A logo with a mermaid in the air

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| From: DTEC | ENG21-3.1.2.11 |
| To: ARM, ENG, VTS Committee(s) | 03 October 2025 |

**LIAISON NOTE**

**DRAFT DISCUSSION PAPER ON IALA VISION TOWARDS DIGITALIZATION**

**INTRODUCTION**

DTEC would like to express its gratitude to ARM, VTS and ENG for the valuable inputs provided for our task 7.1.1 to develop a discussion paper, which is a living document that will be updated from time to time, under the IALA work programme for 2023 to 2027. DTEC has made progress on the task and produced a first draft of the discussion paper title “Vision Towards Digitalization in the IALA Domain”.

The discussion paper aims to present information on the status of IALA publication developments related to the emerging digital technologies, publication timelines, proposal of IALA digitalization vision & strategies and included views from the IALA committees. The information in this discussion paper may be useful for IALA members’ digitalization journey plannings and IALA’s development of practical digital strategies and action tasks for the digitalization works ahead of the Organisation.

**ACTION REQUESTED**

DTEC5 requests ARM, ENG and VTS to::

* Review and provide, if appropriate, inputs and comments on Section 2 under “IALA Digitalization Vision and Strategies”
* Review and provide, if appropriate, inputs and comments on Section 3.2 under “Potential Opportunities”

**ANNEXES**

1. DTEC5-15.5.3-Draft Discussion Paper ON VISION TOWARDS DIGITALIZATION IN THE IALA DOMAIN V3.2



DISCUSSION

ON

VISION TOWARDS DIGITALIZATION IN THE IALA DOMAIN

Edition 1.0

**DOCUMENT HISTORY**

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**1 INTRODUCTION**

* 1. **Maritime Digitalization**

Digitalization is the process of converting information from physical or analogue formats into digital format that can be stored, processed and transmitted by digital systems and devices. In an increasingly interconnected world, digitalization has emerged as a powerful transformative force affecting diverse sectors, and the maritime industry is no exception. As global trade continues to expand and the demands of the consumer-driven economy evolve, maritime stakeholders are compelled to adapt to rapid technological changes. Maritime digitalization offers unprecedented opportunities to enhance operational efficiency, optimize resource utilization, and improve safety standards. By embracing digital technologies, the maritime sector can potentially unlock significant benefits in streamlining processes, automating tasks, and enabling real-time monitoring and decision-making, which potentially promotes cost savings, productivity gains, and better risk management capabilities.

Digitalization with standardized protocols enhances interoperability, enabling better coordination between Vessel Traffic Service centres, thereby improving navigational maritime safety and security. Digitalization enables the integration of diverse data sources and systems, facilitating communication and collaboration across different stakeholders in the maritime ecosystem. From port operations and vessel traffic management to navigational safety and environmental protection, digitalization empowers maritime stakeholders to collect, analyze, and utilize data more effectively, enabling proactive decision-making and strategic planning. Additionally, digitalization is the fundamental prerequisite for the integration of artificial intelligence (AI) in maritime operations.

* 1. **Key Global Trends Driving Maritime Digitalization**

Maritime digitalization is being propelled by a confluence of factors that are reshaping the industry landscape. These key drivers are transforming traditional practices and paving the way for innovative solutions to meet the evolving demands of the maritime sector. The drive towards digitalization is fuelled by the desire to enhance operational efficiency, optimize resources, and address challenges in safety, security, and environmental sustainability. As the industry navigates towards a more interconnected and data-driven future, these drivers are instrumental in shaping the course of maritime digital transformation. The key drivers which are broadly discussed in the literature of maritime digitalization includes 1) Rapid digital technology advancements 2) Shift in User Expectations 3) Sustainability 4) Safety of Navigation 5) Globalisation and 6) Need for cost efficiency & productivity. Figure 1 illustrates some of the key motivators of maritime digitalization.

A diagram of different types of transportation

Description automatically generated

*Figure 1 Key Motivations of Digitalization in Maritime Transportation*

Rapid advancements in digital technology are driving innovation, streamlining processes, and enhancing decision-making capabilities in the maritime industry. Today, users expect seamless and convenient experiences to perform their work efficiently, pushing for more automation and interconnected systems and operations. Sustainability concerns are also prompting the maritime industry to adopt digital technologies that optimize fuel consumption, reduce emissions, and minimize environmental impact [1]. The International Maritime Organization's (IMO) sulphur cap and the Energy Efficiency Existing Ship Index (EEXI) pushes the industry forward to cleaner and more sustainable operations [5]. Today, there are rapid developments in alternative fuels such as liquefied natural gas, hydrogen, methanol, ammonia, and biofuels, as well as advancements in energy-efficient green technologies like wind-assisted propulsion, waste heat recovery systems, solar power technologies, hull air lubrication systems, and improved hull designs and materials. These green technologies are crucial for protecting the environment and ensuring a more sustainable future for the maritime industry. Maritime green technologies and digital technologies are increasingly interconnected as the maritime industry seeks to reduce its environmental impact.

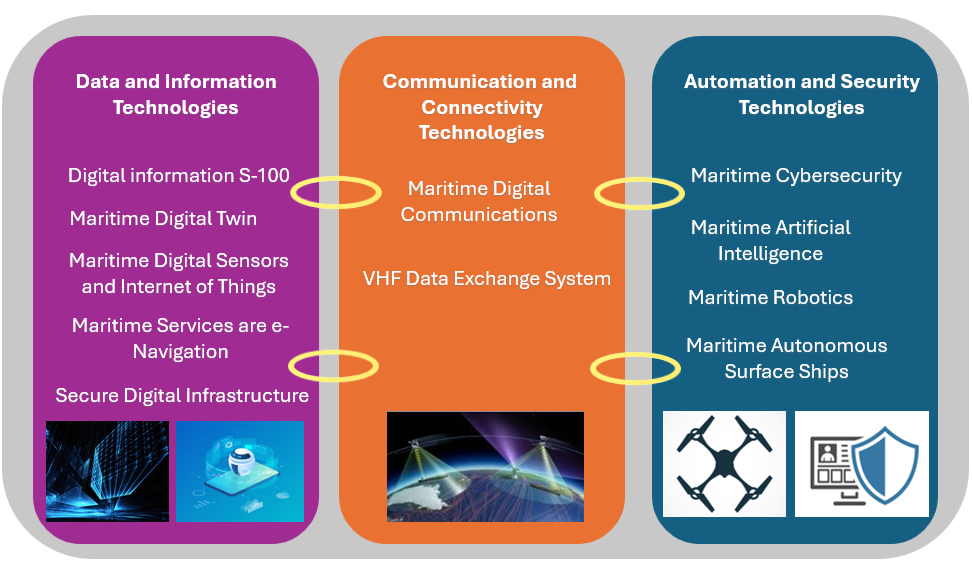
Globalization is driving the need for efficient and interconnected maritime operations, making digitalization essential for seamless communication, coordination, and compliance across international waters. Thus, it is crucial to ensure common digital technology standards within the maritime eco-system to ensure interoperability and robust technologies are adopted to reduce operational risk for a safer and more efficient maritime operations.

Utilizing digital technologies to navigate the complexities of global trade allows maritime businesses to enhance their competitiveness, streamline processes, and adapt to the demands of a connected global economy [2]. The need for cost effective and high productivity in maritime operations motivates the adoption of digital technologies to streamline processes, optimize resources, and reduce operational expenses [3].

It is inevitable that digital technologies will disrupt existing maritime operations. Embracing the adoption of these technologies with a consultative and systematic approach will be crucial for the success of digitalization in the maritime industry.

* 1. **The Technology Radar: Identifying Key Developments**

This section discusses the key digital technologies that have the potential to shape the future of the maritime sector. Monitoring these emerging technologies and understanding their potential impacts are crucial for harnessing their benefits and facilitating strategic planning. As digital transformation accelerates, it becomes essential for stakeholders to comprehend the relevance and maturity of these technologies. Here, we will explore the significance of these advancements in recognizing pivotal digital trends and their implications for future growth. The illustration below provides an overview of the key digital developments that are relevant to IALA.



**Adoption of Maritime Autonomous Surface Ships (MASS)**

Maritime Autonomous Surface Ship (MASS)means a ship which, to a varying degree, can operate independently of human interaction. The three levels of autonomy defined are:

* Full Autonomy: The vessel can operate entirely on its own without human intervention, making decisions and navigating based on real-time data in assessing situations and make decisions autonomously.
* Partial Autonomy: The vessel can perform certain tasks independently, such as navigation and collision avoidance, with some human supervision.
* Remotely Operated: The vessel is operated by a human operator from a control station on shore or another ship.

These ships use advanced technology such as digital sensors, artificial intelligence, and communication systems to navigate and make decisions at sea. While the MASS developments are progressing steadily, several ports of the world have made significant progress in the developments.

**Harnessing Big Data & Artificial Intelligence**

Big data refers to the massive volume of structured and unstructured data that is generated by businesses and individuals. Combining with analytics tools (i.e. Artificial Intelligence (AI) technology), it helps to uncover patterns, trends, and insights that can be used to make informed decisions. Today, there is an increasing number of developments and research in data collection and analytic techniques for the maritime industry. According to Lloyd’s Register research in 2023, it is envisaged that by 2040, AI applications will influence every facet of life. Today's empirical models process only 10% of vessel data, which is significantly inferior to AI models that can process 90% of vessel data, providing accurate performance insights [4]. AI-driven models can enhance decision-making and tackle safety concerns that may occur from insufficient situational awareness or data.

**Digital Maritime Sensors & Internet of Things (IoT) Integration in Maritime Industry**

Digital maritime sensors refer to sensors employed in maritime for the monitoring and enhancing of safety of navigation in the waters. Internet of Things (IoT) is a network of physical devices that are embedded with sensors, software, and connectivity to exchange data. Enabling devices to be controlled and monitored remotely, creating a smart and efficient environment. In recent years, there has been an upward trend in the adoption of digital sensors in maritime operations, along with a noticeable shift from conventional analogue sensors to digital ones. The advantage of utilizing IoT is in gathering and analysing the data collected from these digitalised sensors which can then be used to guide subsequent actions. Given the global efforts to explore alternative fuels such as ammonia, hydrogen, methanol, biofuels, and liquefied natural gas to reduce the sector's carbon footprint, there is a strong need to explore new digital sensors capable of detecting these fuels. This would enable early detection of leaks, ensuring safety in navigation. Digital sensors integrated with IoT will have the potential to significantly enhance maritime safety.

**Adoption of VDES in Maritime Industry**

VHF Data Exchange System (VDES), an advanced communication system designed to facilitate high-capacity data exchange platform for the maritime industry. It builds upon the existing Automatic Identification System (AIS) but offers greater bandwidth and improved data transmission capabilities. VDES enables real-time communication for a variety of applications, including navigation, weather updates, and vessel traffic management and is regarding as one of the key technologies. By integrating satellite and terrestrial components, VDES ensures reliable connectivity even in remote maritime regions. Today, there are two key VDES non-profitable groups in driving maritime VDES developments namely, The VDES Alliance and Satellite VDES Consortium in Japan. The VDES Alliance focuses on promoting VDES technology and ensuring interoperability [6], while the Satellite VDES Consortium aims to support the growing demand for reliable digital communication at sea using satellite-based VDES [7]. At IALA-DTEC, members have been actively demonstrating the VDES capabilities and developments through demonstrations and sharing of trial results.

**Securing Maritime Transactions with Blockchain Technology**

Blockchain technology is a decentralized, distributed ledger system that securely stores data. Blocks are spread throughout a network of various computers. Each block contains data, is marked with timestamp and includes digital signatures linking with the previous block. This technology provides transparency, security, and immutability of data. The essence of this technology is based on trust and transparency with other stakeholders in the shipping process [8].

**Heighten Cybersecurity Focus**

There has been increasing focus and demand of protecting systems, networks, and data from digital attacks in maritime systems. This includes securing computer systems, networks, and mobile devices, as well as implementing processes and procedures to protect data from cyber threats. It is no surprise that cybersecurity is a vital component in the digitalization technology developments [1].

**Maritime Digital Twin Developments**

A digital twin is a virtual representation of a physical object or system. It is created using real-time data from sensors, devices, and other sources to model the physical characteristics and behaviour of an object or system. Digital twin enables monitoring, analysis, and prediction of performance of its physical counterpart by simulating different scenarios and conditions.

**Availability of Robust Digital Communication Connectivity Options via IMT-2020 and Satellite**

The maritime industry is experiencing a significant demand for robust digital communication connectivity. The high-speed and low-latency capabilities of 5G enhance communication efficiency, while satellite connectivity ensures reliable coverage even in remote areas of the ocean. With the availability of 5G and satellite connectivity options, there is potential to revolutionize how ships communicate with onshore operations, enabling real-time data transmission and remote monitoring.

**Use of Robotics for Maritime Operations**

Maritime robotics refers to Autonomous Underwater Vehicles (AUVs) used for underwater exploration, Remotely Operated Vehicles (ROVs) for underwater inspections and maintenance, Unmanned Surface Vessels (USVs) for oceanographic research and monitoring, and Unmanned Aerial Vehicles (UAVs) used in maritime operations. Today, there are successful demonstrations of benefits using robotics like UAVs in the management of maritime oil spill incidents. For instance, deploying UAVs to capture high-quality video footage and transmit back to the shore-based operations centre for incident management and response. These live high quality video footages can also be used to monitor and predict movement of oil spills affected by waves, tides and wind, validate oil spill models, and allow better deployment of response assets.

**Harmonization of Maritime Digital Information (S-100)**

Harmonization of maritime digital information is the process of standardizing and integrating data across various maritime systems and platforms to ensure seamless communication and interoperability. It allows for efficient exchange of information between different stakeholders in the maritime industry, such as ports, shipping companies, and coastal authorities. It aims to improve safety, efficiency, and decision-making in maritime operations and is fundamental building block for digitalization in maritime sector. Developing the S-200 series of product specifications continues to be a key focus of IALA’s technical work, which is closely aligned with the IMO’s Common Maritime Data Structure (CMDS) and IHO’s S-100 framework. The S-200 series is a suite of IALA-developed Product Specifications built on the IHO S-100 Universal Hydrographic Data Model, which serves as the foundation for the next generation of digital navigation systems, including Electronic Navigational Charts (ENCs), maritime services, and other geospatial data [9].

**Maritime Services for e-Navigation**

While the harmonization of maritime digital information through frameworks like S-100/S-200 provides a robust foundation for data modelling, the effective delivery of this information to ships requires a complementary layer of technical services. These services enable the operationalisation of maritime data into usable, real-time digital services that support navigational safety and efficiency.

IALA has taken a leading role in developing such services, with its committees actively contributing to the advancement of e-navigation. The VTS Committee, for instance, is working on digital traffic clearance and route exchange services, while the ARM Committee is progressing the development of AtoN information services. These efforts align with the broader international push, particularly at IMO and IHO, to define and implement Maritime Services as part of the e-Navigation strategy.

**Secure Digital Infrastructure**

To ensure secure and efficient communication of these services, additional digital infrastructure is required. Platforms such IALA’s Maritime Connectivity Platform (MCP) are essential in this regard, providing a trusted framework for identity management, service discovery, and secure data exchange between stakeholders. MCP enables interoperability across systems and supports the seamless integration of digital services into shipboard and shore-based operations.

Together, these developments underscore the importance of not only standardising maritime data but also ensuring its reliable and secure delivery through well-defined technical services and supporting infrastructure.

**2 IALA DIGITALIZATION VISION AND STRATEGIES**

**2.1 Proposed IALA Digitalization Vision Statement**

The maritime industry stands at a critical juncture as digitalization reshapes its landscape. Hence, there is a need to articulate a vision for digitalization where IALA can effectively communicate its long-term goals and aspirations to its members, partners and international stakeholders. The shared vision will help to foster collaboration, innovation, and knowledge-sharing within the maritime community, driving collective efforts towards achieving a safer, more efficient, and sustainable maritime transport chain [10].

IALA Digitalization Vision Statement

*IALA to play a role as an international platform that brings together national authorities, industry stakeholders, research institutions, and relevant international organizations to harness innovative digital technologies, transforming marine navigation and aids to navigation to enhance safety, efficiency, and sustainability through harmonized digitalization endeavours.*

**2.2 Proposed IALA Digitalization Strategies**

IALA is invited to consider the adoption of the following strategies for its digitalization vision:

S1 ‐ Establish IALA as the primary source of maritime digitalization standards, knowledge, and expertise in the context of IALA, empowering national authorities to provide marine Aids to Navigation in alignment with relevant international standards and recommendations.

S2 ‐ Harmonize and coordinate maritime digitalization initiatives with other international organizations to drive the advancement of digital solutions.

S3 ‐ Develop comprehensive standards, guidelines, and recommendations for the maritime community to facilitate the adoption of digital technologies that enhance safety and efficiency of vessel traffic and to protect the environment.

S4- Facilitate and coordinate the sharing of the latest digital technologies from companies, research institutions, and national authorities to broaden knowledge, expertise, and awareness of available digital solutions that have the potential to enhance navigation safety.

S5 ‐ Support capacity-building initiatives for the adoption of digital solutions.

S6 - Support the provision of trusted digital infrastructure that enables the delivery of digital maritime services and secure data exchange.

**3 DISCUSSIONS ON IALA PUBLICATIONS RELATED TO DIGITAL DEVELOPMENTS**

**3.1 General**

This section discusses potential opportunities and the timeline of relevant digital technology-related publications, while also proposing recommendations to enhance the effectiveness of IALA's efforts in shaping maritime navigation in the digital age. The discussion presents the views from the members for the IALA’s consideration. Additionally, it presents a compilation of both existing IALA publications (i.e., recommendations, guidelines, and standards) and developing publications extracted from the IALA work plan for 2023 to 2027, related to IALA digitalization developments. The list of identified digital technologies are as follows:

* Digital information (S-100)
* VDES
* MASS
* Maritime Cybersecurity
* Maritime Digital Twin
* Maritime Robotics
* Maritime Digital Communications
* Maritime Artificial Intelligence
* Maritime Digital Sensors and Internet of Things
* Maritime Services for e-Navigation
* Secure Digital Infrastructure

The respective IALA publications’ development timelines are presented in the subsequent section.

**3.2 Potential Opportunities**

The first observation from the review was the opportunity to enhance the comprehensiveness of existing IALA publications regarding emerging digital technologies. While several publications effectively cover foundational aspects such as MASS, VDES, S-100 digital information, and maritime cybersecurity, there is potential to develop comprehensive publications that provide similar guidance on other emerging digital technologies such as artificial intelligence, digital sensors, Internet of Things, satellite communications, digital twins, and maritime robotics technologies. This will help to set the baseline literacy of all IALA members and maritime industry towards the various emerging digital technology which will aid in their assessments on how these technologies would disrupt their existing operations and develop their future respective operation concepts.

It was observed that recommendations and guidelines for some digital technologies are covered more extensively over the others. This could be attributed to the different pace of the digital technology, or it could be the interests of IALA members to be focused on certain technology over the others. While this may risk certain developed technologies being overlooked and hinders the development and adoption of these technologies. This may also discourage investment in less-promoted technologies, stalling innovation in those areas within the maritime industry and resulting in missed opportunities to harness potential technologies that could enhance maritime safety and operational efficiency. Therefore, it is crucial for IALA to ensure that all digital technologies receive adequate attention to keep pace with the developments.

It was also observed that the publications on digital technologies span all four IALA committees. Some developments may require cross-committee collaboration, highlighting the need for closer and more effective communication mechanisms between committees. It is crucial for IALA to ensure coherent development in the digital publications in all committees. This can be achieved by establishing a clear IALA digitalization vision statement and digital strategies, as presented in the previous section, to foster better understanding and collaboration between committees. With unified goals and objectives, IALA can better focus its resources and work towards supporting digitalization developments for its members and the maritime industry.

To ensure that IALA continues to deliver quality digital technology publications, it must leverage its strengths by harness expertise from various national members, industry members and research institutions, while keeping a close watch on the relevant digital developments at other international organisations. Providing a platform for discussion and the exchange of ideas among stakeholders will help ensure that diverse perspectives are considered when developing these publications. In navigating the uncertainties presented by advancements in digital technologies, it is vital for IALA to continue encouraging the sharing and demonstration of new digital technologies and experiences within its committees.

A critical aspect of IALA's digitalization strategy is the recognition of external dependencies and the need for close collaboration with other international organisations. The IMO is progressing several initiatives that intersect with IALA's domains, including the development of the MASS Code, the IMO Digitalization Strategy, and the Connectivity Framework for S-100. These initiatives may reference IALA standards, recommendations, and guidelines, and conversely, IALA must assess their implications for its own work, particularly in areas of AtoNs, VTS, and the delivery of Maritime Services. In the same vein, the IHO’s ongoing development of the S-100 framework will have direct impacts towards IALA's developments of S-200 product specifications and the associated technical services. IALA must ensure alignment and interoperability across these frameworks. Furthermore, developments in the IMT and IoT space, including those led by the ITU and IEC, may influence communication technologies and infrastructure relevant to IALA's remit. To remain effective and future-ready, IALA's work programme must actively monitor, engage with, and contribute to these international efforts, ensuring that its outputs are both informed by and influential within the broader maritime digitalization ecosystem.

**3.3 Development Timeline for Digital Information (S-100) Related Publications**

**Digital Information S -100**

**Timeline**

Before 2025

2025

2026

2027

2028

2030

2029

2031

Ed2.1 Approved Jun2017

Operational

S-201 Aids to Navigation Information

S-212 VTS Digital Service

S-240 DGNSS Station Almanac

S-210 Inter-VTS Exchange Format

S-230 Application Specific Message

S-245 eLoran ASF Data

S-211 Port Call Message Format

S-246 eLoran Station Almanac

R0147 Product Specification Development and Management

G1106 Producing an IALA S100 Product

Specification

G1088 Introduction to Preparing S-100 Product Specifications

Ed2.1 Approved Jun2017

Ed1.1 Approved Dec2012

Operational

Operational

G1157 Web service Based S-100 Data Exchange

Ed2.0 Approved Dec2022

Operational

Development

Operational

Development

Operational

Development

Operational

Development

Operational

Development

Operational

Development

Operational

Development

Operational

Development

Operational

**3.3 Development Timeline for Digital Information (S-100) Related Publications (Continued)**

**Digital Information S -100**

**Timeline**

Before 2025

2025

2026

2027

2028

2030

2029

2031

Operational

Technical Service Specification for VTS Traffic Clearance

Technical Service Specifications for Route Exchange

Technical Service Specifications for Under Keel Clearance

Operational

Operational

Ed1.0 June 2024

Ed1.0 June 2025

Development

Technical Service Specifications for VTS Information

Operational

Development

Operational

Development

Gxxx Digital route exchange within VTS operations

**3.4 Development Timeline for VDES Related Publications**

**Timeline**

Before 2025

2025

2026

2027

2028

2030

2029

2031

**VHF Data Exchange System**

G1181 VDES VDL Integrity Monitoring

Operational

Ed1.0 Approved Dec2023

Operational

G1158 VDES R-mode

Ed2.0 Approved Dec 2024

Operational

Ed3.0 Approved Dec2022

G1117 VDES Overview

Operational

R1007 VDES for Shore Infrastructure

Ed2.0 Approved Jun2024

Operational

Ed1.0 Approved Jun2025

G1192 VDES Authentication

G1193 VDES Signal Measurement

Operational

Ed1.0 Approved Jun2025

Development

Operational

Gxx VDES Resource Sharing and Coordination

/Cooperation

Development

Operational

Gxx VDES System Integration into Ship and Shore Side

Gxx Retransmission of SBAS data via VDES

Development

Operational

**3.5 Development Timeline for MASS Related Publications**

**Timeline**

Before 2025

2025

2026

2027

2028

2030

2029

2031

**Maritime Autonomous Surface Ship**

Gxxx Provision of AtoN and Risk Management for autonomous vehicle/vessel operation (MASS)

Development

Operational

Gxxx Certification of MASS technical equipment, information systems and technical infrastructure

Gxxx Implications of MASS from a VTS perspective

Gxxx Risk Assessment and Certification Methods in the context of e-Navigation

Development

Operational

Operational

Development

Development

Operational

Gxxx Provision of Marine AtoN and Risk Management for autonomous vehicle/vessel operation (MASS)

Operational

Development

**3.6 Development Timeline for Maritime Cybersecurity Related Publications**

**Maritime Cybersecurity**

**Timeline**

Before 2025

2025

2026

2027

2028

2030

2029

2031

Ed1.0 Approved Dec 2022

R1024 Cybersecurity for the IALA Domain

Operational

G1182 Cybersecurity Specifics from IALA Perspective

Ed1.0 Approved Jun2024

Operational

Operational

Ed1.1 Approved Jun2021

G1161 Evaluation of Platforms for the Provision of Maritime Services

Development

Operational

Gxxx Risk Assessment and Cybersecurity

Gxxx Cybersecurity for Marine AtoN

Development

Operational

Operational

Gxxx Risk Assessment and Certification methods in the context of e-Navigation

Development

**3.7 Development Timeline for Maritime Digital Twin Related Publications**

**Maritime Digital Twin**

**Timeline**

Before 2025

2025

2026

2027

2028

2030

2029

2031

Gxxx Developments and Implementation of the Digital Fairway

Development

Operational

**3.8 Development Timeline for Maritime Robotics Related Publications**

**Maritime Robotics**

**Timeline**

Before 2025

2025

2026

2027

2028

2030

2029

2031

Development

Operational

Gxxx Use of Drones for AtoN Management

R/Gxx Use of Drones for AtoN Inspection and maintenance

Development

Operational

**3.9 Development Timeline for Digital Communications Related Publications**

**Maritime Digital Communications**

**Timeline**

Before 2025

2025

2026

2027

2028

2030

2029

2031

R/Gxxx Communications Channels to be used by Coastal Authorities for Digital Information Transfer between Ship and Shore

Gxxx Migrating Current Analogue VHF Voice

Communications to Digital VHF Voice

Communications

Operational

Ed2.2 Approved Jan2022

G1132 VTS Voice Communications and Phraseology

R1012 VTS Communications

Ed1.2 Approved Jan2022

Operational

Development

Operational

Development

Operational

Development

Operational

Development

Operational

Development

Operational

Operational

Development

R/GXXXX NAVDAT Development Shore based Infrastructure

Update R0144 and G1095 with Latest ASM Developments

Gxx Guidance on VTS Digital Communications

R/Gxx Develop documentation on (free-to-air,

Non-commercial) communications channels to be used by coastal authorities for digital information transfer between ship and shore in coastal areas

**3.10 Development Timeline for Maritime Artificial Intelligence Related Publications**

**Maritime Artificial Intelligence**

**Timeline**

Before 2025

2025

2026

2027

2028

2030

2029

2031

Ed1.0 Approved Dec2022

Operational

G1178 An Introduction to Artificial Intelligence (AI) from an IALA Perspective

**3.11 Development Timeline for Maritime Digital Sensors and IoT Related Publications**

**Maritime Digital Sensors and IoT**

**Timeline**

Before 2025

2025

2026

2027

2028

2030

2029

2031

G1179 An Introduction to the Internet of Things from an IALA Perspective

Ed1.0 Approved Dec2022

Operational

G1190 Harmonised Internet of Things (IoT) Protocol for Visual AtoN

Operational

Ed1.0 Approved Dec2022

G1008 Remote Control and Monitoring of Marine AtoN

Operational

Ed1.0 Approved June 2009

Gxx Use of Simple IoT Sensors on Physical Aids

Operational

Development

Operational

Development

Gxx Guideline on Timing and Synchronization

Gxx Guideline on Coordination of R-mode Test Beds

Operational

Development

Gxx Guideline on High Accurancy Positioning Systems

Development

Operational

**3.12 Development Timeline for Maritime Services for e-Navigation Related Publications**

**Maritime Services for e-Navigation**

**Timeline**

Before 2025

2025

2026

2027

2028

2030

2029

2031

R0148 The Need to Implement Regional e-Navigation Solutions Based on International Standards

Operational

Operational

Ed 1.1 Dec 2015

G1155 The Development of a Description of a Maritime Services in the Context of e-Navigation

Operational

Ed 1.1 Dec 2020

R1019 The Provision of Maritime Services in the Context of e-Navigation in the domain of IALA

Ed 2.0 Jun 2024

**3.13 Secure Digital Infrastructure Related Publications**

**Secure Digital Infrastructure**

**Timeline**

Before 2025

2025

2026

2027

2028

2030

2029

2031

R1023 Maritime Resource Names

Operational

Ed1.0 Approved Jun 2022

G1191Maritime Service Registry Technical Specification

Ed1.0 Approved Jun 2025

Operational

G1143 Unique Identifiers for Maritime Resources

Operational

Ed3.1 Approved Jun 2021

Operational

Ed1.1 Approved Dec 2024

G1183 The Provision of Maritime Connectivity Platform Identities

**4 Conclusion**

This discussion paper first presents the current key global trends driving maritime digitalization, which include the rapid advancement of digital technologies, shifts in end-user expectations, sustainability, a focus on safety of navigation, globalization, and cost efficiency and productivity. The paper identifies nine key digital developments relevant to both IALA and the maritime industry: digital information (S-100) technology, VDES, MASS, maritime cybersecurity, maritime digital twins, maritime robotics, maritime digital communications, maritime artificial intelligence, and maritime digital sensors and the Internet of Things. Each of these technologies is briefly described, along with its relevance and use cases in today’s maritime world.

Recognizing the importance of establishing a common digitalization vision for IALA to communicate its ambitions to its members and other international organizations, this discussion paper also proposes a digitalization vision statement for IALA along with corresponding digitalization strategies to achieve that vision. The vision may serve as a guiding principle for future initiatives, ensuring that all efforts are aligned with the overarching goals of IALA. This will further instil confidence in stakeholders regarding IALA's commitment to advancing maritime digitalization efforts.

The discussion paper presented information on the status of IALA publication developments related to the various emerging digital technologies, publication timelines, proposal of IALA digitalization vision & strategies and included views from the IALA committees. The information in this discussion paper may be useful for IALA members’ digitalization journey plannings and IALA’s development of practical digital strategies and action tasks for the digitalization works ahead of the Organisation.

Lastly, it is recognized that IALA plays a pivotal role in shaping today’s maritime digitalization and must continue to take on the responsibility of custodianship for maritime digital technology standards to help its members navigate through the disruptions and uncertainties associated with the adoption of digital technologies in their operations and strategies.

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