask for more intensity from lights.

Bathymetric surfaces (BS) can be used to define areas where vessels can sail safely, locate sections on the route where manoeuvrability can be limited or calculate how much cargo it is possible to load on board. Real-time water level information is combined with ENC and BS and the results is displayed with Go / No-Go areas to the mariner for decision making.

In the first phase of the testbed, data transfer and modelling will be piloted in on-shore systems like simulators. After successful simulator tests a workstation will be installed on board and data exchange and utilisation will be tested in a real environment on a vessel's bridge and/or VTS.

FTA will be leading the testbed trials and various other partners will participate to the project. Partners will be ports, shipping companies, pilots and software manufacturers.

Finland aims to be a leading nation of testing of autonomous vessels. Results of the intelligent fairway testbed i.e. new navigational data and services will be utilised when an ecosystem for autonomous vessels is established to Finnish waters. Thus the needs of autonomous vessels will be taken into account in the testbed from the beginning.

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-navigation-underway/international-e-navigation-underway-2017/>.

## 6.4 Dublin Bay Digital Diamond

### 6.4.1 Presenter and author

Presenter: Ms Deirdre Lane, Commissioners of Irish Lights, Ireland.

### 6.4.2 Abstract

The Dublin Bay Digital Diamond (DBDD) was an e-navigation demonstrator established by the Commissioners of Irish Lights. The purpose of this project was to improve safety & efficiency of maritime transport and deliver stakeholder value. The project took advantage of existing Irish Lights and partner organisation infrastructure to provide platforms for the core communications network required. The primary objective of the project was to bring together key shipboard and shore interests to demonstrate the harmonised services which can be delivered and the cross sector benefits that can be achieved. A key objective throughout was communication of the potential of e-navigation to the maritime community and the public.



Initially the project concentrated on engaging the maritime community and a number of stakeholder meetings were held to ensure user focussed outcomes. A Technical Advisory Committee (TAC) was convened to provide advice on the technical feasibility of tests and the following trials were established.

A Wi-Fi trial was conducted across the Dublin Bay area to enable data transfer between the four nodes at Irish Lights, Kish Lighthouse, Baily Lighthouse, and Dublin Port, all feeding data back to Irish Lights Head Quarters.

A Stereoscopic Vision Positioning trial was set up, where two photos of the same object/view were taken a few meters apart to establish if they could be compared with real-time on board camera images and processed for a match at a particular bearing.

The Dublin Bay Buoy was fitted with Met/ Hydro sensors and a water quality sonde. The sensors data was then brought back to the Irish Lights centre via an Automatic Identification System (AIS) message.

Finish Company Meritaito provided two Spar buoys. In an e-navigation context they can be used to place sensors on due to constant tension mooring buoys in order to provide the mariner with real time data.

An "AIS to text" tool was tested to establish if a Very High Frequency (VHF) voice reporting point could be replaced with an automated AIS Short Message Service (SMS) text message.

A Video Surveillance System demonstration was established to display remote visual monitoring of activity in Dublin Bay to the stakeholders.

With the end user in mind, a small number of bridge surveys were conducted to establish the mariner's opinion on e-navigation and the current status of electronic bridge equipment. Quarterly publication of an online magazine "e-Navigation News" helped keep stakeholders informed of the status of the project and the development of e-navigation at the International Maritime Organisation.

The Wi-Fi trial found that the receiver had good signal strength. However a lot of noise from external access points was found across the bay. The Stereoscopic Positioning test found that the performance of this system is highly dependent on the quality and spread of land marks.

Stakeholder value was delivered by the Dublin Bay Buoy Met/ Hydro tool and the water quality sonde. The project provided information about sensors, their correct mounting and maintenance as well as safe deployment of spar buoys including their conspicuity issues.

It was found that improved safety & efficiency of maritime transport could be achieved by the "AIS to text" tool and that elements of this tool could be expanded in the future.

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

## 7 THEME 4 - USER PERSPECTIVES

The Session was chaired by Kwangil Lee, Korea Research Institute of Ships and Ocean Engineering (KRISO), Korea.

### 7.1 DanPilots perspective/ use of e-navigation

#### 7.1.1 Presenter and author

Presenter: Søren Westerskov Chief Pilot, DanPilot, Denmark.

#### 7.1.2 Abstract

e-Navigation is defined as the harmonised collection, integration, exchange, presentation and analysis of marine information on-board and ashore by electronic equipment means to enhance berth to berth navigation and related services for safety and security at sea and protection of the marine environment.



Collection, integration, exchange and presentation of marine information is used on all pilotage voyages in DanPilot via the DanPilot port server. The information flows between all DanPilot pilots on duty, so that all ships with DanPilot pilots on board are seen clearly on the respective pilot's PPU (Portable Pilot Unit). Exchange of information is used in the respective ports by replaying to visualise safe operations and compiling safe routes according to best practice for navigation. Data is presented via the PPU in an easily understandable layout and used very easily. It is believed that services such as AIS, weather/ wind/ notices to Mariners, sailing instructions etc. easily could be provided via the maritime cloud.

The use of this electronic aid with all its possibilities supports the DanPilot mission: "Safeguarding our customers' vessels and the environment".

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

#### 7.1.3 Discussion

In discussion it was noted that the DanPilot PPU KPI's are quality (safety) and user satisfaction (revenue).

Responding to a query regarding using the ships navigating data, it was stated that the data from the ships PPU plug is often wrong and hence the PPU is fully independent.



## 7.2 Display of e-navigation information

### 7.2.1 Presenter and author

Prof. Thomas Porathe, Professor, Norwegian University of Science and Technology, Norway.

### 7.2.2 Abstract

IMO's MSC decided in 2009 that the new carriage requirements for mandatory ECDIS on board would be rolled out from 2012 to 2018. The amendment to SOLAS Chapter V regulation 19.2 will require ships engaged on international voyages to be fitted with ECDIS. In worst case, it will be one single stand-alone ECDIS. Is this the display where the information of all 16+ MSP services risk ending up? From a human factors point of view this is not a good solution.



From the vantage point of the human element, navigation can be subdivided into more or less stressful phases. Stress has an effect on the bandwidth of human perception. Information displays for stressed situations have to be more carefully designed than for less stressful situations. Prof Porathe suggested a structure for display of e-navigation information based on the cognitive abilities of the human operator.

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

## 8 THEME 5 – SPECIFIC TECHNICAL SOLUTIONS

The session was chaired by Thomas Christensen, Danish Maritime Authority.

### 8.1 Location Sharing System Using AIS and RADAR TT Information on Cloud Server

#### 8.1.1 Presenter and author

Authors: Mr Yasuyuki Niwa, Senior researcher, National Maritime Research Institute, Japan, Mr Hisaya Motogi, Chief Officer, Oshima College, Japan.

Presenter: Mr Yasuyuki Niwa, Senior researcher, National Maritime Research Institute, Japan.

#### 8.1.2 Abstract

Mr Niwa introduced a location sharing system using on-board Radar TT (Target Tracking) information for non-AIS equipped ships.

Navigators on AIS equipped ships can easily obtain other AIS equipped ships' locations, but they cannot obtain non-AIS equipped ships' locations via AIS. So they use radar to obtain non-AIS equipped ships' information as TT information. But the TT information is only available on board.



The new location sharing system collects AIS and on-board TT information of each ship in a certain sea area on a cloud server and distributes both AIS and TT information to the ships in the sea area via the internet. Using this system, navigators can obtain non-AIS equipped ships' information from other ships' radars. The information is displayed on a dedicated display or on a multi-function display on-board. The new location sharing system does not need any additional equipment for ships.

As the TT information (RATTM sentence) is relative target information against own ship, the absolute ship state information is calculated on the cloud server by using TT information with sender ship's information such as latitude/longitude, SOG, COS and the heading angle.

A series of field tests were carried out with two ships, which are equipped with AIS, radar and 4G mobile router. They sent their ship information and captured TT information to the cloud server. The cloud server integrated the AIS and TT information, drew AIS and absolute TT positions on a chart image and then distributed the chart image via the internet. Finally, it was confirmed that a navigator obtain AIS and non-AIS equipped ship's information as a chart image by web browser using IT devices such as PC, iPhone, iPad and Android phone/tablet.

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

### 8.1.3 Discussion

Concerning position error, it was stated that the radar conforms to the IEC standard error of 50m.

## 8.2 New Funding Opportunities to Support Safety of Navigation: EGNOS and Galileo

### 8.2.1 8.3.1 Presenter and author

Author: Mr Manuel Lopez-Martinez, European GNSS Agency, Czech Republic.

Presenter: Mr Jose Manuel Alvarez, European GNSS Agency, Czech Republic.

### 8.2.2 8.3.2 Abstract

The European GNSS Agency and the European Commission are launching different funding opportunities to support safety of navigation and search and rescue operations.

Several tools are used - (1) H2020 Galileo 2017 Call; (2) Launch of a Pilot project for the transmission of EGNOS corrections via IALA beacons and AIS to support maritime and inland waterways navigation.



Mr Alvarez described a roadmap for adoption of EGNOS.

He invited interest in the H2020 call for Applications in Satellite Navigation – Galileo – 2017.

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

## 8.3 Trials of e-radar/e-racon positioning system at Singapore Port

### 8.3.1 Presenter and author

Mr Takuo Kashiwa, Department General Manager, Furuno.

### 8.3.2 Abstract

The e-Radar/e-Racon position fixing system approach is completely independent of GNSS based position fixing technologies. So far, two trials have been done in Denmark and in the UK, supported by test-bed programs in the EfficienSea project and ACCSEAS project respectively. These trials were carried out in a relatively low-traffic area, and good results have been obtained showing the potential of the system. A new trial has been done in Singapore port, the world's busiest shipping area, in cooperation with Singapore MPA and Tideland Signal Corp.



Several tests have been done and Mr Kashiwa summarised the results. Results using two e-racons for position fixing show better accuracies compared with results using one e-racon, and confirm the results obtained in the previous trials. A unique position fixing test was also done using a test vessel anchored at the port without any drifting or moving during the test. It is shown that a one sigma deviation of less than 1 metre can be obtained, which is comparable to accuracies of GNSS with DGPS augmentation. Real-time display of the obtained position data on ECDIS was also successfully demonstrated.

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

### 8.3.3 Discussion

Responding to queries it was stated that the racon height was constrained by physical limitations of the mounting platform.

The presenter has many ideas for possible improvements to racon system performance.

## 8.4 Automated Ship Reporting Testbed

### 8.4.1 Presenter and author

Mr Fred Pot, Principal, Marine Management Consulting, USA.

### 8.4.2 Abstract

Work Groups 1 and 4 of the IALA ENAV Committee are in the process of developing a Draft Guideline on MSP8 Vessel Shore Reporting Service (VSRS). The aim of the Guideline is to reduce the administrative burden on the bridge team. This workload distracts the bridge team from safe navigation.



Information and Communications Technology (ICT) tools can reduce the workload by populating and generating the required reports automatically using information derived from other systems and re-using information that was entered for previous port calls.

It is estimated that less than 10% of ships are currently using such ICT tools. The Guideline is expected to reduce the cost of tools by publishing a library of required ship report templates and by harmonising the database that is used to generate ship reports. Reducing their cost is expected to enable most if not all ships to use ship reporting ICT tools to minimise the ship reporting workload.

Harmonising the ship reporting database and replicating it with a cloud-based version will allow the bridge team to collaborate with shore-based personnel (i.e. port agents and office personnel) on preparing and submitting the required reports. Doing so will require authentication, authorisation and encryption tools that will enable ship owners/operators to control access to their ship reporting information. They may even allow shore-based authorities to query parts of their ship reporting database.

Ship owners and operators are invited to test a prototype of a ship reporting ICT tool that is based on the ship report library and uses the harmonised database.

On behalf of IALA's ENAV Committee's WG1 and WG4 Mr Pot invited ship owners/operators to participate in the testbed for Automated Ship Reporting.

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-navigation-underway/international-e-navigation-underway-2017/>.

## 8.5 FROM AIS TO IoT

### 8.5.1 Presenter and author

Mr Francisco Sarrias, Managing Partner, Marina System Iberica, Spain.

### 8.5.2 Abstract

AIS is a popular solution for modern Aids to Navigation (AtoN) deployment - it allows easy identification of buoys and other aids to navigation marks. But AIS was not originally developed for such applications, it was conceived for identifying vessels. The SmartCity development concept and its subcategory SmartPort provides a new generation of IoT (Internet of Things) technologies.



AIS is limited by both its power consumption and its radio range, although energy consumption has been significantly reduced.

The biggest challenge to AIS AtoN systems today is related to security, as several published works have demonstrated: [https://en.wikipedia.org/wiki/Automatic\\_identification\\_system#Security](https://en.wikipedia.org/wiki/Automatic_identification_system#Security). The unencrypted and non-authenticated nature of AIS makes it a perfect target for spoofing attacks, and the VHF frequencies used are easily jammed with basic electronic warfare equipment. For critical infrastructure projects like the "Future Electronic Highway" that the government of Iran (PMO) is projecting for managing the vessel traffic in the Persian Gulf these security issues become critical.

The development of SmartCity projects and the evolution of the M2M (Machine to Machine) protocols utilise very low bandwidth transmission technologies with the very energy efficient family of electronic

systems which are widely used in all kind of sensors that control parking places, trash bins, air quality stations, etc. around cities. These sensors consolidate information in internet based repositories in the cloud, which is why this family of technologies is call IoT (Internet of Things). These sensors include long-life batteries that can keep them active during a whole year or more without any service or maintenance needed.

The same IoT platform can be used to control other port assets like containers, platforms, barges, provisional fences, air compressors, hoists, ro-ro ramps, waste collection tanks, etc. and use available open source integrated platforms like FI-Ware for everything.

The main standards are SigFox and LoRa that use very low power consumption communications standards. In many instances, the port does not need to invest in implementing its own infrastructure because there are telecommunications companies that offer these services on a pay per use model.

Mr Sarrias described these technologies and discussed why they are also more secure and easy to deploy that AIS. These IoT technologies could complement AIS for better security and efficiency using a new generation of integrated software platforms to take advantages of IoT developments.

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-navigation-underway/international-e-navigation-underway-2017/>.

### 8.5.3 Discussion

Responding to a query regarding the Open Connectivity Foundation, it was stated that the giants of technology are in the IoT.

The SigFox unit is powered by three AA size batteries, which can be changed in 10 minutes.

## 8.6 CIRM-BIMCO pilot project on software maintenance

### 8.6.1 Presenter and author

Mr Richard Doherty, Chief Technical Officer, CIRM, UK.

### 8.6.2 Abstract

CIRM and BIMCO are about to embark upon a pilot project for software maintenance of shipboard equipment, which will seek to evaluate the effectiveness and practicality of the Draft Standard they have jointly developed in this area. The project will begin in January 2017 and last for six months, and will involve a number of manufacturers, service companies, and ship owners. As ship systems become increasingly dependent on software with increasing complexity, improving the shipboard software updating process for all stakeholders is critical to ensuring safe and efficient navigation of the ship, and is a key element in ensuring the ship-side e-navigation infrastructure is properly maintained.



The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-navigation-underway/international-e-navigation-underway-2017/>.

### 8.6.3 Discussion

Considering type approval of software, it was stated that type approval for software already exists and minor updates are allowed without re-approval. Software for distribution of ENC data is type approved.

It was felt that the standards development time of the IMO was a driver for the development of the software maintenance system outside of the IMO, although in the longer term it is envisaged that the CIRM/ BIMCO system will evolve into an international standard.

## 8.7 Hermitage – the first e-navigation testbed in Russia

### 8.7.1 Presenter and author

Marat Ismagilov, Director of Cartography and Hydrography Department, Group of Companies "Kronstadt" (St. Petersburg, Russia).

## 8.7.2 Abstract

In 2016 the first e-navigation testbed in Russia was established by the Kronstadt Group in cooperation with partners (Transas, Abris and others), on behalf of the Ministry of Transport of Russia as a research and development (R&D) project named “e-Sea” with a budget of €5 to €6 million. Implementation period is from 2016 to 2020. The testbed is named Hermitage and includes both sea and the river segments including river, lake and sluiced (gateway).



The testbed uses GLONASS position fixing with AIS and VTS. The ship side uses ECDIS with water level sensor and AIS AtoN position, both of which communicate by GSM. The system of remote transfer of ENC and other data is protected by a patent of the Russian Federation.

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-navigation-underway/international-e-navigation-underway-2017/>.

## 8.7.3 Discussion

In discussion it was noted that the UAV was used for ice area recognition and sea searches.

## 8.8 Announcing e-Navigation Underway – North America 2017

### 8.8.1 Presenter and author

Mr Fred Pot, Principal, Marine Management Consulting, USA.

### 8.8.2 Abstract

Fred Pot announced that that the Marine Institute of the Memorial University of Newfoundland will host a joint conference which combines the 2017 e-Navigation Underway (North America) conference with the 2017 Ocean Innovation conference. The Marine Institute, IALA and the Danish Maritime Authority will be the organisers of the conference.



The conference will be held at the Sheraton Hotel, St. John’s, Newfoundland, from 16<sup>th</sup> to 18<sup>th</sup> October 2017.

The overall theme will be “Enhancing Technology and Innovation for Polar Navigation” focusing on government plans & programs, ice navigation and passage planning, incident response and sea traffic management.

Mr Pot invited participants to attend this unique conference. For further details go to [www.e-navnorthamerica.org](http://www.e-navnorthamerica.org).

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-navigation-underway/international-e-navigation-underway-2017/>.

## 8.9 Announcing e-Navigation Underway – Asia-Pacific 2017

### 8.9.1 Presenter and author

Mr Sunbae Hong, Head of e-Nav Team, Ministry of Oceans and Fisheries, Korea.

### 8.9.2 Abstract

The e-Navigation Underway Asia-Pacific conference arose from the support of the Asia-Pacific Heads of Maritime Safety Agencies (APHoMSA), and the first conference is to be held at Jeju Island in the Republic of Korea, from 18<sup>th</sup> to 20<sup>th</sup> June 2017.



The e-Navigation Underway Asia-Pacific conference focuses on the implementation of e-navigation in the Asia-Pacific region, especially highlighting the harmonised approach to e-navigation, the e-navigation service for non-SOLAS Ships, the implementation of Maritime Service Portfolios and Supporting Infrastructure, and regional cooperation and collaboration towards e-navigation.



The conference also makes an effort to extend participation to industry, governments, and relevant international organisations in addition to e-navigation users. This might provide an opportunity to establish a practical feedback system among all stakeholders and thereby contribute to facilitating implementation of e-navigation.

Registration will be available from early February 2017 with early bird discount.

Mr Hong also invited participants to the IALA Conference in Incheon from 27<sup>th</sup> May to 2<sup>nd</sup> June, 2018 .

The full presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.

## 8.10 Announcing the first combined IALA VTS / e-Navigation Symposium

### 8.10.1 Presenter and author

Mr Pieter Paap, Rijkswaterstaat Water, Verkeer en Leefomgeving t.a.v. Crediteurenadministratie, Netherlands.

### 8.10.2 Abstract

On behalf of the Netherlands Ministry of Infrastructure and the Environment, Pieter Paap invited all participants via a video presentation to the first combined IALA VTS / e-Navigation Symposium to be held from 25<sup>th</sup> to 29<sup>th</sup> May 2020 in Rotterdam.

The presentation is available at <http://www.iala-aism.org/products-projects/e-navigation/e-nav-underway/international-e-navigation-underway-2017/>.



## 8.11 Panel discussion

Facilitator, Omar Frits Eriksson, Dean of the IALA World Wide Academy and conference chairman.

A panel comprising Kevin Richardson (IHMA), Jorge Arroyo (USCG), Morten Glamsø (Danish Shipowners' Association), Michael Siegel (OFFIS) discussed a number of questions with the audience.

### 8.11.1 What is the next important step in implementing e-Navigation?

It was stated that there is still no compelling case for e-navigation and a business case demonstrating value for money has still to be demonstrated. However, it was argued that e-navigation is a concept not a box that can be purchased. The essence of e-navigation is that any supplier's equipment should be able to work interoperably with any other supplier's equipment. Considering the implementation of e-navigation, it was felt that "you cannot implement music and likewise you cannot implement e-navigation" – you can supply a song and you can supply an e-navigation service. Furthermore e-navigation is already established and operating, demonstrating that the business case for the available services has already been made and accepted.

S-mode is a tangible implementation of e-navigation which is required by ship owners. It was stated that manufacturers are not following the original S-mode definition. S-mode guidelines are due in 2019.

It was argued that the future is user displays leading to challenges regarding software updating.

Ship owners are tending to continue using old equipment rather than buying new equipment boxes. In the last ten years every box has had 2 or 3 version updates.

It was felt that there is a need to harmonise rather than homogenise, i.e. to harmonise systems so that they are interoperable rather than have a single equipment for every service. This allows manufacturers freedom to develop.

### 8.11.2 How will e-Navigation best support Autonomous vessels/shipping?

Connectivity and the VTS interface are the essential features of autonomous vessels.

It was stated that ship owners do not want autonomous vessels and that development of autonomous vessels is driven by research rather than market requirement. Legal, manning and berthing are all

unresolved issues. However it was asserted that automatic vessels are coming but the timeframe is unknown. The key issues are safety, particularly in port entry and manoeuvring in close quarters.

There is a need to distinguish between remote controlled vehicles, autonomous vehicles and unmanned vehicles. Unmanned vessels cannot happen under the IMO COLREGS. Many existing vessels are already partially autonomous and there are more than 10,000 autonomous vehicles. Hence the main question to be considered is unmanned vessels.

In Norway, there is a test area for autonomous vessels and a 10 person project team is working with the technology.

Questions were raised regarding who is responsible for an autonomous vessel. It was suggested that a lesson could be learned from the Tesla car manufacturer who assumes full responsibility for the automatic performance of their cars.

It was considered that standards bodies are well behind development of the technology and industry are now leading development of autonomous vessels. There are already many autonomous air and sea vehicles operating without regulation. IMO MSC98 will address the issue of autonomous vessels.

It was envisaged that autonomous vessels will be engaged in national trading in Norwegian waters within 3 to 4 years.

### 8.11.3 What will help demonstrate the commercial benefits of e-Navigation (business cases)?

It was felt that there may be a need to educate users regarding e-navigation and its benefits. However it was argued that the benefits of e-navigation are evident through the benefits of the services provided.

It was stated that ship owners use technology to save fuel and consequently achieve cost savings. Improved services may provide opportunities for further commercial benefit.

It was considered that weather forecasting from supplier to ship is a proprietary system and not e-navigation. e-Navigation is all weather forecasters getting together to supply harmonised information. The business case is delivering weather routing services globally.

Ship owners are willing to invest if there is commercial advantage.

It was stated that there has been a focus on funding testbeds and perhaps now is the time to deliver services.

It was noted that Class B AIS accounts for 45% of AIS transponders and this sector is growing while the volume of Class A transponders is relatively static.

It was stated that the opportunity is in the leisure market for e-navigation services.

## 9 CONFERENCE HIGHLIGHTS

### 9.1 Conference highlights

Ómar Frits Eriksson, the Conference Chairman, presented the conference highlights derived from the conference proceedings.

It was made clear that IALA will consider the following conference highlights and identify any appropriate actions required, thus there are no associated Recommendations.

The conference highlights were:

- 1 There is a need to identify reliable business cases for e-navigation addressing the interests of various maritime stakeholders.
- 2 At least one national authority is considering e-navigation to address autonomous shipping in its coastal waters.
- 3 Cyber security continues to be an issue that needs to be addressed within e-navigation.

- 4 The list of 16 MSPs in the e-Navigation Strategy Implementation Plan requires further refinement and should be considered by all organisations involved including the IMO/IHO Harmonization Group on Data Modelling.
- 5 The Maritime Cloud requires a sound business case including cyber security, ownership and governance.

## 10 CLOSING OF THE CONFERENCE

Mr Francis Zachariae, Secretary-General of the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) thanked all participants for their attendance. He congratulated the speakers, supporting organisations and the steering committee for the excellent arrangements as well as the conference partners. In particular, on behalf of all attendees, he thanked the keynote speaker, the Danish Maritime Authorities 'Dream Team' led by Thomas Christensen, the IALA secretariat and Graham & Partners for their dedicated efforts and preparations. He paid tribute to Omar Frits Eriksson who has been key to the success of the e-Navigation Underway conferences since they began.

e-Navigation is already a reality. Mr Zachariae was pleased to observe the change in emphasis from governments influence in early e-Navigation Underway conferences to industry influence now. He noted that some things are too complex to regulate and natural evolution will happen. Major e-navigation projects are commencing, building on the experience and success of earlier projects. He noted particularly the great advances in e-navigation in Korea, strongly supported by the government of the Republic of Korea.










All participants were invited to the e-Navigation Underway International 2018 Conference from 24<sup>th</sup> to 26<sup>th</sup> January 2018.



In closing, Mr Zachariae wished all delegates a safe voyage home and looked forward to attending the 2018 e-Navigation Underway International Conference.

## 11 EXHIBITION

### 11.1 Exhibitors

The names of the exhibitors and their products are given below:

Name of exhibitor	Products
<p><b>Danish Maritime Authority *</b> Thomas Christensen</p> 	<p><b>ACCSEAS test bed project</b> BalticWeb. Maritime Cloud. End use services. VDES communications channels.</p>
<p><b>Fraunhofer IDMT</b> Jens Ekkeby Appell</p> 	<p><b>Automatic Speech Recognition for Maritime Communication</b> Automatic recognition of SMCP phrases, bridge and ship to shore communications.</p>
<p><b>Graham &amp; Partners</b> Jane Graham</p> 	<p><b>Event Organiser</b> Live event &amp; conference management.</p>
<p><b>Kongsberg Norcontrol*</b> Todd Schuett</p> 	<p><b>The SESAME Strait Project</b> Secure, efficient and safe maritime traffic Management in the straits of Malacca and Singapore.</p>
<p><b>Marina System Iberica – MSI</b> Francisco Sarrias</p> 	<p><b>Long live GPS tracker</b></p>
<p><b>OFFIS Institute for Information Technology*</b> Axel Hahn</p> 	<p><b>Maritime Cloud demonstrator</b> eMaritime Integrated Reference Platform (eMIR). North Sea airborne surveillance service simulator. Maritime Cloud eMIR display testbed.</p>
<p><b>OMC International*</b> Jonathon Pearce</p> 	<p><b>Dynamic under keel specialist and proven e-nav solution</b> Improving navigational safety. Use of chart overlays.</p>
<p><b>Safebridge GmbH</b> Ralph Becker-Heins</p> 	<p><b>Vessel training kit</b> Fully stand alone bridge equipment &amp; familiarisation training Voyage training with ECDIS.</p>
<p><b>Slipstream Engineering Design Ltd</b> Plilip Wilson</p> 	<p><b>RF design and fabrication</b> Solid state power amplifier and power supply unit. Radar transponder.</p>

Name of exhibitor	Products
<p><b>Sjöfartsverket /Swedish Maritime Authority *</b> Björn Andreasson</p> 	<p><b>Sea Traffic Management (STM)</b> Defining Sea Traffic Management. Presentation of STM project validation process. Dynamic route exchange in practice. STM testbeds.</p>
<p><b>Vega*</b> Peter Orre</p> 	<p><b>AtoN equipment</b> Short range LED marine lanterns. Precision sector light. AIS monitoring and control.</p>

\* Indicates an IALA member

## 12 SOCIAL EVENTS

### 12.1 Welcome Reception

On day 1, following a welcome reception in the Columbus Club on board, a buffet dinner was held in the 7 Seas Restaurant of the M/S Pearl Seaways. On day 2, personal photographs and a welcome event were followed by a 3 course dinner in the Blue Riband Restaurant concluding with a visit to the live music session in the Columbus Club.

### 12.2 Weather

Participants experienced fair weather conditions throughout the voyage with moderate winds and calm seas.

### 12.3 Acknowledgments

The conference expressed its appreciation to the Danish Maritime Authority and IALA for its joint organisation of e-Navigation Underway International 2017. The “Dream Team” led by Thomas Christensen was congratulated on an excellent event. In particular the support given by the following was acknowledged:

The Nautical Institute (NI)  
Comité International Radio-Maritime (CIRM)  
International Hydrographic Organisation (IHO)  
Baltic and International Maritime Council (BIMCO)  
International Chamber of Shipping (ICS)

Thanks were also extended to those who contributed to the drafting of the conference highlights.

Photographs provided by DMA were available on the memory sticks provided at the end of the Conference.



**ANNEX A PARTICIPANTS LIST**

First name	Sur name	Company/organisation	Email	Country
José Manuel	Alvarez	European Satellite Services Provider (ESSP)	jose-manuel.alvarez@essp-sas.eu	Spain
Peter	Andersen	Cobham SATCOM	peter.andersen@cobham.com	Denmark
Björn	Andreasson	Swedish Maritime Administration	bjorn.andreasson@sjofartsverket.se	Sweden
Jens Ekkeby	Appell	Fraunhofer IDMT Hearing, Speech and Audio Technology	jens.appell@idmt.fraunhofer.de	Germany
Jorge	Arroyo	U.S. Coast Guard	Jorge.Arroyo@uscg.mil	United States
Gjermund H.	Bakken	Norwegian Hydrographic Service	gjermund.bakken@kartverket.no	Norway
Jakob	Bang	Danish Maritime Authority	cjb@dma.dk	Denmark
Frances	Baskerville	CIRM	fb@cirm.org	United Kingdom
Christoph	Becker	Raytheon Anschütz GmbH	christoph_becker@raykiel.com	Germany
Ralph	Becker-Heins	Safebridge GmbH	office@safebridge.net	Germany
Michael	Bergmann	Victoria Swedish ICT	michael.bergmann@bergmann-marine.com	Germany
Gilles	Bessero	IHO	gilles.bessero@iho.int	France
Annick	Bessero	Spouse		
Jinofer Kavasji	Bhujwala	AATASH NORCONTROL LTD.	jino@aatash.com	India
André	Bolles	OFFIS	bolles@offis.de	Germany
Poul	Bondo	GateHouse	pba@gatehouse.dk	Denmark
Stefan	Borowski	Bundeslotsenkammer	stefan.borowski@kielpilot.de	Germany
Jan	Boyesen	MDC - Maritime Development Center	jb@mdc.center	Denmark
Anders	Brodje	Bahamas Shipowners Association	abrodje@bahamasshipownersassociation.com	United Kingdom
Willem	Brouwers	Cobham SATCOM	willem.brouwers@cobham.com	Denmark
William	Cairns	American Pilots	bcairns@americanpilots.org	United States
Michael	Card	IALA	michael.card@iala-aism.org	France
Bruno	Cardoso	Geodatastyrelsen	bruca@gst.dk	Denmark
Deuk Jae	Cho	KRISO	djcho@kriso.re.kr	South Korea
Tomas Groth	Christensen	Danish Maritime Authority	tgc@dma.dk	Denmark
Thomas Steen	Christensen	Danish Maritime Authority	thc@dma.dk	Denmark
Doyoung	Chung	ETRI	thisisdoyoung@etri.re.kr	South Korea
Gabriel Ferrús	Clari	Fundación Valenciaport	gferrus@fundacion.valenciaport.com	Spain
Nick	Cutmore	International Maritime Pilots' Association	office@impahq.org	United Kingdom

First name	Sur name	Company/organisation	Email	Country
Troels Blicher	Danielsen	Danish Maritime Authority	trd@dma.dk	Denmark
Aline	Debievre	IALA	alinedebievre@btopenworld.com	United Kingdom
Philippe	Dengreville	CS systemes d'information	philippe.dengreville@c-s.fr	France
Berit Nanna	Dissing	Danish Maritime Authority	bnd@dma.dk	Denmark
Richard	Doherty	CIRM	rd@cirm.org	United Kingdom
Seamus	Doyle	IALA	seamus.doyle@iala-aism.org	France
Rainer	Droste	OFFIS	rainer.droste@offis.de	Germany
Anette Fenger	Dybdal	Danish Maritime Authority	anf@dma.dk	Denmark
Cato	Eliassen	Kongsberg Seatex	cato.eliassen@kongsberg.com	Norway
Morten Søborg	Elmbo	Furuno Maritime Training	mse@furuno.dk	Denmark
Omar Frits	Eriksson	IALA	omar.eriksson@iala-aism.org	France
Cajsa Jersler	Fransson	Swedish Maritime Administation	Cajsa.jerslerfransson@sjofartsverk et.se	Sweden
Gert	Frost	DanPilot	gfr@danpilot.dk	Denmark
Johan	Gahnström	INTERTANKO	johan.gahnstrom@intertanko.co m	United Kingdom
Morten	Glamsø	Danish Shipowners' Association	mgl@shipowners.dk	Denmark
Frank Adler	Gottlieb	Danish Maritime Authority	fgo@dma.dk	Denmark
Josephine	Gretlund	Danish Maritime Authority	jog@dma.dk	Denmark
Yann	Guichoux	e-Odyn	yann.guichoux@e-odyn.com	France
John Erik	Hagen	Norwegian Coastal Administration	john.erik.hagen@kystverket.no	Norway
Axel	Hahn	OFFIS	axel.hahn@offis.de	Germany
Soomi	Han	KRISO	sumihan@kriso.re.kr	South Korea
Freddy	Hansen	FURUNO	fh@furuno.dk	Denmark
Odd Sveinung	Hareide	Royal Norwegian Navy	Ohareide@sksk.mil.no	Norway
Stian	Haugland	Rederiet Stenersen AS	snh@stenersen.com	Norway
Christian	Hauglie- Hanssen	Kongsberg Defence Systems	christian.hauglie- hanssen@kongsberg.com	Norway
Bjørn Åge	Hjøllø	NAVTOR AS	bjorn.hjollo@navtor.com	Norway
Sun-bae	Hong	Ministry of Oceans and Fisheries	elfstalker80@gmail.com	South Korea
Mikael	Hägg	Viktoria Swedish ICT	Mikael.Hagg@viktoria.se	Sweden
Marat	Ismagilov	Kronstadt Technologies (JSC)	Marat.Ismagilov@kronshtadt.ru	Russia
Nobuyuki	Ito	Japan Radio Co., Ltd.	ito.nobuyuki@jrc.co.jp	Japan
Mohd Saiful Redzuan	Jamil	Light Dues Board Peninsular Malaysia/Ministry of Transport Malaysia	saiful@mot.gov.my	Malaysia
Palle Broberg	Jensen	Scandlines Danmark ApS.	palle.b.jensen@scandlines.com	Denmark
Jung Sik	Jeong	MOKPO NATIONAL MARITIME UNIVERSITY	jsjeong@mmu.ac.kr	South Korea

First name	Surname	Company/organisation	Email	Country
Jeppe Skovbakke	Juhl	BIMCO	jsj@bimco.org	Denmark
Sung Heon	Jung	DK M-Tech	logixer@dkmtech.com	South Korea
Fredrik	Karlsson	Swedish Maritime Administration	fredrik.karlsson@sjofartsverket.se	Sweden
Takuo	Kashiwa	Furuno Electric Co., Ltd.	takuo.kashiwa@furuno.co.jp	Japan
Walter	Kenda	Mistral'81 d.o.o.	walter.kenda@mistral81.com	Croatia
Joon Bum	Kim	Ministry of Oceans and Fisheries Republic of Korea	jbkim@krs.co.kr	South Korea
Torsten	Kruuse	Søfartsstyrelsen	torsten.kruuse@gmail.com	Denmark
Deirdre	Lane	Commissioners of Irish Lights	deirdre.lane@irishlights.ie	Ireland
Tom Buhl	Larsen	Danish Maritime Authority	tbl@dma.dk	Denmark
Kwangil	Lee	ETRI	leeki@etri.re.kr	South Korea
Junshik	Lee	KHOA/IHO	ljs7979@korea.kr	South Korea
Hye-Jin	Lee	Korea Maritime Institute	jinlee@kmi.re.kr	South Korea
Han Jin	Lee	KRISO	hjlee@kriso.re.kr	South Korea
Malin	Liljenborg	Swedish Maritime Administration	malin.liljenborg@sjofartsverket.se	Sweden
Mikael	Lind	Viktorias Swedish Ict	Mikael.Lind@viktorias.se	Sweden
Paul	Marks	United Kingdom Hydrographic Office	paul.marks@ukho.gov.uk	United Kingdom
Tuomas	Martikainen	Finnish Transport Agency	tuomas.martikainen@fta.fi	Finland
Manuel Lopez	Martinez	European GNSS Agency	manuel.lopezmartinez@gsa.europa.eu	Czech Republic
Iurii	Marushchenko	State Hydrographic Service of Ukraine	belinskyi.v@hydro.gov.ua	Ukraine
Shohei	Masaki	Japan Radio Co., Ltd.	masaki.shohei@jrc.co.jp	Japan
Bo	Mathiesen	Danish Pilot Service	bm@dps.as	Denmark
Svein David	Medhaug	The Norwegian Maritime Authority	sdm@sdir.no	Norway
Krzysztof	Mendalka	Sprint S.A.	krzysztof.mendalka@sprint.pl	Poland
Georg	Michelitsch	Airbus Defence and Space GmbH	georg.michelitsch@signalis.com	Germany
Hisaya	Motogi	Oshima Maritime College	motogi@oshima-k.ac.jp	Japan
Brian Schmidt	Nielsen	DanPilot	bsn@danpilot.dk	Denmark
Koichi	Nishimura	TOKYO KEIKI INC.	k-nishimura@tokyo-keiki.co.jp	Japan
Yasuyuki	Niwa	National Maritime Research Institute	yaniwa@nmri.go.jp	Japan
Sewoong	Oh	KRISO	osw@kriso.re.kr	South Korea
Peter	Orre	Vega Industries Ltd.	peter.orre@gmail.com	New Zealand

First name	Suriname	Company/organisation	Email	Country
Pieter I.	Paap	Rijkswaterstaat Water, Verkeer en Leefomgeving t.a.v. Crediteurenadministratie	pieter.i.paap@quicknet.nl	Netherlands
Han-Seon	Park	Korea Maritime Institute	hspark@kmi.re.kr	South Korea
Kae-myung	Park	Korean Register of Shipping	kaemyoung@krs.co.kr	South Korea
Jin Hyoung	Park	KRISO	jin.h.park@kriso.re.kr	South Korea
Kwang-youl	Park	Ministry of Oceans and Fisheries	elfstalker80@gmail.com	South Korea
In Sung	Park	Ministry of Oceans and Fisheries	elfstalker80@gmail.com	South Korea
Jonathon	Pearce	OMC International	j.pearce@omcinternational.com	United Kingdom
Lars Robert	Pedersen	BIMCO	lrp@bimco.org	Denmark
Bjørn Borbye	Pedersen	Danish Maritime Authority	bbp@dma.dk	Denmark
Hannu	Peiponen	Furuno Finland Oy	hannu.peiponen@furuno.fi	Finland
Esben	Pejstrup-Pedersen	Danish Maritime Authority	epp@dma.dk	Denmark
Simon	Pelletier	IMPA	simon.pelletier@videotron.ca	United Kingdom
Erik Styhr	Petersen	Wartsila Lyngsø Marine A/S	erik.styhr.petersen@wartsila.com	Denmark
Thomas	Porathe	NTNU, Norwegian University of Science and Technology	thomas.porathe@ntnu.no	Norway
Fred	Pot	Marine Management Consulting	fpot@enavsolutions.org	United States
Julia	Powell	NOAA	Julia.Powell@noaa.gov	United States
Jean-Jacques	Quinquis	CEREMA	Jean-Jacques.Quinquis@cerema.fr	France
Michael Adrian	Rambaut	Consultant	michael.rambaut@btinternet.com	United Kingdom
Olivier	Reichert	Safran Electronics & Defense	Olivier.reichert@safrangroup.com	France
Kevin	Richardson	IHMA-IALA	kevin.richardson1503@gmail.com	United Kingdom
John	Robinson	Sperry Marine	john.robinson@sperry.ngc.com	United Kingdom
Dmitry	Rostopshin	Transas	rost@transas.com	Russia
Anders	Rydlinger	Transas Marine Ltd	rydlinger@transas.com	Sweden
Christopher	Saarnak	Danish Maritime Authority	chs@dma.dk	Denmark
Francisco	Sarrias	Marina System Iberica - MSI	fsarrias@msicom.net	Spain
Mario	Sattler	viadonau - Oesterreichische Wasserstrassen GmbH	mario.sattler@viadonau.org	Austria
Katja	Schlesinger	Danish Maritime Authority	ksc@dma.dk	Denmark
Todd	Schuett	Kongsberg Norcontrol	todd.schuett@kongsberg.com	Norway
Sören Bastian	Schweigert	OFFIS		

First name	Sur name	Company/organisation	Email	Country
Mika	Semann	Airbus Defence and Space GmbH	mika.semann@airbus.com	Germany
Oleksii	Shpachenko	State Hydrographic Service of Ukraine	belinskyi.v@hydro.gov.ua	Ukraine
Michael	Siegel	OFFIS	siegel@offis.de	Germany
Gurpreet	Singhota	Swedish Maritime Administration	gurpreetssinghota@gmail.com	United Kingdom
Michael	Skov	Danish Maritime Authority	msk@dma.dk	Denmark
Scott	Smith	US Coast Guard	Scott.j.smith2@uscg.mil	United States
Annette	Spatz	Spouse		
Ulf	Steden	Safebridge GmbH	office@safebridge.net	Germany
Cathrine M.	Steenberg	FORCE Technology	cms@force.dk	Denmark
Michael	Strandberg	Danish Maritime Authority	mst@dma.dk	Denmark
Tor	Svanes	NAVTOR AS	tor.svanes@navtor.com	Norway
Lars Lund	Sørensen	Danish Geodata Agency	lalun@gst.dk	Denmark
Peter Krogsgaard	Sørensen	FORCE Technology	pks@force.dk	Denmark
Jonas	Terp Nielsen	FURUNO	jtn@furuno.dk	Denmark
Socrates	Theodossiou	TOTOTHEO Group	KATHY@SATLINK.COM.CY	Cyprus
Jorma	Timonen	Finnish Transport Agency	Jorma.Timonen@fta.fi	Finland
Dimitris	Toskas	TOTOTHEO Group	KATHY@SATLINK.COM.CY	Cyprus
Juergen	Troegl	viadonau - Oesterreichische Wasserstrassen GmbH	juergen.troegl@viadonau.org	Austria
Dirk	Vael	EMPA	dirk.vael@skynet.be	Belgium
Jeffrey	van Gils	Rijkswaterstaat / Water, Verkeer en Leefomgeving	jeffrey.van.gils@rws.nl	Netherlands
Helga	Van Noten	Antwerp Maritime Academy	helga.van.noten@hzs.be	Belgium
Eduard	Verbeek	STODEL/Dutch Pilots' Corporation	c.vandenbor@loodswezen.nl	Netherlands
Dierik	Vermeir	ALSIC BVBA	dierik.vermeir@alsic.be	Belgium
Eric	Verschoor	Datema Delfzijl	everschoor@datema.nl	Netherlands
Lene	Vesterlund	Kongsberg Norcontrol AS	lene.vesterlund@kongsberg.com	Norway
Jorge	Viso	American Pilots	moanamarine@verizon.net	United States
Benjamin	Weinert	OFFIS	benjamin.weinert@offis.de	Germany
Jan	Wellmann	Fraunhofer IDMT	jan.wellmann@idmt.fraunhofer.de	Germany
Søren	Westerskov	DanPilot	sws@danpilot.dk	Denmark
Susan Ann	White	Spouse		
Philip	Wilson	Slipstream Engineering Design Ltd	accounts@slipstream-design.co.uk	United Kingdom
Gareth	Wimpenny	General Lighthouse Authorities, UK & Ireland	gareth.wimpenny@gla-rrnav.org	United Kingdom
Chun	Yu	China Classification Society	cyu@ccs.org.cn	China
Roslee Mat	Yusof	Light Dues Board Peninsular Malaysia / Marine Dept Malaysia	roslee@marine.gov.my	Malaysia

---

First name	Surname	Company/organisation	Email	Country
Francis	Zachariae	IALA	francis.zachariae@iala-aism.org	France
Almir	Zerem	Viktorias Swedish ICT	almir.zerem@viktorias.se	Sweden



The conference is organized by



# DANISH MARITIME AUTHORITY



**IALA**

The conference is supported by

