



Realization of e-navigation Maritime Service in the Asia-Pacific region

3~5 June 2018

Millennium Seoul Hilton Hotel, Seoul, Republic of Korea

Conference Report

(Draft)

Table of Contents

1. Introduction	4
2. Opening of the conference.....	4
2.1. Opening and Welcome Speech: OH, Woonyul, Ministry of Oceans and Fisheries (MOF), Republic of Korea, Director General.....	4
2.2. Congratulatory Speech: Andreas Nordseth, DMA, Director General	4
2.3. Congratulatory Speech: Michael Card, IALA, Deputy Secretary-General	5
3. Themed sessions.....	5
3.1. Session 1 – International Developments	5
3.1.1. The Work of the IMO/IHO Harmonization Group on Data Modelling.....	5
3.1.2. Key e-navigation Developments Being Progressed by IALA	6
3.1.3. The Work of the IALA ENAV Committee – Recent Achievements and What’s Next?.....	7
3.1.4. Developing IHO S-100 Standards in Support of e-Navigation Interoperability ...	8
3.1.5. Collaborative Decision Making in Support of Global Maritime Trade	9
3.2. Session 2 - Maritime Services.....	9
3.2.1. e-Navigation Services from VTS to SOLAS vessels	9
3.2.2. e-navigation Maritime Services for non-SOLAS Ships.....	11
3.2.3. Development of Maritime Single Window in Singapore.....	12
3.2.4. International Cooperation to Develop S-100 Based Product Specifications (IHO, IALA and IMO).....	13
3.2.5. The SMART-Navigation Example.....	14
3.3. Session 3 - Communications for e-navigation	15
3.3.1. Development of LTE-M.....	15
3.3.2. Test Result and Lesson Learned from LTE-M Pilot Project	15
3.3.3. Communications and Data Exchange in the Maritime Autonomous Surface Ship (MASS)	16

3.3.4. Maritime Connectivity Platform and the AP Web	17
3.3.5. Development plan of S-100 Based Specification for SMART-Navigation	18
3.3.6. Danish Focus on e-navigation – Efficiensea 2 and Beyond	18
3.4. Session 4 - Services to Support Electronic Navigation.....	19
3.4.1. ENC Services for Non-SOLAS Ships.....	19
3.4.2. ECDIS – How Will It Aid / Be Part of e-navigation?	20
3.4.3. Resilient Positioning, Navigation and Timing.....	21
3.4.4. Enhanced Radar Positioning.....	22
3.4.5. Satellite Based PNT Service for Asia Pacific Region	22
3.4.6. SBAS Trials in the Australia and New Zealand Region (Presented by Australia)	23
3.5. Session 5 – Wrap Up session, Conference Session Summary	23
3.5.1. Session 1 – International Developments	23
3.5.2. Session 2 - Maritime Services.....	25
3.5.3. Session 3 - Communications for e-navigation.....	26
3.5.4. Session 4 - Services to Support Electronic Navigation	28
4. Panel discussions (Q&A) Session	29
5. Conference Highlights	30
6. Closing of the Conference	31
7. Exhibition.....	31
8. Social Events	31

E-Navigation Underway Conference 2018 Asia-Pacific

“Realization of e-navigation Maritime Service in the Asia-Pacific Region”

1. Introduction

The second E-Navigation Underway Asia-Pacific Conference was held from 3rd to 5th of June, 2018 at Millennium Seoul Hilton hotel, Republic of Korea. It was organized by the Ministry of Oceans and Fisheries (MOF), R.O.K, International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) and Danish Maritime Authorities (DMA). The sole exhibitor from the Korean SMART-navigation project team have interested the participants with the latest development of their own test project. Total 164 participants from 18 countries including 8 Asia-Pacific Heads of Maritime Safety Agencies (APHoMSA) Member States have attended the conference to share and gain the latest knowledge in the e-navigation in the Asia-Pacific Region.

The conference concentrated on the technical aspects of providing maritime services for SOLAS and non-SOLAS ships, information exchange technologies, Positioning, Navigation and Timing (PNT) technologies and of course, regional cooperation to achieve the e-navigation maritime service in the Asia-Pacific region.

2. Opening of the conference

2.1. Opening and Welcome Speech: OH, Woonyul, Ministry of Oceans and Fisheries (MOF), Republic of Korea, Director General

Mr. OH, Woonyul, Director General of the MOF welcomed the distinguished guests from IALA and DMA, and as well as the 5 representatives for signing the MoU on International Cooperation on the e-Navigation technology development. In addition, he have mentioned about the results of last year's e-navigation conference such as the range of service should be opened to the non-SOLAS ships and the cooperation between the regional countries. Furthermore, he have quoted that the significance and the development plan derived from the conference will start to bring positive changes to the e-navigation.

2.2. Congratulatory Speech: Andreas Nordseth, DMA, Director General

Mr. Andreas Nordseth, Director General of the DMA, have expressed that the e-navigation being realized in the maritime world and the present is the breaking point to accept the technology that

will impact the world. Furthermore, he voiced out that the cooperation among stakeholders earned during e-navigation underway is crucial factor to face the obstacles and challenges in near future.

2.3. Congratulatory Speech: Michael Card, IALA, Deputy Secretary-General

Mr. Michael Card, Deputy Secretary-General of IALA have emphasized the importance of the data modelling and communications channels which have to be further developed. Moreover, the role of the shore services of e-navigation was pointed out which are enhancing safety, security and protection of the environment.

3. Themed sessions

3.1. Session 1 – International Developments

Chair: **Nick Lemon**, AMSA, Manager Nautical and Regulation

3.1.1. The Work of the IMO/IHO Harmonization Group on Data Modelling

Presenter and Author

HONG Sunbae, Chair for the IMO/IHO HGDM, and Deputy Director for Korean e-Navigation project team, Ministry of Oceans and Fisheries (MOF), Republic of Korea

Abstract

The e-Navigation has been discussing at the IMO for almost 12 years since 2006. From the viewpoint of its efficiency and necessity in the process of implementing the e-Navigation, the IMO has agreed that it should be based on the user needs, goal based and FSA analysis. The e-Navigation Strategic Implementation Plan (SIP) has been finally adopted by the IMO MSC 94 in 2004. First of all, one of the most important tasks of the SIP is to develop the guidance on the Maritime Service Portfolios (MSPs) of e-Navigation. The reason is that the guidance on the MSPs of e-Navigation enables maritime communities to start e-Nav services by allowing them to clearly understand the concepts, operating structures of each MSP, and its effects. Once e-Navigation services are introduced and implemented in the maritime sector, though we start with some of MSPs, not all, the e-Navigation will be facilitated and further developed continuously in the future.

The presentation shared the several views to support implementing the SIP so that we could start and further develop the e-Navigation services. It included that “why the guidance on MSPs should be developed by 2019 as scheduled in the SIP?”, “what kind of items should be included in the guidance?”, and “the roadmap and status of the IMO/IHO Harmonization Group on Data Modeling (HGDM) for the MSPs”.

The IMO/IHO Harmonization Group on Data Modeling (HGDM) was established and has been activated by the decision of IMO MSC 98 in 2017 with the scope of work to the guidance on definition and harmonization of the format and structure of MSPs. Since then, the first HGDM meeting has held at the IMO during the period of five days from 16 to 20 October 2017. The second HGDM meeting is to be held at the IMO during the coming October, 2018. The guidance is to be drafted in the 2nd HGDM meeting to be approved by IMO MSC101 in 2019, in compliance with the SIP of the e-Navigation. The data modeling for each MSP is expected to be completed before the year 2020.

3.1.2. Key e-navigation Developments Being Progressed by IALA

Presenter and Author

Michael Card, Deputy Secretary-General, IALA [IALA, Saint Germain en Laye France]

Abstract

The development of e-navigation is being carried out in a cooperative relationship by a number of international organisations and projects. IALA has a key role in this development.

The e-Navigation work of IALA is focused on the following

- Services from shore authorities including VTS
- Harmonised data models
- Connectivity - Ship-to-ship-, ship-to-shore and shore-to-shore-communication infrastructure

- Resilient Positioning, Navigation and Timing (RPNT)

IALA's technical work is carried out to meet the two Goals of IALA's "Strategic Vision" which also has a set of Strategies to achieve the Goals by 2026. Two of these Strategies related specifically to e-Navigation. A more detailed "Position on the Development of AtoN Services" sets out technical policy related to specific aspects of the work, and is reviewed and amended at regular intervals.

The Strategic Vision and the arrangement of IALA's guidance documents under a set of seven Standards enable a logical organisation of Committee work tasks and programme. All four IALA Committees will be involved in aspects of e-Navigation work at IALA between 2018 and 2022.

3.1.3. The Work of the IALA ENAV Committee – Recent Achievements and What's Next?

Presenter and Author

Hideki Noguchi, IALA, Chair of IALA's e-Navigation (ENAV) Committee, 2-1-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8976, JAPAN

Abstract

The presentation briefly looked back the achievements and contributions made by the Committee then identify some issues found during the development of e-navigation. Based on these achievements and issues, the presentation did foresee subjects that need to be discussed and developed by the IALA e-Navigation Committee in future.

The IALA e-Navigation Committee was established after having the agreement of new work "Development of an e-navigation strategy" at MSC81 in 2006. Since then, the Committee has greatly contributed to the work at IMO and IMO has recently entered in the implementation stage in accordance with the e-Navigation strategic implementation plan (SIP). However while e-Navigation has finally reached at its implementation stage after more than 10 years of discussion, the rapid development of technologies has exceeded the speed of e-Navigation. The world maritime community are facing a starting point of new era beyond e-navigation.

The new era beyond e-Navigation does not mean that the e-Navigation becomes legacy and old.

As a matter of fact, the new era exists in expansion of e-Navigation technologies. Therefore, the Committee still maintains "e-Navigation" in its name and continues the development of e-Navigation technologies. In addition, simultaneously, the Committee is expected to be pro-active rather than re-active to the development of technologies in the new era beyond e-Navigation.

3.1.4. Developing IHO S-100 Standards in Support of e-Navigation Interoperability

Presenter and Author

Yong BAEK, IHO S-100 Working Group, Vice Chair, #351, Haeyang-ro, Yeongdo-gu
Busan, Republic of Korea.

Abstract

This presentation introduced the latest IHO S-100 development; S-100 infrastructures, S-100 based product specifications, S-100 test bed programs.

IHO specification provides the data framework for the development of the next generation Electronic Navigational Charting products, as well as other digital products required by the hydrographic, maritime and GIS communities.

S-100 provides a contemporary hydrographic geospatial data standard that can support a wide variety of hydrographic-related digital data sources, products, and customers. This includes the use of imagery and gridded data, enhanced metadata specification, unlimited encoding formats and a more flexible maintenance regime. This enables the development of new applications that go beyond the classification, marine GIS, et cetera. S-100 is designed to be extensible and future requirements such as 3-D, time-varying data (x , y , z , and the time t) and Web-based services for acquiring, processing, analyzing, accessing, and presenting hydrographic data can be easily added when required.

The IHO and other organizations are now developing S-100 based product specifications such as S-101, the product specification for the next generation of electronic navigational charts (ENCs), S-102, S-111, S-129 and S-412 which will be key services for e-Navigation.

3.1.5. Collaborative Decision Making in Support of Global Maritime Trade

Presenter and Author

Robert Ward, Consultant and Advisor, RISE Viktoria, Lindholmen in Gothenburg, Sweden.

Co-authors: Michael BERGMANN and Mikael LUND, RISE Viktoria

Abstract

The speaker reported on the development of the PortCDM (Port Collaborative Decision Making) concept, as an enabler of the Sea Traffic Management (STM) concept. The presenter identified the relationship between PortCDM and the ongoing development and implementation within the STM Validation Project, as well as its conformance with the underpinning principles, standards and objectives of e-Navigation. He also pointed out the many potential advantages of the PortCDM concept to all those parties involved in the sea transportation chain, not just from Port-to-Port but from initial freight pick up point to final delivery destination.

3.2. Session 2 - Maritime Services

Chair: Jon-Leon Ervik, Norwegian Coastal Administration, Head of Department for Pilotage and VTS

3.2.1. e-Navigation Services from VTS to SOLAS vessels

Presenter and Author

Fredrik Karlson, Swedish Maritime Administration, Innovation Coordinator at R & D department, Lindholmospiren 5417 56 Gothenburg, Sweden

Abstract

Traffic monitoring in- and outside VTS (Vessel Traffic Services) areas may be conducted in different ways depending on e.g. the VTS service level, what kind of data that needs to be collected, on traffic image and geographical conditions. However, regardless of what kind of monitoring service

is provided, when it comes to preventing accidents, the process for all VTS/monitoring functions is mainly the same. Events leading to a possibly dangerous situation, e.g. a grounding or a collision, must be spotted in time and a message with information, a question, warning or advice must be passed to concerned vessels in order to solve the situation. A collision cannot take place without a preceding close quarter situation, i.e. a situation where two or more vessels approaches the same spot of water at the same time with a small CPA. This is something that can easily be avoided with conventional radar or even better an ARPA as long as the ships move in open water keeping their course and speed.

This presentation elaborated on the new enhanced functionality for VTS operations powered by common information shared between ship and shore such as exchange of detailed voyage plans, automated monitoring and new means of providing Traffic Organisation and Navigational Assistance Services. Sharing of information and collaborative decision-making will also lead to improved predictability and efficiency in ports, which in turn not only gives more efficient port operations but also creates means for right and green steaming for the whole voyage and increased possibilities to manage vessel traffic. All this is in line with the IMO concept of e-Navigation and the derived Maritime Services (Prev. MSP) No. 1, 2 and 3.

In an area where a VTS or SRS area has been instituted, traffic image is likely to be far more complex. To be able to predict upcoming close quarter situations in those areas, it is necessary to know not only the vessels' present speed and course but also their intentions. Examples on regular basis worldwide shows that misunderstandings, slow response times, linguistic confusion and reactive responses lead to accidents that might have been avoided if only the information of the planned voyage for all vessels in the given situation had been known by all involved parties such as VTS centres, SRS Surveillance, port authorities/Control in advance.

The VTS domain is at the verge of being able to implement solutions to reduce the above problem of short response time, limited situational awareness and predictability shortcomings. By adopting and implementing the Voyage Information Service in on-board navigational systems and on-shore VTS software the new standardized route format, RTZ, part of IEC 61174 ed 4, makes machine to machine importing and exporting voyage data simpler and has been the base for new graphical functions in STM-capable ECDIS-systems and planning stations. By sharing the required voyage plan according to IMO res. A.893(21) and SOLAS Chapter V - Annex 24 when a ship's route is loaded for monitoring in a vessel's navigational system before departure, it is also sent to stakeholders along the voyage such as different SRSs, VTS areas or other areas under surveillance. This feature allows the shore operator to, well in advance, review how a vessel is planning to navigate in a certain passage. When reviewing the route the operator, such as a VTS operator, can chose to monitor parameters like draught, size of vessel, kind of vessel, air draught etc. and

compare that to the planned route and early spot any deficiencies in the vessels voyage plan. If obvious errors are found in a vessel's voyage plan, it is possible to send a corrected voyage plan back to the ship. This now available feature are spawning a number of up-coming Maritime Services. However, maybe the most important one is to use this new and powerful tool as a sort of next generation monitoring tool, the surveillance operator's domain and situational awareness will improve vastly. Well ahead of when a vessel is closing in on a narrow passage the operator can see the intentions of the approaching vessel. Should the VTS deem it necessary to give the vessel an alternative route, this can be done by sending a route that will be displayed on the vessel's ECDIS, avoiding a lot of misunderstandings.

To be able to predict the traffic flow based on the vessels' intentions – the future – rather on their history is a huge advantage and will increase the VTS domain and other surveillance domains situational awareness significantly. The mentioned advantages with Advanced Monitoring service is being deployed within the Sea Traffic Management Validation (STM) project and will be implemented in upcoming Swedish national VTS system.

The project are ready to take VTS operations to a new level with common situational awareness created through this shared information. Sea Traffic Management Validation project is working in a huge testbed that includes over 300 ships, 13 ports and 6 different VTS centers in all over Europe. Testbeds around the world is well underway and will also help to spread the necessity to push for this kind of initiatives and standards.

3.2.2. e-navigation Maritime Services for non-SOLAS Ships

Presenter and Author

Trond Langemyr, Senior Advisor, Norwegian Coastal Administration, P.O. Box 1502, N-6025 Alesund, Norway

Abstract

The presentation provided information about Norway's work on e-navigation and the possible utilization of e-navigation Maritime Services on non-SOLAS ships. It also gave information about a project where we demonstrated an alternative and better way to present navigation information on board recreational crafts.

e-Navigation is an important focus area for the Norwegian Coastal Administration (NCA). The

NCA believes it will be an important tool to meet future challenges in maritime transport, and we are well underway to prepare for a future with increased digital, automatic and seamless exchange of information between ships as well as between ships and authorities.

So far, e-Navigation has mainly focused on SOLAS ships. Norway nevertheless believes that the concept and several of its Maritime Services may also be of relevance to non-SOLAS ships.

3.2.3. Development of Maritime Single Window in Singapore

Presenter and Author

Nelson Tay Kai Xian, IT Manager, Maritime and Port Authority of Singapore (MPA), 460 Alexandra Road, Singapore 119963, Singapore

Abstract

The Maritime and Port Authority of Singapore (MPA) leads a working committee involved in the planning, designing and development of Singapore Maritime Single Window (MSW), with support from other governmental agencies, such as the Immigration and Checkpoints Authority (ICA), the National Environment Agency (NEA) and other stakeholders.

The MSW aimed to simplify the reporting formalities for ships calling at the port of Singapore by providing an interconnected digital platform that facilitates information exchange among stakeholders from both the public and private sectors. As part of the project, the committee will also review and re-engineer business processes, as well as define system requirements to facilitate the implementation of the MSW within Singapore. Under the proposed MSW, the shipmaster, or any other person authorised by the operator of the ship, will be able to provide the relevant ship, crew/passenger and cargo information in one single electronic submission prior to calling at the port of Singapore. The information will then be disseminated as required to the various authorities for purposes such as port clearance and compliance with regulations.

The development of the MSW will bring about efficiencies in shipping and port operations with the reduction of administrative red tape, and consequently enhances the safety of navigation within the port of Singapore as shipmasters can focus their attention on their primary responsibility of navigating their ships safely. These outcomes are aligned with the International

Maritime Organization's broad objectives of facilitating the smooth passage of ships, cargo and crew/passengers from port to port without unnecessary delays, by simplifying and reducing paperwork and formalities, as well as to improving safety at sea. The MSW will also serve as a centralised information hub, connecting authorised parties and port community systems to form a maritime business ecosystem that facilitates just-in-time operations and services. MSW will become a one-stop repository for maritime data and serves as a digital maritime connectivity platform for sharing and reuse of data between stakeholders.

3.2.4. International Cooperation to Develop S-100 Based Product Specifications (IHO, IALA and IMO)

Presenter and Author

Eivind Mong, eNavigation System Analyst, Canadian Coast Guard, 867 Lakeshore Road, L7S 1A1, Burlington, Ontario, Canada; Chair of IHO S-124 Correspondence Group

Abstract

The paper discussed how international cooperation is a requirement in the development of most S-100 based product specifications. Using the examples of S-124, Navigational Warnings, and S-201, Aids to Navigation Information, drawing on experience from various degree of involvement in most currently ongoing product specification developments, the author elaborates on the typical process of developing a product specification. A particular focus was on the intricate relationships between various international organizations and how these relationships may impact the product specification developments. For this purpose, the paper investigated what typical activities of the International Maritime Organisation (IMO) are needed and how IMO e-Navigation guidelines may impact product specification development. International Hydrographic Organisation (IHO) and International Association of Lighthouse Authorities (IALA), whom are typically examples of organizations that lead the S-100-based product specification developments, were examined for how they utilize international cooperation to develop product specifications. The role of the International Electrotechnical Commissions (IEC) is essential for all S-100 based product specification targeting ECDIS, radar or other navigational related equipment and the paper reviewed how IEC input can affect product specification development.

3.2.5. The SMART-Navigation Example

Presenter and Author

PARK Jinhyoung, Senior Researcher, SMART-Navigation Office, KRISO, Daejeon, Republic of Korea

Abstract

The SMART-Navigation project aimed to implement e-Navigation services in Korean waters, which were based on IMO's e-Navigation concept while adding special features:

- (1) Services for non-SOLAS ships
- (2) Broadband communication services using navigation-dedicated LTE networks (LTE-Maritime) for better connectivity between ship and shore.

As fishery ships have been involved in more than 70% of marine accidents, the project aimed to provide domestic ships with safety services by using wider connectivity. To widen the connectivity, LTE network and the Maritime Connectivity Platform (MCP) was used. On the basis of the wider connectivity, six main e-Navigation services were provided:

- (1) Navigation Monitoring & Assistance Service (NAMAS)
- (2) Ship-borne System Monitoring Service (SBSMS)
- (3) Safe & Optimal Route Planning Service (SORPS)
- (4) Real-time Electronic Navigational Chart Distribution & Streaming Service (REDSS)
- (5) Pilot & Tub Assistance Service (PITAS),
- (6) Maritime Environment and Safety Information Service (MESIS).

The services were dedicated for accident-vulnerable ships which were defined as the ships with high-accident ratio or huge accident impact socially, environmentally or economically.

3.3.Session 3 - Communications for e-navigation

Chair: AN Kwang, Professor, Mokpo National Maritime University

3.3.1. Development of LTE-M

Presenter and Author

LEE Hanjin, SMART-Navigation Project

Abstract

The main feature of the SMART-Navigation project of Korea is that it includes not only e-Navigation services for SOLAS vessels being discussed at IMO but also non-SOLAS vessels as service targets. There are about 70,000 registered fishing boats on the Korean coast. In order to secure the communication speed and bandwidth required to include all of these fishing vessels in service, we considered expanding LTE communication maritime called LTE-Maritime. Most of our fishing boats are within 100km of the coast. So, when we set up our first LTE-Maritime plan, we set the communication coverage to 100km from the coast. We constructed and tested the pilot network before the full-scale network construction. The presenter introduced the results of the pilot test of LTE-Maritime.

3.3.2. Test Result and Lesson Learned from LTE-M Pilot Project

Presenter and Author

CHOI Dujeong, Director, Telecommunications Technology Association (TTA)

Abstract

Before the nationwide deployment of LTE-Maritime network, the Korean Government had performed a pilot project at three harbours, Gangneung, Busan and Mokpo. The main purpose of pilot project was to test LTE-Maritime characteristics in the perspective of coverage and communication service quality. The commercial network carrier won the pilot project and supplied

the LTE-Maritime core network together with access network of 14 Digital Units, 22 Radio Units and 3 Femto base stations. This pilot project period was from Nov. 2016 to Feb. 2017.

As a cooperative R&D partner of Korean e-Navigation project, TTA tested the pilot network in order to see the coverage and communication service quality. From the test result, TTA learned what must be considered when developing a nation-wide project.

There are three major findings. First, LTE-Maritime service can reach up to 100km at sea, which is the goal of e-Navigation service. Second, LTE-Maritime pilot network provides lower quality of service compared with commercial networks and theoretical LTE data throughput. Last, but not least, there is frequency interference from Public Safety LTE network. Same frequency band is allocated to the LTE-Maritime and PS-LTE network.

The presentation provided an overview of pilot network deployment followed by the test results and lessons learned.

3.3.3. Communications and Data Exchange in the Maritime Autonomous Surface Ship (MASS)

Presenter and Author

LEE Yunsok, Korea Maritime and Ocean University

KIM Daehae, Korea e-Navi Information Technology

AHN Youngjoong, Professor, Korea Institute of Maritime and Fisheries Technology (**Presenter**)

Abstract

In developing the operating solution for the Maritime Autonomous Surface Ship (MASS), key professional technologies such as the ship data processing and transmitting system and the maritime communication environment are essential. In particular, in order to perform Ship Remote Operation / Control, collecting and processing data in ship, transmitting collected data to shore and data sharing on shore must be optimized to shore and maritime environment. Previous studies focused on processing and utilizing data for data integration and processing on a single vessel, but in order to remotely control a ship on shore, many recent studies are considering dispersed processing and integration of mass ship data using optimized techniques.

The real time ship operating data collection and transmission system currently under development is designed to collect data using NMEA and MODBUS that are the standard protocols to process digital data on a ship. The operating system for remote control on shore as the application uses Kafka Messaging system, a message processing software such as MOM (Message Oriented Middleware) for effective dispersed processing of a complicated ship system, message exchange between ship and shore, message exchange between stakeholders on shore and establishment of various service systems.

The development system largely consists of the ship (Onboard) and the Shore Operational Center (SOC). In design, it can have number of ships and number of SOCs. The ship collects major ship operational data for navigation, engine and communication, which is sent to a server consisting of modules that can process and save for service applications on shore and ship as needed. SOC consists of a server consisting of modules that collect and process data from a number of ships and send as needed and servers for service applications. It is designed so that users can access services such as the navigation monitoring service via a web browser on a personal computer. In order to develop and verify such a system, it has been installed to a Training ship of the Korea Maritime and Ocean University called the T/S Hanbada. In 2017, the integrated interface with the onboard equipment, connection with the navigation simulator, implementation of onboard / shore monitoring and data processing have been verified. In 2018, based on the V-SAT satellite communication, the usefulness and the effectiveness of the data transmission system is being verified.

3.3.4. Maritime Connectivity Platform and the AP Web

Presenter and Author

Thomas Christensen, SMART-Navigation Project

Abstract

The presentation gave a short presentation of the MCP (Maritime Connectivity Platform - formerly the Maritime Cloud), explaining the main functionality and benefits of the core modules, the Maritime Identity Registry (MIR), the Maritime Service Registry (MSR) and the Maritime Messaging Service (MMS). A status was given on the development, the future plans, and not the least, the

prospect of a governance model.

Following this, an update on the development of the Asia Pan Pacific Web (APPweb) was explained. A web-based platform for accessing e-navigation services which utilizes the MCP and builds upon previously developed systems.

3.3.5. Development plan of S-100 Based Specification for SMART-Navigation

Presenter and Author

SON Gumjun, Korean Register of Shipping

Abstract

The SMART-NAVIGATION product specification is a product specification for exchanging, Integrating, portraying data between the ship and shore based on SMART-NAVIGATION service. In the early stages of the project, we developed product specifications for each service, but as the development progressed, the data was constantly changed, making it difficult to present a clear and consistent structure.

Therefore, it was necessary to set up a new development direction considering maintenance and reusability, and we adopted the development of module-based product specification as an alternative. The module-based product specification develops a message model (Request, Response) based on the purpose and the similarity of data, and presents a service model and system model based on the association between message model.

Based on the initially defined data, the presenter explained the case of application based on service scenario, and introduce future schedule.

3.3.6. Danish Focus on e-navigation – Effiensea 2 and Beyond

Presenter and Author

Linda Assels Hald, Project Manager, Danish Maritime Authority

Abstract

The presentation gave a short introduction to the EfficienSea2 project and showed the overall road ahead for the concepts and solutions identified in the project. Furthermore the presentation shortly introduced a few of the focus areas of the Danish Maritime Authority after the finalization of the EfficienSea2 project.

EfficienSea2 is a three year EU-funded project consisting of 32 partners, including IALA and many IALA members. The 11.5M e-Navigation project has had the ambition to reach global impact by innovating digital solutions for the maritime domain and hereby supporting efficient, safe and sustainable traffic at sea. The solution architecture is divided into four components: End user services, communication channels, service platforms for web and on board equipment, and the overarching Maritime Connectivity Platform, combining all the elements, making integration possible.

Throughout the project a wide variety of solutions, including new generation navigational warnings, Smart Buoys, Ice Charts, VDES (VHF DATA Exchange System) and SOx Monitoring Systems have been developed and tested.

On top of this work, many partners involved in EfficienSea2 have provided input to IALA's Committee for E-navigation and other standardisation bodies on a regular basis.

The Danish Maritime Authority continues its focus on innovation of e-Navigation solutions, digitalization in the maritime sector and standardization.

Among others the Danish Maritime Authority is currently involved in 1) the EU funded MARIA project which together with SSPA in Sweden looks into data analysis and identification of near-miss situations, 2) the Baltic Web which is an open source demonstration interface for some of the prototype services available in the Maritime Connectivity Platform (MCP), and 3) continues work on digitalization of the coastal state in order to adapt to the future needs of the maritime industry.

3.4. Session 4 - Services to Support Electronic Navigation

Chair: Hideki Noguchi, IALA, Chair of IALA's e-NAV Committee

3.4.1. ENC Services for Non-SOLAS Ships

Presenter and Author

OH Sewoong, Senior Research Engineer, Korea Research Institute of Ships and Ocean Engineering (KRISO)

Abstract

The SMART Navigation project was designed to contribute to IMO strategic implementation of e-Navigation, reduce maritime accidents and enhance shipping efficiency. Considering the necessity to reduce the incidents of small vessels, services for non-SOLAS ships were included in the project. As ENC Services is a representative service for small vessels, two kinds of services have been developed to meet the nautical chart requirements for safe navigation. The first service is an ENC download and update service for ECS (Electronic Chart System) that provides up-to-date ENCs considering relating guidelines of IHO. The second service is an ENC streaming service for mobile device users who is not equipped with ECS or GPS Plotter. The ENC streaming service has been developed following the WMS (Web Map Service) and WFS (Web Feature Service) guidelines of OGC (Open Geo Consortium). The ENC Services for non-SOLAS Ships were prototyped within the SMART Navigation architecture consisting of MCP (Maritime Cloud Platform) and information exchange system of S-100 and detailed function development and trial operation will be followed from this year. This presentation introduces service operation structure and main development results in the SMART Navigation project.

3.4.2. ECDIS – How Will It Aid / Be Part of e-navigation?**Presenter and Author**

Mai Matsuura, Engineer, TOKYO KEIKI INC.

Abstract

ECDIS (Electronic Chart Display and Information System) is expected to be the main display equipment of e-navigation. It can contribute to the safe navigation by displaying many kinds of information such as alternative route, weather, and maritime safety information, etc. However, many issues should be considered to keep the safe navigation while the information is gathered, integrated, and displayed on ECDIS.

This presentation included the following two parts:

1 – What is “ECDIS”

Before talking the ECDIS as a part of e-navigation, the reality of ECDIS will be introduced. The part will describe the basic system component and the function of ECDIS. Then, the part will introduce how ECDIS is used and what is really required now. In addition, the problems of ECDIS from the manufacturer’s point of view will be described.

2 – How will it be a part of e-navigation?

Considering the situation introduced in part 1, the e-navigation information should be implemented to ECIDS step by step. The part will introduce a proposal of the system and required functions of ECDIS as a part of e-navigation system

3.4.3. Resilient Positioning, Navigation and Timing

Presenter and Author

GUG Seunggi, Professor, Korea Maritime and Ocean University

Abstract

In this presentation, the speaker explained why Resilient Positioning, Navigation and Timing (RPNT) is necessary for e-Navigation and Autonomous Vessel, for highly accurate positioning, navigation and timing data to improve the reliability, performance and safety of these critically, remoteabide often high-risk operations. To ensure higher levels of accuracy, integrity and availability of PNT, PNT technologies and system must be resilient. e-Navigation gives the benefits for users and stakeholders to enhance berth to berth navigation and related services for safety and security at sea and protection of the marine environment through better organization of data on ships and on shore, and better data exchange and communication between ships and the ship and shore.

And emerging autonomous shipping could be the future of the maritime industry, and bring the biggest revolution in shipping. Automated ships are next generation vessels with no crew members on board which will be commanded from a shore operating center, where shore masters and engineers will be monitoring Ana’s controlling their navigation through detectors, sensors, high-resolution cameras and advanced satellite communication systems. The reliable PNT system is the key element of the autonomous shipping. The presentation will provide an overview of the

Resilient Positioning and Timing technology at sea and trials currently taking place in Korea and other FERNs (Far East Radio Navigation Service) Area.

3.4.4. Enhanced Radar Positioning

Presenter and Author

Jun Yamabayashi, Engineer, Radio Navigation Engineering Section, R&D Department, FURUNO Electric Co. Ltd.

Abstract

Radar has always been used as a resilient relative positioning system. When used with fixed, known absolute position targets, a fair absolute position solution for a vessel can be calculated. But identifying targets can be difficult and published (navigation chart) positions may be approximate. A system known as Enhanced Radar Positioning System (ERPS) uses specially modified racons (radar beacons, or eRacons) with specially modified radars (eRadars) to allow radars to automatically calculate absolute position. In this system, eRacons provide their absolute position encoded on their response signals to eRadars, which use these signals to calculate their own vessels' positions. Recent trials in Singapore using three eRacons demonstrated dynamic absolute position differences of better than 27 meters compared to Real Time Kinetic position solutions, and accuracies of 2.5 meters with the vessel berthed.

3.4.5. Satellite Based PNT Service for Asia Pacific Region

Presenter and Author

Yoshihiro Iwamoto, Senior Manager, NEC Corporation

Abstract

The QZSS, Quasi-Zenith Satellite System, is a Japanese regional satellite navigation system. One of the most important features of the QZSS is that it can be sending the POSITIONING SIGNAL with fully compatible with US-GPS. We can make use of this feature to significantly improve the

availability in the Asia and Oceania region. In addition to this important role, the QZSS has high precision positioning capability of sub-meter level and centimeter level augmentation service. Also, the QZSS has the Message delivery function. Currently, four satellites constellation is established and now under the initial trial service. The full operational service will start within this Japanese fiscal year. Furthermore, the SBAS should be serviced as L1Sb from 2020's. This presentation introduces a latest trend of the QZSS.

3.4.6. SBAS Trials in the Australia and New Zealand Region (Presented by Australia)

Presenter and Author

Mahesh Alimchandani, Head of Navigation Safety, Australian Maritime Safety Authority

Abstract

The presentation described how Satellite-Based Augmentation Systems (SBAS) use space and ground infrastructure to improve the accuracy, integrity and availability of Global Navigation Satellite System (GNSS) signals, such as those currently provided by the Global Positioning System (GPS). First generation SBAS is already in use internationally; instances are the Wide Area Augmentation System (WAAS) in the United States and European Geostationary Navigation Overlay Service (EGNOS) in Europe. In the southern hemisphere, the Australian and New Zealand governments have funded a two-year (2017-19) project that is testing first generation SBAS and multi-constellation, multi-frequency SBAS. This provides sub-metre, high integrity positioning. A second generation SBAS is also being tested. It has a precise point positioning capability, which can provide decimetre level positioning accuracies. If implemented operationally, SBAS technology can offer significant safety and efficiency benefits to the maritime and other sectors. The presentation will provide an overview of the SBAS technology and trials currently taking place in Australia and New Zealand

3.5. Session 5 – Wrap Up session, Conference Session Summary

Chair: HONG Sunbae, Chair for the IMO/IHO HGDM, and Deputy Director for Korean e-Navigation project team, Ministry of Oceans and Fisheries (MOF), Republic of Korea.

3.5.1. Session 1 – International Developments

Chair: Nick Lemon, AMSA, Manager Nautical and Regulation

Session 1 Chair, Mr. Nick Lemon, briefly summarized presentations in the session titled 'International Developments' on e-Navigation.

Mr. HONG Sunbae introduced the work of the IMO/IHO Harmonization Group on Data Modelling (HGDM), which is developing guidance on the definition and harmonization of an initial set of maritime services. Mr Hong noted that the aim was to have the guidance approved at NCSR 7 in 2019, as scheduled in the e-navigation strategy implementation plan (SIP). He stated that the aim was to have maritime services available by 2020. Mr Hong concluded by saying that there needs to be more work on e-navigation on the IMO MSC / NCSR work program after 2019. Perhaps IMO Member States could propose new services, which would result in the guidance being revised.

The 2nd speaker, Mr. Michael Card, presented the work of the IALA Committees on e-navigation. Starting with IALA's vision and goals, he outlined IALA's work on e-navigation, which is focused on services provided by shore authorities and includes those provided by Vessel Traffic Services. Harmonised data models, ship-shore-ship communication, and resilient positioning, navigation and timing were some of the main topics. He noted that all four IALA Committees would be involved in different aspects of e-Navigation in the next four years.

Mr. Hideki Noguchi briefly looked back the achievements and contributions made by IALA's e-Navigation Committee since 2010 and discussed some current issues such as the 16 initial maritime services, the use of the S-100 framework and potential links of e-navigation with marine autonomous surface systems in the development of e-navigation. He mentioned that while e-navigation has finally reached an initial implementation stage after more than 10 years of development, the rapid development of technologies has exceeded the speed of e-navigation development. The world maritime community is now at the threshold of a new phase of e-navigation. Mr. Noguchi emphasized that IALA will be pro-active regards IALA's response to the development of new technologies for e-navigation.

Mr. BAEK Yong introduced the work of the International Hydrographic Organization (IHO) with regard to developing S-100 (move to Ed 5 by 2021), including a simple user guide, infrastructure (maintained by KHOA for IHO), product specifications and test bed programs. He noted that the IHO and other authorized organizations are creating S-100 product specifications. He listed the steps required to create a product specification. For the IHO's part, it is currently focused on S-101 for new generation Electronic Navigational Charts (ENCs), and other specifications such as S-102, S-111, S-129 and S-412, which will facilitate key e-navigation services.

The last speaker of the session, Mr. Robert Ward, reported on the concept and development of PortCDM (Port Collaborative Decision Making), an enabler of the Sea Traffic Management (STM) concept. He identified the relationship between PortCDM and the ongoing development and implementation within the STM Validation Project, as well as its conformance with the underpinning principles, standards and objectives of e-navigation.

During the session, it was stated that there should be new e-navigation-related work items placed on IMO's post 2019 work programme, as the current list of work items in the IMO's e-navigation SIP would have been completed by then.

Considering that e-navigation will be impacted by rapidly evolving technology and user needs for new maritime services, it may be that a new IMO output is required that seeks to revise IMO's guidance on maritime services.

It was recognized that interoperability of services and systems was a key challenge, and that much work is needed to support successful implementation of e-navigation services. This can be shaped by applying efforts through global test beds, supported as appropriate by IMO, IALA and the IHO.

3.5.2. Session 2 - Maritime Services

Chair: Jon-Leon Ervik, Norwegian Coastal Administration, Head of Department for Pilotage and VTS

The 1st speaker, Mr. Fredrik Karlson, presented e-Navigation Services from VTS to SOLAS vessels, talking about the new enhanced services from VTS powered by common information shared between shore and ship and ship to shore. He emphasized that the Sea Traffic Management Validation (STM) project was ready to take VTS services further with sharing of common situational awareness based on this shared information. The results and outcome from STM testbeds has been in line with the IMO concept of e-Navigation and especially the Maritime Services (Prev. MSP) No. 1, 2 and 3.

Mr. Trond Langemyr talked about Norway's work on e-navigation and the utilization of e-navigation Maritime Services on non-SOLAS vessels. The project demonstrated an alternative and better way to present digital navigation information for recreation vessels. He mentioned that the e-Navigation process has mainly focused on SOLAS vessels. The Norwegian project proves that several of the Maritime Services may also be of relevance to non-SOLAS ships.

Mr. Nelson Tay Kai Xian presented the ongoing development regarding a Maritime Single Window

(MSW) in Singapore. He presented the goals for the MSW in Singapore including the benefits. The development of the MSW will enhance the efficiency in shipping and port operations and reduce the administrative burden, and consequently enhance the safety of navigation. The shipmasters can focus on the navigational process and safety. It was emphasized that the MSW will become a one-stop repository for maritime data.

Mr. Eivind Mong presented how international cooperation is essential for the work on standards and the development of S-100 based product specifications. Using the examples of S-124, Navigational Warnings, and S-201, Aids to Navigation Information, based on his experience from various involvements in most currently ongoing developments on product specification. He explained the typical process of developing a product specification. He also clarified the intricate relationships between various international organizations and how these relationships may impact or contribute to the developments of product specifications.

Mr. PARK Jinhyoung presented the SMART-Navigation Example, introducing the SMART-Navigation project. The project aims to implement e-Navigation services for non-SOLAS ships in Korean waters. To widen the connectivity among fishery vessels and other domestic vessels, a broadband LTE-M network and Maritime Connectivity Platform (MCP) has been developed. He explained that six main e-Navigation services are developed dedicated for accident-vulnerable ships with high-accident ratio or huge accidental impact.

It was concluded that the development of 'Maritime Services' for non-SOLAS vessels will contribute to safety for non-SOLAS vessels and demonstrates that this can reduce maritime accidents, in harmonization with maritime services for SOLAS vessels.

3.5.3. Session 3 - Communications for e-navigation

Chair : AN Kwang, Professor, Mokpo National Maritime University

Session 3 Chair, Prof. AN Kwang summarized the results of the session 3 with titled communication for e-navigation as follows.

In the Session 3, 6 speakers presented under the THEME of "communications for e-navigation.

As you may well aware, the seamless communications are key element for the realization of e-navigation maritime services.

The 1st speaker, Dr. LEE Hanjin, head of SMART-Navigation Project Office, introduced the current development status of Korean SMART-Navigation Project in general. The SMART-Navigation project is focused on not only for SOLAS-ships but also for Non-SOLAS Ships. According to the

National e-navigation Strategy Implementation Plan, LTE based maritime mobile communication network is under development, namely LTE-M. It is expected that LTE-M will provide seamless high-speed communication environment in the Korean coastal waters in order for the implementation of e-navigation maritime services.

In line with the LTE-M development project, Mr. CHOI Dujong, Director of Telecommunications Technology Association (TTA) introduced the test result and lesson learned from the LTE-M pilot project. He presented three findings which was obtained from the pilot test as follows:

- LTE-M covered within 100km in the coastal waters;
- LTE-M service quality was low compared with commercial networks; and
- Frequency interference with Public Safety LTE was occurred.

Recognizing that regulatory scoping exercise for the use of Maritime Autonomous Surface Ships (MASS) has become an important agenda in the Maritime Safety Committee of IMO, AHN Youngjoong, Professor of Korea Institute of Maritime and Fisheries Technology (KIMFT) presented communications and data exchange in the Autonomous Ship. Key professional technologies are under development for a ship data processing and transmitting. In order for the remote ship control environment, onboard data collection and processing, transmitting data between ship and shore should be optimized efficiently. He introduced the related test projects which are carried out in the Training Ship of Korea Maritime and Ocean University.

The 4th speaker, Mr. Thomas Christensen, a special advisor for SMART-Navigation Project introduced the Maritime Connectivity Platform and the AP Web as a technical advisor of Korean SMART-Navigation Project. His presentation gave an introduction about the MCP (Maritime Connectivity Platform - formerly the Maritime Cloud), explaining the main functionality and benefits of the core modules, the Maritime Identity Registry (MIR), the Maritime Service Registry (MSR) and the Maritime Messaging Service (MMS). He also presented the status of development and future plans for the AP web.

The fifth speaker, Mr. SON Gumjun, deputy senior researcher at ICT center in Korean Register of Shipping, presented the development plan of S-100 based specification for SMART-Navigation. He introduced the development of module-based product specification which is a message model. He also explained the case of application based on service scenario with a future schedule.

Lastly, Linda Assels Hald, project manager in Danish Maritime Authority, presented Danish Focus on e-navigation namely, Efficiensea 2 and Beyond. She introduced the EfficienSea2 project and showed the overall road ahead for the concepts and solutions identified in the project. She also introduced the focus areas of the Danish Maritime Authority after the finalization of the

Efficiensea2 project. EfficienSea2 is a three year EU-funded project consisting of 32 partners, including IALA and many IALA members. The project had the ambition to reach global impact by innovating digital solutions. The solutions are relating to new generation navigational warnings, Smart Buoys, Ice Charts, VDES (VHF DATA Exchange System) and SOx Monitoring Systems. The Danish Maritime Authority continues its focus on innovation of e-Navigation solutions, digitalization in the maritime sector and standardization.

Following the discussion in the session, there was a clear understanding that the digital communication is a key element for successful realization of e-navigation maritime services.

I would like to conclude that without communication technology and information systems, we cannot say about the harmonized collection, integration, exchange, presentation and analysis of marine information. In order to realize the seamless information transfer onboard ship, between ships, between ship and shore and between shore authorities, wide efforts are required to introduce the advanced communication technology including LTE-M in the existing maritime communication systems.

3.5.4. Session 4 - Services to Support Electronic Navigation

Chair: Hideki Noguchi, IALA, Chair of IALA's e-NAV Committee

The first speaker, Dr. OH Sewoong introduced ENC services for non-SOLAS vessels developed under the SMART Navigation project. The first service is an Electronic Nautical Chart (ENC) download and upload service for the Electronic Chart Service (ECS) and the second service is an ENC streaming service for mobile device users who do not have ECS or GPS Plotter.

The second speaker, Ms. Mai MATSUURA explained some technical issues when ECDIS is used as an e-navigation information display then she proposed step by step approach in order to incorporate ECDIS as a part of e-navigation system.

The third speaker, Professor GUG Seung-Gi introduced resilient Position, Navigation and Timing (PNT) services that are provided in Korea and Far-East region. He described how the resilient PNT services are useful for not only e-navigation but also autonomous ship operation that is anticipated for the future shipping.

The fourth speaker, Mr. Jun YAMABAYASHI introduced an Enhanced Radar Positioning System (EPRS) that is combined of specially modified radar (e-Radar) and Racon (e-Racon) and independent from other satellite or terrestrial PNT service. He also explained the result of the recent ERPS trial conducted in Singapore.

The fifth speaker, Mr. Yoshihiro IWAMOTO of NEC introduced the Quasi-Zenith Satellite System (QZSS) that is Japanese regional navigation satellite systems providing a PNT service with sub-meter accuracy and centimeter accuracy by augmentation. The QZSS also provides message delivery service.

The last speaker, Mr. Mahesh ALIMCHANDANI explained space based augmentation system (SBAS) that provides sub-meter, high accuracy positioning service. He then introduced an overview of the SBAS technology and trials currently taking place in Australia and New Zealand.

After the presentation, the chair summarized the session as follows;

E-navigation is an IMO led concept however its advantage and benefit should be extended to non-SOLAS vessels such as fishing ships and pleasure crafts that occupy a large part of marine accidents. The SMART Navigation project is certainly aimed to this purpose and thus wider participation to the project is encouraged;

Human machine interface is a key component to realize e-navigation and ECDIS is truly one of the devices for this human machine interface. However it should be noted that the existing ECDIS contains various limitations and such limitations should be dissolved with step by step approach in order to utilize ECDIS in e-navigation;

Resilient PNT service is the most basis foundation of e-navigation. Therefore development and use of multiple PNT services such as onboard Enhanced Radar Positioning System (ERPS), terrestrial e-Loran, R-mode, and regional satellite based QZSS and augmentation services should be encouraged in order to avoid a vulnerability of using single PNT service.

4. Panel discussions (Q&A) Session

The session chairs have discussed a number of questions with the audience after each session.

(Session 1) Mr. Hideki Noguchi was asked by Professor KIM Inchul about the different characteristics that could identify the differences between autonomous ship and e-navigation. Mr. Noguchi answered that e-Navigation is an individually developed technological concept that supports harmonized data exchange system and facilitation such as port CDM. Mr. Hong Sunbae added that e-navigation can be considered as an operational platform for autonomous ships.

Mr. Mahesh Alimchandani asked to Mr. Robert Ward whether the port CDM will take into account in the maritime single window reporting system. Mr. Ward replied that the whole point of port CDM is about maritime single window reporting and it provide appropriate information sources to the customers as well.

(Session 2) Mr. Michael Card have raised a question regarding the installation of the Virtual Reality

(VR) equipment to show safety information in non-SOLAS ships and leisure crafts. Mr. Trond Langemyr answered that if mobile phones are unavailable to support the VR system, then specific equipment should be made and installed onboard.

(Session 3) Mr. Omar Fritz Eriksson asked to Mr. LEE Hanjin regarding the installation of telecommunication radio stations and antenna coverage intersecting the territorial boundaries between Republic of Korea and China and solutions to the difficulties that arise. Mr. Lee stated that the ROK and China is planning to sign a MoU regarding this project and no disputes have occurred until present times. The project will continue unless there is a major problem that directly affect the project plan.

(Session 4) Mr. Hong, Sunbeae asked about the loss of important navigational data when ECS is applied in the mobile phone. Professor OH Sewoong responded that a specific guide on the extended type in the mobile phone app. will be a solution before applying it in actual performance and as of now, the current technology is able to support without huge concerns.

5. Conference Highlights

Mr. HONG Sunbae, Chair of session 5, leaded the conference highlights drawn from the conference proceedings.

The Conference Highlights were:

- The conference recognised that, now high-level guidance on maritime services will be completed soon, administrations can prepare to implement such services for SOLAS and non-SOLAS vessels. It was also recognised that users may identify need for new maritime services and then this guidance would need to be reviewed.
- The Conference heard that so far, most e-navigation development has addressed the needs of SOLAS vessels. It heard that in Korea and other countries the safety of fishing vessels and pleasure craft is of concern. Appropriate digital maritime services and economical connectivity out to sufficient distance from land is needed for these vessels.
- The Conference noted that in order to realise seamless information exchange ship-shore-ship globally, coordinated efforts are required to introduce communications technologies and frameworks such as VDES, LTE-M and the Maritime Connectivity Platform.
- Several presentations captured the need to consider users and their need for systems that are usable, reliable, and promote safe operation of ships.
- Presentations highlighted the initiative of the Korean SMART-Navigation test project, to provide Electronic Navigational Charts (ENCs) service for non-SOLAS vessels.


- In the presentations on Positioning, Navigation and Timing (PNT) the importance of resiliency was underscored. Autonomous vessels entering service now and in future will need assured positioning and automatic compensation for GNSS outages or disruption. Several candidate technologies were identified. QZSS, SBAS, R-Mode, Radar positioning and eLoran are electronic systems likely to be used to help achieve the necessary resilience.
- The Conference noted that there is a capacity-building workshop on the implementation of e-Navigation after this conference aimed at enhancing maritime safety in the Asia-Pacific region.

6. Closing of the Conference

Mr. Michael Card, Deputy Secretary-General of the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) congratulated the Session chairs, speakers, supporting organisations and the steering committee for the outstanding performance and arrangements. In particular, he showed his sincere appreciation to the host, the MOF, ROK for successfully hosting the second E-Navigation Underway Conference 2018 Asia-Pacific.

7. Exhibition

One exhibitor participated to show their products.

Name of the exhibitor	Product
SMART-Navigation Project P.I.C.: Sumi, Han 	SMART-Navigation

8. Social Events

On the 3rd of June, the pre-conference dinner in the Atrium hall on Millennium Hilton hotel, was held. Korean style course menu was served and the distinguished guests and participants greeted each other casually and openly manner.

On 4th of June, the dinner started with a popera performance by the "Pastello", singing "Sole Mio". After the performance of 4 songs, toasts were made by Mr. SEO Byoung-Gyu, the President of the Korea Institute of Maritime and Fisheries Technology (KIMFT), followed by Mr. Andreas Nordseth,

the Director General of DMA and finally Mr. Michael Card, the Deputy Secretary General of IALA.

The network building dinner was held on 5th of June. The remaining attendees were served barbeque style with drinks in the terrace of the Atrium hall in the 3rd floor of the Millennium Seoul Hilton Hotel.