

Conference Report

E-NAVIGATION UNDERWAY

INTERNATIONAL CONFERENCE ON E-NAVIGATION

M/S Crown Seaways, Copenhagen–Oslo–Copenhagen
18 January - 20 January 2012

Jointly organized by the EfficienSea project and the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA)
Supported by the Nautical Institute and
the International Association for Marine Electronics Companies

Executive Summary

The 2012 “E-Navigation Underway” conference entitled From a Bird’s Perspective to Practical Solutions” gathered 143 delegates from 21 countries. A number of presentations were given on general developments and other aspects of e-Navigation as well as experiences gained from existing e-Navigation test beds were presented and discussed. Live demonstrations were given on the existing e-Navigation services provided within the EfficienSea project.

The conference arrived at twelve conclusions concerning e-Navigation, the regulatory environment and test bed processes.

Conference participants were generally very satisfied with the conference. Many of whom expressed that the conference had helped to provide clarity, and pragmatism to e-Navigation, and found such conferences useful for sharing knowledge and coordinate test bed activities for the benefit of the general e-Navigation process.

The conference was filmed and the films are available on www.ufficiensea.org, or directly through the links that you find below in connection to each section.

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Annex 1 Transitioning from Traditional Aids to Navigation, Mike Sollosi

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E-Navigation: The Big Picture

1 Welcome and introduction

– Andreas Nordseth, Director General, Danish Maritime Authority

The scene was set with an overview of traffic in and out of the Baltic was given, together with the hazardous nature of much of its cargo before reference was made to the current financial state and the squeeze that it is putting on the maritime industry. The attraction of a route opening to the Far East, around the north of Russia, was set in the context of the consequences of incidents. It was emphasised that, with regard to e-Navigation solutions, there is a need to push for solutions in close partnership with industry.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=3bea1a16-a1c0-4f1b-b89c-6988c0e2fb50>

2 Key Note Address: From a bird's eye perspective to practical solutions

– Gary Prosser, Secretary-General, IALA

The presentation began with a brief introduction of those who had steered e-Navigation Underway 2012 to its commencement. Having introduced IALA its involvement in e-Navigation was covered in some detail, including e-Navigation relationship with IMO and two Correspondence Groups. The composition of the e-NAV Committee was explained, as was the association between IALA and the EfficienSea project and the impact that this project is having on e-Navigation. A personal view about the need for a regulatory approach to e taken to e-Navigation, together with some possible options were outlined, as well as an envisioned step by step approach being taken to development. It was also suggested that it might be beneficial for IMO to form a panel of experts, which could recommend revised minimum standards as aspects of e-Navigation develop. The IALA net, the IALA Risk Management Toolbox and the World VTS guide were touched on, before IALA's willingness to participate in e-Navigation test beds, where it could, was indicated and the hope expressed that there would be an e-Navigation Underway conference 2013.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=31cb1b79-0909-4b54-8479-d06ec69533a8>

3 The IMO e-Navigation strategy implementation plan

– John Erik Hagen, Chairman of the IMO e-Navigation Correspondence Group

Beginning with the background to 'Why e-Navigation' and its definition, the key elements in the vision for e-Navigation were covered. This led to a statement of the process, which in turn has led to a proposal for the strategy implementation plan to be finalised in 2014. The underlying important principles were stated, together with the need to take user needs into account. Later presentations and comments showed just how ambiguous the term 'users' can be in the context of e-Navigation. Possible solutions were illustrated before attention turned to Formal Safety Assessment. This led to a more in depth review of the components of the IMO Strategy Implementation Plan. Reference was then made to the Marine Electronic Highway project in the Malacca and Singapore Straits. The presentation ended with a statement about IMO's strength as the co-ordinator of e-Navigation.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=5a56b500-17df-4132-b689-099186b05c58>

4 e-Navigation – a vision and its practical implementation – Andy Norris, Vice President, Royal Institute of Navigation

Having explained that what was to follow is a personal view, there was an opening question, “What really is e-Navigation?”, which led to the statement that “We have had electronic navigation for years. E-Navigation is very different”. A simplified conceptual structure was shown, with emphasis initially on the communications element and the use of existing standards. This was followed by discussion of the data sources and the importance of data integrity. This led to presentation of e-Navigation workstations and how their use could affect bridge practices. What e-Navigation will allow us to do better was then followed by a suggestion that an ‘Apps like’ approach could be taken to development, with various levels of App having different standing in the regulatory process. The applicability of introducing e-Navigation into new build ships and the challenges for retrofitting were covered before consideration was given to the factors that could affect timescales, with the introduction of ECDIS being used as an example. Concluding slides gave perceived advantages and difficulties, the most challenging of which was seen as the considerable changes in legislation.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=d97ca00f-6c4c-4658-96c6-92c1f21bf021>

5 Tell us what you want and we will build it – Mike Rambaut, Secretary-General, CIRM

Having briefly introduced the role of CIRM and its goal of the free movement of goods, the factors affecting what manufacturers choose to make and the process that they go through in making their decisions were explained and the associated drivers. Standards and their development were covered, as was the impact of Committees on development of a concept (e-Navigation was used as an example) to type approval. It was asked if design by a Committee works? The speaker thought not, and also thought that reaching a consensus posed challenges. With regard to standards in e-Navigation it was suggested that the current IMO Gap Analysis portrays too dark a picture, which led to a discussion on the drafting of standards; IMO performance standards in particular. This led to comments on displays and indicators, availability, followed by what were considered to be basic steps in the implementation of e-Navigation. This included a plea to freeze standards as soon as possible. There were then some concluding remarks that ended with the statement that “We, the manufacturers, can’t start designing things until this is all clear.”

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=74e21509-ed57-4202-8a0f-48f43bf29451>

6 Ensuring competence – John Murray, International Chamber of Shipping

In an opening remark it was said that it is “Reasonable to use ECDIS experience as a window onto e-Navigation”. Having briefly reviewed the bodies that are involved in setting standards and approving training for competence, within the context of e-Navigation, the case of the development of ECDIS was used as an example of what ought to be avoided. In this case it was suggested that there had been a potential for conflict between the pace of technological development and the established regulatory process. The concepts in the current status were listed, as were the opportunities likely to arise. It was then suggested that without competence various challenges may not be sufficiently addressed. The theme of ECDIS was again used to make a plea for generic training and type specific training to be used, with assessment, to determine competence. Familiarisation training, if necessary on board, can then be used to acquire ‘operational competence’. How familiarisation might be facilitated was then reviewed. With regard to e-Navigation training it was concluded that:

- ICS considers that training, but not necessarily a training course may be required to introduce the concept of e-Navigation to users;
- The automation, harmonisation and integration driven by the definition of e-Navigation should ensure that training additional to that already required under the STCW is generally unnecessary.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=d7d0e95d-85c2-4342-98ec-5c349fd703c8>

7 The work of the IALA e-Navigation Committee – Bill Cairns, Chairman of the IALA e-NAV Committee

The statistics, including its size, for the last e-NAV Committee were presented, before the impact of e-Navigation across each of the IALA Committees was stressed. What IALA is involved in, together with its relationship with IMO were covered, before details of the Committee's Working Groups and their responsibilities were covered in some depth. The outline timeline for various e-Navigation activities was shown and stress was laid on the importance of the forthcoming IHO / IALA meeting, where the mechanics of IALA becoming a submitting organisation and a domain holder under the IHO's S-100 GI Registry. This was followed by a look into what the future holds for the e-Navigation Committee, including its immediate next tasks.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=67ca57a2-8a6c-45b5-ad84-bfe7b0ac3029>

8 The human element in test beds – David Patraiko, Director of Projects, The Nautical Institute

After introducing the Nautical Institute, there was a clear statement of how the human element and user needs should be involved in e-Navigation. The challenging environment, for the mariner, as e-Navigation comes into being was made clear. This led to a review of the meaning of usability and decision making, which in turn led to the presentation and brief description of a selection of various tools that included: Draft Guidelines for Usability Evaluation – Japan, Human Element Analyzing Process, Principles related to Bridge design. SOLAS Ch V, Reg 15 and the Training Effectiveness Critical Analysis Tool. There was then a statement about complexity, which drew comment in subsequent discussion, followed by a review of training options and the value of mentoring, which it was suggested was one of a list of items that could be profitably included in e-Navigation test beds.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=4a055c23-e108-4f7b-869e-e9c3f4928f47>

9 A co-ordinated approach: Transitioning from traditional aids to e-Navigation – Mike Sollosi, Chair of IMO Sub-Committee on the safety of Navigation (NAV)

There were no slides accompanying this presentation, the full text of which is reproduced in Annex 1.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=a2583300-3b94-4b3e-92df-c5f4d9ec8a92>

10 The IMO process for the development of the e-Navigation strategy implementation plan – Gurpreet Singhota, Deputy Director, Maritime Safety Division, IMO

Having outlined the background to the development of e-Navigation and shown the steps considered in developing the strategy for the development and implementation of e-Navigation, during which it was emphasised that the vision for e-Navigation included 'on board', 'Ashore' and the communications required to link the two. The core objectives were presented in some detail, which led to a review of the benefits of e-Navigation. It was stated, again, that e-Navigation should be based on user needs not technology driven and over-reliance should not be placed on technology. The potential ship and shore-based users were presented, which again showed how elastic the term 'user' needs to be. The high-level generic user needs and key strategy elements were reviewed before the framework for the implementation process was discussed. This led to a brief review of roles of the sub-Committees that are contributing to the work on e-Navigation at IMO: NAV, COMSAR & STW. In sketching out the steps so far in the development of e-Navigation specific mention was made of the use of the IHO's S-100 standard. This was followed by mention of future radio spectrum requirements. Gap analysis was mentioned which led to a statement about the anticipated impact that e-Navigation would have on IMO. The presentation ended the latest revised co-ordinated approach to implementation between 2012 and 2014.

Reports from test beds and related topics

11 SmartOcean Ireland Innovation Cluster: Developing ICT solutions for the Global Marine Sector – Barbara Fogarty, National Centre for Sensor Research, Ireland

The size of Ireland's marine area was mentioned, together with an introduction to the Marine Institute and its key activities and its relationships with key ICT companies. The main drivers for Marine ICT were reviewed leading to marine spatial planning and the concept of multi-functional platforms. Taking advantage of technology convergence is a key interest, which led to the creation of SmartBay, a multi-purpose test bed. Some of the projects, such as subsea acoustic monitoring, communications networking and scalable communications networking and decision support were featured. The launch and purpose of SmartOcean Strategy, which draws together SME's, national organisations and government was described. The presentation ended with an indication of the output of SmartBay is leading to commercial exploitation and the perceived benefits of public / private partnerships.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=e1cc79b3-6258-4fd8-abce-d773535dd92c>

12 Tampa Bay Pilot e-Navigation test bed – Jorge Viso, American Pilots Association

The presentation featured Application Specific Messages (ASM). Tampa is one of three test beds using data provided by NOAA. The aim is to reduce voice communications and improve navigation safety and efficiency. PORTS, a real-time system to provide environmental data was described and its benefits for depth sensitive port operations and the need to use slack water for difficult turns. Access to real-time meteorological data has assisted in developing producing procedures for the movement of cruise ships. The information has been available via a website but is now available via ASMs and the pilot's PPU. The reason for choosing tabular vice graphic display, which was expanded on later, was given and the planned display on an ECS were shown. The benefits and challenges of using PORTS was discussed, as was the effect of the test bed providing suspect information. The reliability of AIS data and the need to verify it was stated. Comments made by pilots (the users) were quoted. In conclusion the beneficial use of PORTS data was reviewed, together with some caveats, which included the loading of the VDL.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=7050345f-9225-4f73-a347-5afd12cc9cf8>

13 EfficienSea - A platform to build upon – Thomas Christensen, Danish Maritime Authority

The background of the EfficienSea project was given before the presentation focussed on the aims with regard to e-Navigation. The establishing of test beds was outlined, with the results already being fed back to the IMO Correspondence Group. The topology of to test bed was introduced before the currently operational services were described, each of which was then covered in more detail. The question was then asked 'Where are the users?' and the answer was that wherever he / she may be they are in the test beds. The presentation concluded with the description of the flow through into ACCSEAS and an overview of key work that had been completed.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=7a5c05ac-fedf-47c6-9e8f-a3c5fb52430e>

14 EfficienSea - Enhanced Radar Positioning – Jens Kristian Jensen, Danish Maritime Authority

The importance of resilient position, navigation and timing was stated before a description of radar positioning system was given. This had led to e-RACON and e-Radar. Current functionality was described before the key enabling technology was outlined before the area used by the test bed was shown. The set up for the test bed and the way theory used was described before the results were displayed for static and moving targets. It has been concluded the automatic position verification is realistic but one needs to use at least 2 RACON's with a suitable geometry. The challenges to be overcome, including the need for standards, were described and a look ahead to the next steps, including the continuing need for test beds, made.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=7a5c05ac-fedf-47c6-9e8f-a3c5fb52430e> (scroll to the middle of the film)

15 EfficienSea - Communication for e-Navigation - results of the tests and measurements – Jerzy Zurek, Gdynia Maritime University, Poland

The approach to making the required measurements was described, with each then being enlarged upon. The distances covered, the number of measurements taken and multiple data systems utilised were described. The results were shown before the conclusions drawn were presented. The overall results, for systems not maximised for marine use, were considered encouraging.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=7a5c05ac-fedf-47c6-9e8f-a3c5fb52430e> (end of film)

16 The National e-Navigation strategy and e-Navigation test beds in the United States – Brian Tetreault, US Army Corps of Engineers

The US e-Navigation strategy was described, briefly, noting that it was really an action plan that includes internal waters. The key elements and actions were identified before current test beds / activities were described, with the focus on River Information Services (RIS) and Lock Operations Management (LOMA). The RIS concept involves the use of an RIS portal, which will lead to the development of Apps and public / private partnerships. For LOMA there was an overview of the developing infrastructure with considerable emphasis on AIS. Developments in AIS ASMs, associated with lock operations, and the associated test beds were described. Predictive tools were described as a future capability before the lessons used were shown. This included the challenges of a user focus, innovation, stakeholder outreach, introducing new capabilities and the fact that policies rather than technology can be the problem.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=8b5713ad-a451-46b4-a55e-0901185dcde1>

17 Dynamic and Proactive Routing - Moving Maritime into the Digital Age – Ulf Svedberg, Swedish Maritime Administration

The presentation featured the Mona Lisa project, beginning with its background and scope with the focus on dynamic and proactive routing. A short film, showing the problem of coping with green house gas reduction, coupled with the expected growth in transport and the resulting conclusion that sea transport had an important to play. The consequence of this and the resulting activities that would aid both safety and efficiency, developed in project Mona Lisa were illustrated. It was asserted that Sea Traffic Management / Sea Traffic Control are needed. This leads to the concept of Green Routes, the implementation of which was described. This also involves marine

spatial planning and the ability to save on fuel usage. This led to the introduction of System Wide Information Management. The possibility for dynamic separation, as opposed to static separation, was hinted at. With ship's routes held centrally in a Sea Traffic Control system, assistance in avoiding congestion and 'open sea pilotage' become possible. Other potential benefits / functionality were described. The presentation then turned to automatic verification system of watch-keepers qualifications and working conditions, using an identity card, the information from which can be transmitted via AIS, was outlined.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=e6d8fcfc-943e-4b15-b15a-943cef3ba357>

18 e-Navigation on the St Lawrence River in Canada: Past, Present and Future – Lee Alexander, University of New Hampshire

The presentation described a partnership test bed. It was asserted that the users and requirements are already known, which led to a user demand for e-Navigation. The background to the test bed was described, this included optimising vessel transits and the necessity for an easily understandable system. The test bed is based on PPU; pilots were leading the push for e-Navigation but the project was only possible because the users have common interest and purpose; the project is funded by the users but uses national infrastructure and data. The test bed results were stated, including river and waterways bathymetry, the MARINFO portal operated by the Canadian Coast Guard, connection to vessel equipment and navigation condition update. It was concluded that many existing facilities are adequate for current needs and can be expected to develop incrementally; there is not necessarily a need for new functionality or systems. It was concluded that:

- e-Navigation has gone from concept to practice
- Both Pilot Corporations now use PPU's
- Technical solution now allows for new ways to broadcast and transfer marine data (i.e. AIS-ASM)
- Partnership between Port of Montreal and the Saint Lawrence pilots was essential to make this project a reality and a success!

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=2c828509-9102-498e-a05a-211913ce7626>

19 Development of guidelines for usability evaluation of navigational equipment – Yasuyuki Niwa, National Maritime Research Centre, Japan

Having outlined the background, which included a statement of the difficulties that led to the work being undertaken and purpose of the guidelines. Attention was drawn to relevant definitions, such as 'usability', 'effectiveness', 'efficiency', 'satisfaction' and 'usability test'. The scope was stated as covering navigational equipment that use GUI. The process of summative usability testing was described, this included planning, preparation, which was described in some detail, implementation and analysis, which was also described in some detail. The NMRI ship-handling simulator was mentioned and the offer made for delegates to visit it. The test procedure was outlined together with specimen results. The conclusions drawn included the necessity of assessing navigation report systems and that the usability guidelines had been developed focussing on the usability test.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=6ef6c59b-baf1-4d2e-9418-0b28f0921686>

20 Integrated data streams as information backbone of e-Navigation – Michael Bergman, Jeppesen

The presentation set the context of for data integration with e-Navigation, which began with the IHO S-100 GI Registry and the e-Navigation framework. This was a change since last year has been detected. Looking at 'What and How', the what is covered by the regulatory framework but the how is down to innovation from industry, whilst remaining with the type approval framework. e-Navigation is seen as a journey, which has already begun and not a destiny. The presentation turned to data versus information and illustrations were taken from the

aviation industry, including an example of how digitising data can lead to de-cluttering of an air chart. There was then brief discussion of collecting data to develop information, which then led to data overlays and the challenges that they can pose and the complexity of data streams. This leads to data integration as a part of e-Navigation. The presentation then turned to the Situation Centric concept, some examples of which were shown together work undertaken by WG6 (Portrayal) of the IALA e-NAV Committee and the use of the S-100 standard for non-cartographic data.

Not for the first time, the presentation led to a question about liability.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=2482ba96-d048-46b6-8a1a-1772287d14b5>

21 Portraying e-Navigation Information: Challenge and Opportunities – Lee Alexander, University of New Hampshire

It was stated that the presentation would reinforce the previous one. It started with the definition of e-Navigation and the IMO's vision of it, before turning to perceived challenges, which were then expounded on. This included coverage of what you need to see is what you want to do, the definitions involving data versus information and portrayal versus presentation. It was said that there are 6 basic ways in which to portray any e-Navigation information, a topic that was then illustrated by examples, including symbology and Marine Information Overlays (MIO). The challenges in displaying ASM information and harmonising chart information, of which three options were shown, were mentioned. e-Navigation should allow more time to look out of the window and what must be avoided is information overload.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=19989b6a-92d0-42e2-b640-3a4614c808f4>

22 Core elements of e-Navigation: IMO concept for integrated e-Navigation systems – Florian Motz, Fraunhofer, Institute for Communication, Information Processing and Ergonomics

As an opening remark it was maintained that the presentation contained nothing new; everything was already covered in IMO documentation. It began with the individuality of existing bridges and the current information overload. It moved across some aspects of IMO e-Navigation aspects, which had already been covered. The high-level user needs of e-Navigation were stated, much of which is contained in existing IMO requirements for integrated navigation systems, before turning to detailed user needs. The presentation then turned to coverage of the modular bridge concept, its objectives and function, including a basic block diagram. The INS performance standards were covered, together with the IMO definition and its ability to cover carriage requirements. The tasks of INS were described, including route monitoring, collision avoidance, navigation control data, alert management and status and data display. The modules comprising INS were state before it was concluded that modular bridge and INS are essential components of e-Navigation.

23 e-Navigation seen from a regulator's perspective – Carsten Jensen, Danish Maritime Authority

The extension with the stretched 'road map' was welcomed but what will happen in 2014? The envisaged workload on IMO and administrations was described and it was asked is this what we want. The DMA vision for e-Navigation and the benefits sought for both ships and administrations were explained and the idea of a ship e-cloud introduced. Mention was made of rationalisation of ship reporting systems, the use of S-Mode, which leads to e-Navigation being seen as a 'system of systems'. Existing standards and the application to e-Navigation were reviewed and it was speculated that it might be possible to squeeze e-Navigation into existing regulations. After a brief look a possible future work for IMO some of the challenges being faced were discussed. It was suggested that the focus of e-Navigation should shift from ship regulation to include more of the human element, as well as easing the day-to-day administrative burden, especially for ship's officers.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=fbe95323-f933-45bb-bbd4-f8847f83b0b1>

24 ACCSEAS: Prototyping e-Navigation for the North Sea from the legacy of EfficienSea – George Shaw, General Lighthouse Authorities of UK & Ireland

The ACCSEAS (ACCessibility for Shipping, Efficiency Advantages and Sustainability) project was introduced together with its aim (To implement and demonstrate an e-Navigation test-bed in the North Sea to improve regional maritime accessibility) and objectives:

- accessibility of congested and remote North Sea ports
- environmental protection by reduction of accidents
- maritime safety of navigation
- efficient berth-to-berth operations for shipping
- support Short Sea Shipping (modal shift)

The challenges faced in the North Sea were outlined. Recently approved, starting 1 March 2012, the project's statistics were shown. It follows on from EfficienSea and focuses on the practical implementation of e-Navigation test bed applications. The presentation then turned to the technical approach to be taken and it was mentioned that the project would be informing IMO and IALA be in line with the EU concept of e-Maritime. The e-Navigation services to be exploited were shown. The test bed would also explore resilient positioning, drawing on existing work where possible and also focus on training and co-ordination. It is intended that there will be an annual ACCSEAS / e-Navigation conference, following on from the experience gained from EfficienSea's conferences. The presentation concluded with an open invitation for stakeholders to become involved.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=919638d4-bcb3-469f-b5b3-1f7a6747e540>

25 Resilient PNT: Vision and mission – Evelin Engler, DLR Institute of Communication and Navigation, Neustrelitz, Germany

The overarching challenge for resilient PNT was explained, followed by reference to IMO's e-Navigation strategy, from the perspective of strategic key elements and high-level user needs. Provision of resilient PNT data is part of the e-Navigation strategy and its impact on each of the components explained. What resilient PNT actually means was then discussed in some detail before turning to the technical requirements for improving the reliability of PNT, indication of reliability. The generic architecture for a PNT system was outlined with each of three modules being indicated. There was mention of current GNSS utilisation, given the availability of multiple systems, before the challenges that will be encountered in designing a resilient PNT system were described. An approach based on an INS was shown, followed by a modular PNT unit approach. It was stated that an open architecture is required that is modular, scalable and extendable. Where e-Navigation stands, between strategy and implements, particularly with respect to formal safety assessment was explained before the presentation was summarised and conclusions reached indicated.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=f00e9461-138f-4861-aabc-1b72e050dee8>

26 Redundant positioning as part of the maritime integrated PNT system concept – Michael Hoppe, Traffic Technology Centre, Federal Waterways and shipping Administration, Germany

It was explained that the presented was elated to the previous one. The presentation began with the PNT requirements for berth to berth navigation, with the need to ensure accuracy and integrity functionality, together with robustness. Some general statements regarding PNT within e-Navigation were made, leading to issues of dependence and reliance, emphasising that the data is used both within the ship and transmitted o other users. The

vulnerability of GNSS to both unintentional and intentional interference was covered, giving rise to the need for resilient PNT. An overview of possible PNT components was illustrated, followed by a brief introduction to the ship and shore side components, with the implicit communication links. The concept of R-mode as a candidate solution for redundant positioning was described, leading to the possibility of an ‘All in view’ receiver. It was stated that the feasibility of R-Mode will be studied in the ACCSEAS project. It was concluded that:

- The envisaged maritime integrated PNT system is a core element of e-Navigation.
- Terrestrial radionavigation systems are important to ensure resilient PNT.
- Ranging signals from MF radiobeacon and AIS have the potential to contribute to the PNT backup requirement.
- ACCSEAS will be the platform to execute feasibility studies, to develop a prototype receiver and to perform field tests.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=e31b6542-bef5-412f-b1d2-42f5fb09e149>

27 e-Navigation in practice with Iridium – Wouter Deknopper, Iridium

Communications connectivity is often taken for granted and this is usually a more complex situation than is generally realised. There was an introduction to Iridium and its services and its global coverage, due to LEO satellites, covering the 90% of the earth’s surface not covered by wireless connectivity, which leads to global usage. Developments planned for Iridium (Iridium Next) were outlined, emphasising that the project is fully funded. The gaps left by VSAT coverage were illustrated before a description was given of what was called the data connection revolution, covering the IP era in maritime only started, simplification of connections, broadband / always-on experience, data costs continue to reduce and volumes & throughputs increase. Mention was then made of the technology evolution was briefly discussed, indicating the number of technologies involved and a common user interface. A block diagram of the Iridium Openport test bed was shown, which was followed by some test bed statistics. In conclusion, it was said that shipping companies have not invested in the necessary bandwidth, which is believed to be available.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=fb1721c0-2af4-4eeb-ac35-3d5e58e3f598>

28 e-Navigation – the need for robust communications with tracking and monitoring – Guy Sear, Inmarsat

The presentation began with an overview of trends in communications and technology, in which the transfer from capability to applications was emphasised. There was then a description of the INMARSAT maritime portfolio and how data integration can benefit from the results from a test bed. INMARSAT’s Dynamic Telemetry Service was introduced, based on maritime sector requirement and the solution chosen. The application opportunities were indicated, including position reporting, condition based monitoring and reporting, engine and system management and event driven alarms. FleetBroadband Safety Services were briefly described. Before the conclusions drawn by INMARSAT were stated.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=64be0d08-13d2-4c2e-a4ec-d799542872f4>

29 Enhanced Navigation: The use of dynamic charting overlays to assess underkeel clearances in real-time – Jonathon Pearce, OMC International

The presentation follows on from one presented at EfficienSea 2011. After briefly introducing OMC International, it was shown why DUKC is being implemented and what it is. The methodology was explained and shown to be ‘bottom up’. The modules employed in DUKC were indicated, together with an area of operating and the data inputs stated. A specimen pre-planning Transit Planning Report was shown and explained; the trouble and time taken to involve the users was given. This has developed into an ‘in-transit’ system, which synchronises

the pilot's plan with the VTS. The system was then illustrated and commented on in a sequence of slides, including real-time monitoring via AIS. The use of DUKC to provide a dynamic overlay, for integration on a pilot's PPU is being developed. Other overlays and their current limitations were illustrated and the implementation of low and high waves and the benefits of a dynamic system were shown. The presentation ended with the statement 'smarter ports don't come about by accident'.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=97fc2083-528f-4c73-8eb7-b5cb77fb358e>

30 SAR and the unregulated e-Navigation user – Keith Oliver, Head of Operations, HM Coastguard

It is the intention for HM Coastguard to become proactive in the next three years. The presentation began with consideration of how e-Navigation may support SAR operations, taking into account the user needs. The capability of nearby vessels needs to be known, as does provision of relevant meteorological data, whilst improved data about ships can affect what are currently somewhat historical search plans. It was indicated that future use of drift and on scene environmental data will prove useful. Reference was made to the automated transmission of search area coverage plans by AIS, which can also be used to monitor execution of the plan. Turning to unregulated users, reference was made to the variety of small boat user equipment and how it may be connected together and the challenges that can pose were illustrated. The growth in unregulated Apps was shown to pose difficulties for shore authorities, including alarm generation and charting. The effect of the growth in the use of social media was outlined and mention made of how it might be managed. It was concluded that the genie is out of the bottle and we must now decide how to deal with it.

Link to filmed presentation: <http://presenter.qbrick.com/?pguid=694e3d39-36de-4a43-91f9-7b3388f65421>

31 How Satellite AIS can contribute to e-Navigation – Robert Tremlett, ExactEarth

An overview of the exactAIS system was presented, with reference to the amount of inaccurate data that is being transmitted, with illustrations of the consequences. Various aspects of validation of declarations (information), including verification of adherence to requirements and calculation of emissions. Other uses mentioned were traffic monitoring, dynamic ship routing, both once restricted to radar and coastal AIS coverage. Examples of the augmentation of AIS data with other data were shown. The possibility to detect incidents, such as undeclared engine failure were illustrated. The use of satellite based AIS as an alternative approach for LRIT was mooted. It was concluded comparison of COG and ship's heading is useful, ships heading is crucial for determination of risk, ship's draft and cargo are crucial for ship routing.

Conference conclusions and the way forward

The session began with a brief introduction to DMA AIS data repository including IALA Net and Denmark's activities in regard to satellite based AIS. This touched on policy issues surrounding the distribution of data.

32 Conference conclusions – Ómar Frits Eriksson, Conference Chairman

The following 12 conference conclusions were discussed and agreed upon in plenary:

The regulatory environment

1. Some level of regulation is necessary but it should be goal-based.
2. More effective use of existing navigational aids can be made by their integration and harmonisation, together with simplification of relevant rules and regulations. This process is already underway.
3. The IMO INS performance standards should be used as the basis for the shipboard integration of existing and future navigational aids, as a component of e-Navigation.
4. Initially, existing performance standards for navigational aids are most likely to be satisfactory in the e-Navigation context, as they already work with INS. Performance standards will need to be refined and structured towards a modular concept to accommodate changes in technology within an e-Navigation environment.
5. e-Navigation applications will be useful tool to support maritime spatial management and Coastal states should consider their use.
6. All national authorities should consider developing their own e-Navigation strategic action plan, taking into account the IMO strategy.

Test beds

7. Test beds are essential for progressing e-Navigation.
8. e-Navigation test beds should demonstrate a response to identified user needs and should take into account the human element and economic implications.
9. Test beds could look at ways to reduce the administrative burden on mariners and operators ashore.
10. It is recognised that errors occur, thus e-Navigation should help to reduce for errors onshore and aboard and mitigate the consequences.
11. Tools, procedures and training for ensuring usability of e-Navigation applications should be considered during design and testing.
12. Test bed methodology and evaluation criteria should be harmonised to facilitate validation of outputs and quality assurance.

There was a general comment about the need to focus more on Aids to Navigation in any future conferences of this type.

See also the filmed discussion on Conference Conclusions regarding test beds on this link: <http://presenter.qbrick.com/?pguid=f83d9b79-a55c-4b2c-b3f4-fed2f61d2f46>

31 The way forward – Panel discussion in plenary – Bill Cairns, Chairman

The questions posed to the conference were:

Q1: How to get the lessons learned from test beds into the 'official' e-Navigation process?

The owner of the process is IMO NAV. Access can be gained via the IMO Correspondence Group, IMO NAV or IMO MSC. An INF paper would be appropriate for IMO meetings. It is important that the results of EfficienSea be passed on and not lost. Other organisations indicated that they would like to assist in future work in any way that they can. e-NAV WG6 has a method of storing the results of test beds.

Q2: Harmonisation of test bed methodology has previously been identified as a need. What has transpired?

It was suggested that a small technical group needs to decide on the way ahead and draft guidance. Such work is in IALA's work programme. When GAP analysis has been analysed, this should lead to a better understanding of what is required. The IMO CG is content that IALA will take the lead on defining methodology. An important conclusion has been that there is a need to harmonise test beds, so that their results can be fed into the development of e-Navigation. EfficienSea WP4 is still offering to help unify test bed results. It is also important to share information – cross-pollination.

Q3: What are the specific principles for test beds?

Do not reinvent the wheel. They have been captured well in the conference conclusions; taking into account user needs and usability. Future test beds will need take account of the IMO CG's GAP analysis. Test beds should be spread all over the world; encouraging this is a possible task for IALA. There needs to be 'plan and structure', which should serve the needs of e-Navigation. This calls for co-ordination; it should not be ad hoc. The IMO CG will be issuing advice on topics for further research. There should be a registration process for test beds, something that was raised at e-Navigation Underway 2011. This could lead to a measure of co-ordination (and control). By this means, test beds would also be able to see who is doing what and plan accordingly. Experience seems to indicate that test beds in different parts of the world are not sharing their results; IALA could encourage such information sharing. Should test beds focus on technology, which seems to be the current case? A good question but technology is required to establish functionality and, as such, needs to be tested. However, it was maintained that the human element and usability are being considered and this is certainly the case for EfficienSea, which has exchanged personnel with other test beds. Cultural issues need to be considered when trying to harmonise test beds. It was advised that it is necessary for e-Navigation to look beyond the limits of shipping requirements. It was confirmed that the human element is also being pursued by at least some National Authorities.

Q4: Where should e-Navigation be at next year's conference?

This conference was reckoned to be successful, building on last year. For e-Navigation Underway 2011, 2012 and 2013 the sequence was characterised as 'letting go the lines', 'underway' and, next year, 'making way'. It was anticipated that some of the ideas for applications will have been made fact. It was expected that the partnering of test beds would emerge. Regional applications are anticipated, possibly leading to international applications. It will be interesting to see what comes out of project Mona Lisa and, by 2013, there should be a clearer view of where e-Navigation is going. By then, it should be possible to put some borders around the regulatory issues, although this will be a long road. GAP analysis should be complete by NAV58 and the first version of the strategy implementation plan should be available in a year's time. Manufacturers feel that it is important that products are made and are attractive to the user. By next year we should expect to see the results of 'selling' the e-Navigation concept to a wider audience.

It was observed that without user 'by in' e-Navigation will fail. It is expected that the Torres Strait DUKC, having just become operational, will see the governing regulation reviewed. Depending on the human element feedback, AMSA will be looking towards making the system mandatory and enhancing it. It was asserted that the US is already way and the course being taken is based on user input. It was also stated that Canada has been implementing electronic navigation for 6 years, funded by the user; e-Navigation is already happening there. Can we expect a proposal for a communication plan for e-Navigation by NAV58? To which the answer was that this will be dependent on the participants but a communications plan would be beneficial. It was confirmed that the IMO CG is working on a marketing plan.

Q5: How do we promote innovation and minimum capabilities of e-Navigation within the regulatory framework?

We need to try and be more careful to use goal-based standards. We should talk about frameworks and not what is within them. It needs to be established how one can make better use of or speed up the IMO process. At the moment

the technology is developing too fast and there is a need for a ‘fast track’ procedure for updating performance standards that avoids opening them up to all comers.

Q6: Is INS the basis for the first stage of e-Navigation on board, and if so, what augmentation is required?

It was suggested that a communications module is required to convey INS information ‘to the world’. Duplication and availability need to be investigated. A test standard needs to be finalised. Will we see standardisation in the next 5 years on a minimum bandwidth requirement? It was pointed out that this work is already being considered by the WRC. However, it was remarked that it is necessary for the users to declare what is necessary to be sent, both ship to shore and shore to ship, before a sensible proposal can be made about the bandwidth required. It was also noted that bandwidth does not come free. In this context, work on the data model should help. It was stated that this topic is expected to be discussed at NAV58. One view was that as INS has yet to arrive and ECDIS is constrained by existing performance standards, the answer is a PPU but we should be aware of other technology, such as smart phones. An alternative view was that INS is the next building block and that augmentation will take the form of an application interface, similar to the function of the existing pilot plug.

Link to filmed panel discussion: <http://presenter.qbrick.com/?pguid=2fcdfb65-fa2b-4524-9e42-ec0d7f61e16a>

32 The future work of the IMO e-Navigation working groups – John Erik Hagen, Chairman

It was remarked that the conclusions of this conference reflect the on-going work at IMO, which already includes many of the points raised. The conference and its conclusions confirms what we now think that e-Navigation is. It was agreed that public relations and the marketing of e-Navigation are important and the IMO CG is now in a position to start that work.

COMSAR 16 will discuss performance standards and the issues raised in the panel discussion. Communications and the next generation AIS, VHF and digital broadcasting of MSI will also be discussed and test beds highlighted.

For STW43, the date for inputs is today! Discussions at this meeting will include:

- computer based training (CBT); is it agreed that the delivery of equipment should include CBT?
- competency in language skills for e-Navigation.

NAV58. The report for this meeting is not yet written but input from the IMO CG will be requested shortly. The focus will be on:

- Maritime Service Portfolios
- usability
- outcome of the GAP analysis
- presentation of examples of possible solutions, again with input from the IMO CG

After this it will be time to start the reports for 2014, which means further questions for the IMO CG, without whose help the work cannot be taken forward.

Link to the filmed presentation: <http://presenter.qbrick.com/?pguid=b977e8d0-8ddd-4261-be86-7bba68f38d4a>

33 Summary - Ómar Frits Eriksson, Conference Chairman

The Conference was considered a success, with thought provoking presentation, leading to a clearer understanding of e-Navigation. Thanks were expressed to all involved.

34 Closing remarks – Gary Prosser, IALA

Additional thanks were extended to all who had helped to create and host the Conference and to the participants for their lively input. IALA will be continuing its work on e-Navigation in the e-NAC Committee, under the Chairmanship of Bill Cairns. It will take into account the conclusions of the Conference, which is expected to lead to additional input into the IMO CG. Everyone was again thanked for their participation and wished a safe journey home.

The Conference was then declared closed.

Link to filmed Closing Remarks: <http://presenter.qbrick.com/?pguid=f83d9b79-a55c-4b2c-b3f4-fed2f61d2f46>

Annex 1

Transitioning from Traditional Aids to Navigation Mike Sollosi, E-Navigation Underway, 18 January 2012

It is an unfortunate fact in this industry that accidents, incidents and tragedies often serve as the catalyst to progress and additional regulations. As an example, at 0141 local time on 18 January 1971, in near zero visibility, the tankers ARIZONA STANDARD and OREGON STANDARD collided near the Golden Gate Bridge in San Francisco, spilling 800,000 gallons of oil into San Francisco Bay, causing extreme environmental damage and raising national publicity and fomenting a public outcry. This collision resulted in the complete shutdown of the port. Contributing causes of the accident, according to the US Government's accident investigation agency, the National Transportation Safety Board (NTSB), were the failure of the vessels to establish and maintain communications; failure of the OREGON STANDARD to make timely radar contact; loss of radar contact by the ARIZONA STANDARD and negligence on the part of both masters. Subsequent to the accident, the Coast Guard determined that all aids to navigation in the area were on station and operating properly.

Interestingly, this accident happened while Coast Guard watchstanders at the experimental Harbour Advisory Radar Project (HARP) looked on helplessly, unable to contact either ship on VHF-FM. The HARP was experimental rather than operational because professional mariners resisted having watchstanders ashore providing them any guidance.

The NTSB, in their report of the investigation, recommended that HARP be continued and that there be legislation requiring the use of the Bridge-to-Bridge radiotelephone. The NTSB also faulted the master of Arizona Standard for not using all means at his disposal to fix the position of his ship and determine a safe course to steer. The eventual outcome of this accident was that the Bridge to Bridge Radiotelephone Act and the Ports and Waterways Safety Act were passed. The former mandated the use of the bridge to bridge radiotelephone and set aside channel 13 (156.65 MHz) for exclusive use by the navigation team; the latter gave the Coast Guard authority to establish and operate Vessel Traffic Services.

So it was just 40 years ago that e-Navigation, as something other than a crude positioning system, had its nascent beginnings in the United States. We've been transitioning ever since. The next level of transition may well be from analog to digital, or visual to virtual.

Now this article will primarily deal with visual AtoN, but I will not be able to restrain myself from saying a few words on the pertinent subjects of e-Navigation and waterways management in order to be in accordance with the work of the IMO on E-Navigation, which correctly states the intention of e-Navigation to establish an integrated information environment for the maritime community. This integrated information environment will of necessity reach beyond the shipboard environment and will affect the provision of aids to navigation and waterway management services. And, like all public services, there is a regulatory, an economic and a technical component.

There's a hierarchy in the international legal framework. At the top of which we have SOLAS and, in the instant case, its regulation V-13, telling us that it is a binding undertaking by contracting Governments to provide such aids to navigation as the volume of traffic justifies and the degree of risk requires, and in doing so should take into account international recommendations and guidelines. SOLAS is where IMO comes in, and the recommendations and guidelines I mention is where IALA has a role.

In the US, meeting this binding undertaking translates into about 51,000 visual aids and one electronic GPS augmentation system. Those numbers have remained fairly constant over the years with respect to visual aids. To maintain that constellation we employ 2,500 military personnel assigned to 57 cutters and 65 Aids to Navigation Teams. That's down from 91 cutters and 4,000 people just 12 years ago.

I'm sure most of you have experienced similar trends in other aspects of the maritime industry. And probably the same things have enabled those trends such as improved hardware and reduced servicing visits. This trend to reduce cost and maintain service will continue, even though I'm quite sure the volume of traffic and the degree of risk that IMO refers to in SOLAS has not changed. The question becomes how to manage the increased or, at best, steady risk, with decreasing resources.

Let's also look back at what has already happened in navigation services and systems. It started with the lighthouse thousands of years ago, then came the lead line, then some enterprising soul tied a rock to one end of a line and a barrel to the other and launched the first buoy. Then came the sextant, and with Harrison's chronometer we mastered longitude. Then with electronics we got echo sounders and radar, loran, RACONs, Decca, Consul, Omega, GPS, DGPS, Galileo, VTS, AIS, LRIT;ECDIS and now eNav promising to establish an integrated information environment for the maritime community. Note how the pace of delivery is quickening and the number of new tools is increasing. With that rate of change in mind, one could argue that we're constantly transitioning to the next level of navigation precision, reliability and risk reduction.

So with that we have the regulatory, economic and technical background that could underpin the practical applications for delivering e-Navigation. In order for this to happen, regulations and technology will have to advance together, and of course economics will always have a role. Sooner or later, economics influences the decision. But, as we proceed and progress, we must also transition the user to the next level.

The way to address the navigation challenges of the future will be through an integrated system of visual, electronic, and regulatory measures based on existing technology but able to readily adapt new technology and new competencies on the part of the service providers, the equipment providers and the maritime users. An integrated aids to navigation system will be asked to do more than simply impart positioning information, and it will have to be operated in conjunction with existing rules, regulations and restrictions, without having to rely - too much - on regulatory change.

This is a lot to ask for, and unfortunately, we will always have to address yesterday's mariner at the same time that technology is moving toward developing systems for tomorrow's mariner. But allow me to break my perception of integrated aids to navigation down into some easily digested pieces.

First of all, visual references will be with us for a long time to come. An integrated aids to navigation system will have to contain visual references in sufficient quality and quantity to operate independently of any electronic system. Virtual aids to navigation or electronic positioning systems cannot impart the same information that a fixed or floating visual aid can impart. And there will always be a population of users that is not able, not willing or not equipped to use more sophisticated tools. What's next for visual aids is:

- Augmented information through the use of electronic means that provides, for example, the health of the aid or more detailed identity information
- Improved optics that produce more light and better sector definition and that consume less energy
- Interlinked aids with synchronous flash
- Interactive aids such as user activated sound signals
- Better conspicuity through better coatings
- Better station keeping for floating aids in exposed locations.

Although we've come a long way in these components in recent history, we shouldn't rest. The U.S. Coast Guard deployed their first set of synchronized flashing buoys in the San Francisco Bar Channel. That deployment came about with the assistance of the California Maritime Academy. Using their very capable simulator, we were able to test synchronized flashing buoys with the Bar Pilots in a laboratory environment before deploying them in the field.

Along these same lines, changes in the aids to navigation system should always be made with user involvement. This is the same whether it be discontinuing a sound signal, changing the effective range of a light or deploying new and untested technology.

When you see GPS synchronized flashing buoys fitted with LEDs it might occur to you that there have been a lot of changes and a lot of transitioning since whale oil. But our legacy is the US Lighthouse Service, a very forward thinking and innovative organization in its time. Even so, it's doubtful they ever imagined virtual aids to navigation.

Most modern mariners have heard about virtual aids to navigation. The topic has been getting increased attention lately, some of which can be attributed to increased attention being placed on Arctic navigation and the obvious difficulty we'd face in trying to maintain physical aids to navigation in that environment. Virtual aids have also been mentioned as a less expensive alternative to floating aids. I do not condone this latter argument, but as I said before, economics drives a lot of decisions.

Virtual aids have a place where it is not possible to establish physical aids due to either time or environmental conditions. Time of course refers to the case where it is essential to alert the mariner to a newly created hazard such as a wreck, and environmental refers to the arctic case I mentioned. But we can take this discussion to another level. Could virtual aids be used to mark a navigable channel in a river in which the water level, and consequently the channel width, frequently and rapidly changes faster than the buoy tender can adjust the buoys? We have the technology to transmit a polygon that depicts a certain depth contour. This can be displayed on the bridge and the navigator need only keep his vessel within the polygon. The U.S. Coast Guard is already looking for a laboratory to test this concept with mariners' involvement. This is a drastic transition from placing traditional visual references along the route to using other visual references in the wheelhouse.

We have also recently been confronted with another type of environmental condition that might preclude the establishment of physical aids to navigation. And it's quite the opposite of arctic ice. It's tropical coral. The Endangered Species Act will not allow us to disturb or "take" coral by establishing aids to navigation on top of endangered coral (of course) or in any area or habitat that could support the growth of endangered coral. This has already prevented us from servicing long established aids in the Gulf Coast.

Are virtual aids to navigation a workable solution in this case? Only if they're augmented by two things, improvement and growth in electronic signals and improved navigation displays in the wheelhouse.

Modern marine navigation places enormous reliance on GNSS. Perhaps over reliance. As such, there is unquestionably a global need for a reliable and accurate electronic source of positioning. The benefits are too great to ignore.

There's been a lot of talk and a lot of evidence about over reliance on electronic means, not looking out the window, e-Navigation influenced accidents etc. But nobody has counted the number of accidents that have been avoided through much improved voyage planning, precise positioning and better informed collision avoidance that improved displays and, by extension, e-Navigation can deliver.

E-Navigation improves situational awareness and decision making at sea and ashore. When used in conjunction with other communications and display systems it enables shore organizations to deliver more timely and relevant information to the mariner. And through its many levels of sophistication and scalability it can embrace all levels of system users from recreational craft to the largest and most modern commercial vessels.

A drawback is that its use requires that there be a new level of sophistication and equipment on the part of the system users. And this in turn requires new levels of user training and certification. Fortunately the new

generation of waterway users is more technologically astute or more used to technological advances than past generations. They will learn fast but systems and procedures cannot be imposed overnight, they will have to transition gradually.

In the not too distant past, aids to navigation were placed to enable a mariner to determine his or her position, determine a safe course to steer or to avoid unseen dangers. A few visual aids and the COLREGS were all that anyone needed. Not anymore. The aid mix of the future will be asked to do much more. It will define sea lanes and exclusion areas. It will support security as well as waterway efficiency. It will not only serve the navigator, but its benefits will be extended to a host of shore based users in government and commerce.

The aid mix of the future will support regulatory efforts as sea space that was once the exclusive domain of the independent navigator becomes parcelled into aquaculture, minerals extraction, renewable energy, recreation, naval exercise or any other type of limited or exclusive use area. The term for this phenomenon is Coastal Maritime Spatial Planning. This will be a challenge. It's already taking place with 12 Wind Energy Areas being considered for the Atlantic Coast, forcing the Coast Guard to devise a system of Traffic Separation Schemes and fairways around the structures. Thankfully, we were successful in discouraging the placement of a wind farm at the terminus of a TSS leading into Delaware Bay, but the parties involved failed to see the harm in their initial proposal. Their concerns were water depth, a good bottom to support construction and access to the grid on shore.

Coastal Marine Spatial Planning in many ways is similar to air space management. The aviation community is rigorous in ensuring that the activities in any given piece of airspace are all compatible. They would never allow a tall building at the end of a runway or hang glider to enter the airspace of a busy international airport. Yet we happily allow VLCCs, fishing boats, recreational craft, jet skis and wind surfers to all compete for the same channel with nothing to keep them apart except the COLREGS.

The available sea room is shrinking. The numbers of Particularly Sensitive Sea Areas and Areas to be Avoided increase each year. Public demands for sources of renewable energy have brought about the offshore wind farm as well as tide, current and wave generated energy installations. Industrial aquaculture will be necessary to feed a growing world population. Trends such as these are irreversible. The aid mix of the future will have to consider and support these trends.

In the not too distant future, coastal states or maybe even an appropriate international organization might find themselves adjudicating the demands of competing interests as they vie for access to the waterway. And if the waters under our jurisdiction are divided into single use or limited access areas, we will have to find a way to define these limits and inform all waterway users of the bounds. Supporting and enforcing these regulatory efforts can be done by either physical or electronic measures, but it will need to be done.

Similar regulation of ship traffic movement has been going on for many years. But, through AIS and LRIT, shore based authorities can already track and monitor cooperative shipping anywhere in the world. It is, I believe, only a matter of time, before participation in a berth to berth reporting and tracking regime is mandatory for ships on international voyages. This in turn will lead to attempts by the shore authority to influence the traffic in some way. It is essential that shore authorities employ this new capability to reduce the burden on the ship's master through some form of integrated reporting and tracking and information processing. E-Navigation principles, when properly applied, should benefit all participants and not redistribute, or worse, increase the burden on the mariner.

e-Navigation could bring all information services that affect shipping into a cohesive package. This includes not only navigation services but all other government and commercial activities that impact shipping, and this should be done globally, without regard to national boundaries.

E-Navigation will, as is intended, start to bring about an orderly evolution in shipboard display and



communications systems and a better ship to shore connection. It will deliver a considerable portion of the aid mix of the future and it will improve the safety and efficiency of shipping. The transition will not happen overnight but it will happen. It's already started.

Mike Sollosi is the Chief of the Office of Navigation Systems in Coast Guard Headquarters. In this capacity, he has responsibility for short range aids to navigation, Electronic Navigation systems, navigation equipment standards, the Navigation Rules and ships' routing measures. He has served on the U.S. Delegation to the International Maritime Organization's Safety of Navigation Subcommittee for 17 years, and is currently Chairman of the Subcommittee, a position he has held for three years. He was an active member of the IALA VTS Committee for 20 years.



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Annex 2

Participants List



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