

The Regulatory and Standardization Landscape in the Maritime Domain

Content

Introduction.....	3
Organizations.....	5
International Maritime Organization	5
Overview.....	5
Assembly.....	5
Council	5
Maritime Safety Committee (MSC)	5
Marine Environment Protection Committee (MEPC).....	5
Sub-Committees	5
Facilitation Committee (FAL).....	6
International Hydrographic Organization	6
Overview.....	6
Committees under IHO.....	6
IALA.....	7
Aids to Navigation Requirements and Management (ARM).....	7
e-Navigation Information Services and Communications (ENAV)	8
Vessel Traffic Services (VTS)	8
CIRM	8
RTCM	9
NMEA.....	10
IEC.....	10
TC80.....	11
Key Initiatives	12
e-Navigation	12
Introduction.....	12
The Context of e-Navigation.....	12
General Thoughts	12
The Key Stakeholder.....	13
The Focus Areas of e-Navigation.....	14
The Cluster Concept Development	14
CMDS and the GI Registry - An Overview.....	15

Maritime Connectivity Platform - MCP	15
Ship Reporting	16
Overview.....	16
The actors	16
Industry Initiatives	19
Overview.....	19
SRCG - Ship Reporting Correspondence Group.....	20
IPCDMC.....	21
IPCOTF	22
Tradelens	23
Digital Container Shipping Association (DCSA).....	23

Introduction

Within the electronic industry for the maritime domain a very complex scenario of regulations, standards and recommendations are to be considered. Besides those influencing factors, a variety of industry groups with different focus areas are working to support industry products.

This document describes the conditions of products of the maritime electronic industry as it relates to regulations, standards and recommendations as well as key initiatives. It is intended to allow those involved to get an overview of those conditions and how they can be adjusted to meet changing market conditions.

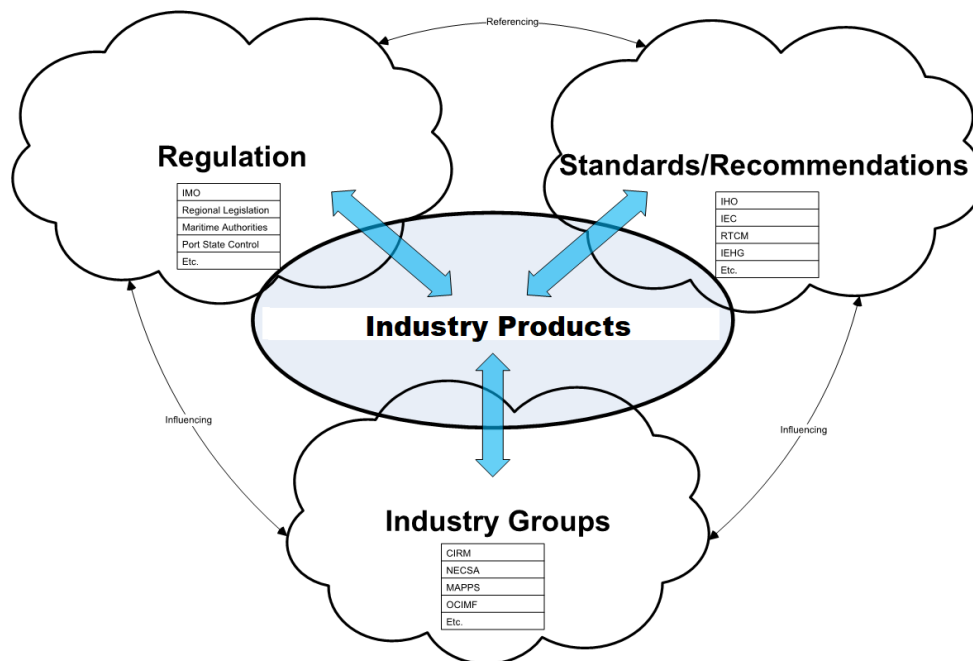


Figure 1 The Maritime Electronics Landscape

Figure 1 illustrates on a high level this landscape. Regulations on an international level are set by the International Maritime Organization. Those regulations, e.g. the SOLAS Convention, are implemented in national laws as well as regional legislation, like the European Union Marine Electronics Directive (MED). In addition to this, nation and regional legislation can set own rules in their respective area of responsibility, e.g. in countries Exclusive Economic Zone (EEZ).

The regulations are referencing international standards of international or regional standardization bodies, like IHO, IEC, RTCM or others.

Both the regulations and the referenced standards are basic requirements of any industry product which is developed to meet the needs of the maritime industry. Lately organizations like IMO and IALA are introducing guidelines or recommendations to support regulations and standards. While usually not mandatory, those guidelines or recommendations are becoming an integral part of the requirement set the industry is building their products on.

The industry groups, often IMO accredited Non-Governmental Organizations (NGOs), are supporting regulatory and standardization bodies to ensure regulations and standards are actually implementable as well as usable by the end customers. The NGOs are contributing in working groups of the respective bodies to help maintain existing and build new standards to support the changing needs of the maritime sector.

In the next section key organizations are described in more details. Please note that not all organizations noted in the Figure 1 are mentioned to keep this document at a manageable size.

One of the most prominent and game changing aspect in the current maritime domain is digitization. “Whatis” defines this as follows: “The fourth industrial revolution is the current and developing environment in which disruptive technologies and trends such as the Internet of Things (IoT), robotics, virtual reality (VR) and artificial intelligence (AI) are changing the way we live and work.”

The maritime industry was long lacking behind, but the speed of adopting to this concept has grown. In fact, in the maritime domain the term “Maritime 4.0”, sometimes also called “Shipping 4.0”. Fraunhofer, in their invitation for a conference on the topic in 2018 stated: ““Maritime 4.0” is the current buzzword in the shipbuilding industry and refers to the digitization of all processes from planning through design to maintenance.” . The Lincoln Project, in its invitation for an event in September 2019, while focusing on ship building, are even more specific on the general definition of Maritime 4.0: “The Industry 4.0 becomes Maritime 4.0 to reinforce the research focus to specific blue challenges, to develop innovative digitally connected vessels concepts, to improve the market competitiveness, overall of SMEs, to plan the appropriate skills developments and last, but not least to include the environmental sustainability of vessels and shipbuilding.”

When looking more into this topic, it is important to differentiate between different aspects of the whole concept. There are two different levels of Maritime 4.0 to be understood: “Digitalization” and “Digitization”. Gardner defines those two levels as follows:

“Digitalization is “the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business” whereas “Digitization is the process of changing from analog to digital form.”

While quite a few information in the maritime sector are available in digital form for some time, the availability of data for analysis and further digital use according to the digitalization are very limited. The IHO had an very early start on this with their S-57 Electronic Nautical Charts (ENCs) in ECDIS. This organization also realized very early that the concept needs to be enhanced and as such started the S-100 initiative for full integration of various hydrographic information. This was a leading step towards Maritime 4.0. The IMO picked the trend up as well and started the e-Navigation Initiative. Besides adopting an e-Navigation “Strategic Implementation Plan (SIP), the IMO agreed to use the IHO GI Registry, home of the IHO S-100 series of standards, as the basis for IMO’s Common Maritime Data Structure (CMDS). This structure is now hosting various standards of different organizations and enable data sharing and interoperability of different data sets.

Besides the work on ship centric Maritime 4.0 aspects, the shore has also grown up to this concept. IALA for VTS work, shipping lines for their fleet operation center, collaborations like the Digital Container Shipping Alliance (DCSA) and organizations like the “International PortCDM Council” (IPCDMC) have focused their efforts to develop various aspects of Maritime 4.0 both on shore as well as in collaboration with ships and hinterlandoperations.

This document will provide an overview of the current situation and provides a repository of the most important initiatives to date. The author would appreciate any comments as well as the submission of additional information to improve this repository.

Organizations

International Maritime Organization

Overview

IMO – the International Maritime Organization – is the United Nations specialized agency with responsibility for the safety and security of shipping and the prevention of marine pollution by ships.

The IMO is tasked by the United Nations to develop international maritime regulations, the law of the sea. IMO is focusing on the ship side of the equation and their relationship with the shore side. An important concept, under development by IMO, is e-Navigation. It is intended to increase safety and efficiency of sea traffic by utilizing the communication and data exchange between ship and shore, shore and ship, ship and ship and shore and shore. A specific section below is providing further information on this important IMO concept.

The decision and rule making process of IMO is very detailed defined. The respective rules are establishing the responsibilities and the activities which can be executed by member states, observer organizations (NGOs, IGOs), the IMO Office, the committees, working groups and other groups within the IMO domain.

Assembly

The Assembly is the highest body of IMO. A main task is to define the work program for IMO and the election of the Council members. It is approving the Secretary General, elected by the Council.

Council

Is supervising the IMO office. It works on the directives of the Assembly and elects the Secretary General.

Maritime Safety Committee (MSC)

The MSC is the highest technical body of the Organization. MSC has to “consider any matter within the scope of the Organization concerned with aids to navigation, construction and equipment of vessels, manning from a safety standpoint, rules for the prevention of collisions, handling of dangerous cargoes, maritime safety procedures and requirements, hydrographic information, log-books and navigational records, marine casualty investigations, salvage and rescue and any other matters directly affecting maritime safety”.

The expanded MSC adopts amendments to conventions such as SOLAS and includes all Member States as well as those countries which are Party to conventions such as SOLAS even if they are not IMO Member States.

Marine Environment Protection Committee (MEPC)

The MEPC works on regulations and guidelines on prevention and control of pollution from ships.

Sub-Committees

The two main Committees of IMO the MSC and the MEPC, are executing their work through a series of sub-committees, which are asked by the committees to develop documents, which in turn can be agreed to by the committees

- Sub-Committee on Human Element, Training and Watchkeeping (HTW);
- Sub-Committee on Implementation of IMO Instruments (III);
- Sub-Committee on Navigation, Communications and Search and Rescue (NCSR);
- Sub-Committee on Pollution Prevention and Response (PPR);
- Sub-Committee on Ship Design and Construction (SDC);
- Sub-Committee on Ship Systems and Equipment (SSE); and
- Sub-Committee on Carriage of Cargoes and Containers (CCC).

Facilitation Committee (FAL)

The Facilitation Committee consists of all the Member States of the Organization and deals with IMO's work in eliminating unnecessary formalities and "red tape" in international shipping by implementing all aspects of the Convention on Facilitation of International Maritime Traffic 1965 and any matter within the scope of the Organization concerned with the facilitation of international maritime traffic. In particular in recent years the Committee's work, in accordance with the wishes of the Assembly, has been to ensure that the right balance is struck between maritime security and the facilitation of international maritime trade.

FAL is taken on the task to coordinate the definitions and regulations associated with mandatory ship reporting, the relevant "Maritime Services" as defined in by IMO in respect of e-Navigation, as well as the development of the Maritime Single Window system (MSW).

International Hydrographic Organization

Overview

IHO is led by a secretary General and two elected directors. The staff at the office in Monaco is gathered from member national hydrographic offices. The Secretariat of the IHO, coordinates and promotes the IHO's work programs and provides advice and assistance to Member States and others.

Committees under IHO

Hydrographic Services and Standards Committee (HSSC)

Objectives are stated as to promote and coordinate the development of standards, specifications and guidelines for official products and services to meet the requirements of mariners and other users of hydrographic information. Membership of HSSC and its subsidiary Working Groups is open to representatives of IHO Member States. Representatives of Non-Governmental International Organizations (NGIO's) accredited with the IHO and other organizations/institutions that have been formally recognized by the IHO may participate as observers where matters of special interest to those organizations are being considered. Expert Contributors, primarily from industry, participate in the work of HSSC Working Groups on an individual basis by invitation.

HSSC oversees S-100 Working Group (S-100WG), Data Protection Scheme Working Group (DPSWG), ENC Standards Maintenance Working Group (ENCWG), Nautical Information Provision Working Group (NIPWG), Nautical Cartography Working Group (NCWG), Data Quality Working Group (DQWG), Tides, Water level and Currents Working Group (TWCWG), Hydrographic Dictionary Working Group (HDWG) and Advisory Board on Law Of the Sea (ABLOS). Working groups has recently been reorganized and therefore some time is expected to pass before the work of the various groups settles in and gets progressed.

S-100 Working Group (S-100WG)

The group maintains S-100 data dictionary and is developing S-101 and other S-1xx standards in development, related to navigational safety.

ENC Standards and Maintenance Working Group

Maintains the IHO standards that relate to ENC and ECDIS (S-52, S-57, S-58, S-62, S-64 and S-65). It is maintaining the existing standards and those created by the S-100 WG once those standards are set into force.

Nautical Information Provision Working Group (NIPWG)

Developing digital nautical publication (NPubs) standards for use in ECDIS. Working on the domain model and creating S1xx series of standards for NPubs.

Data Quality Working Group (DQWG)

Working group develops methods for expressing quality of data for the various IHO product specifications under development. It currently focuses on bathymetric quality, but also looks into data quality aspects for S-101 (ENCs) and other hydrographic products.

Inter-Regional Coordination Committee (IRCC)

The International Hydrographic Organization has established the Inter Regional Coordination Committee (IRCC) to promote and coordinate those activities that might benefit from a regional approach, such as Capacity Building, Training and Education; Promulgation of Radio Navigational Warnings; General Bathymetry and Ocean Mapping and implementation of policies related to the World-wide Electronic Navigational Chart Database (WEND), all matters identified as strategic objectives of the IHO.

IRCC oversees Regional Hydrographic Commissions (RHC), Hydrographic Commission on Antarctica (HCA), World-Wide Navigational Warning Service Sub-Committee (WWNWS), Capacity Building Sub-Committee (CBSC), World-wide ENC Database Working Group (WENDWG) and IHO – Data Center for Digital Bathymetry (DCDB).

Finance Committee

Committee for the financing of the IHO and IHB. Not open to industry.

IALA

The International Association of Marine Aids to Navigation and Lighthouse Authorities is a nonprofit, international technical association and accredited Observer at IMO. Members are marine aids to navigation authorities, manufacturers, consultants, and, scientific and training institutes.

The work of the committees is aimed at developing common best practice standards through publication of IALA Recommendations and Guidelines.

IALA contributes to a reduction of marine accidents, increased safety of life and property at sea, as well as the protection of the marine environment.

Aids to Navigation Requirements and Management (ARM)

The Committee work is organized according to five IALA Standards, as follows.

- Standard 1010 Aton Planning and Service requirements
 - Obligations and Regulatory Compliance
 - Risk Management
 - Quality Management
 - AtoN Planning
 - Virtual Marking
- Standard 1020 Aton Design and Delivery
 - Visual Signalling
 - Design Implementation and maintenance
 - Standard 1050 Training and Certification
 - Work domains:
 - Training and certification
 - Capacity building
- Standard 1060 Digital Communication Technologies
 - Wide/Medium bandwidth systems (AIS& VDES)
 - Capacity Building

- Standard 1070 Information Services
 - Data models and data encoding
 - Data exchange systems (traffic Information)
 - Terminology, symbology and portrayal

The AtoN Requirements and Management Committee (ARM) is structured into three Working Groups to deliver the 2018 – 2022 work plan. They are:

- WG1 – Navigational Requirements
- WG2 – Information Services and Portrayal
- WG3 – Risk management;

e-Navigation Information Services and Communications (ENAV)

IALA has created an e-Navigation committee, which develops guidance for IMO e-Navigation correspondence group to define the concept of e-Navigation (e-NAV). Jeppesen participates in the work of the e-Navigation committee with the aim of steering e-Navigation development and promote Jeppesen as a leading industry partner and trend setter, meanwhile investigating new business opportunities. Work of the e-Navigation committee is divided into three technical domains:

- Technical Domain 1 – Digital Communications Technologies
 - Wide/Medium bandwidth systems (AIS & VDES)
 - Narrow bandwidth systems (NAVDAT, MF beacons, etc.)
 - Harmonised maritime connectivity
- Technical Domain 2 – Information Services
 - Data models and data encoding (IVEF, S-100, S-200, ASM, etc.)
 - Vessel tracking and data exchange systems
 - e-navigation user requirements
- Technical Domain 3 – Training and Certification
 - Work domains:
 - Training and Certification

Vessel Traffic Services (VTS)

The VTS Committee produces a range of Recommendations, Guidelines and Model Courses related to the IALA Standards. A list of IALA publications related to VTS can be downloaded [here](#).

The work of the VTS Committee is structured into three working groups (WG) to deliver the 2018 – 2022 work plan. They are:

- WG1 – Operations
- WG2 – Technology
- WG3 – VTS Training

VTS Committee meetings are normally held at IALA HQ in Paris and the Committee meets normally twice per year.

CIRM

The Comité International Radio-Maritime (CIRM) is the principal international association for marine electronics companies.

CIRM...

- promotes the application of electronic technology to the safety of life and efficient conduct of vessels at sea.
- strives to foster relations between all organisations concerned with electronic aids to marine navigation, communications and information systems.
- represents the interests of the marine electronics industry, internationally;

- co-ordinate. the views and actions of members in resolving regulatory issues and in the promotion of marine electronics;
- provides technical and industrial advice to the international regulatory organisations;
- provides a specialist information service for members;
- provides a private forum for members to exchange information and business opportunity;
- enables our members to participate in the development of international regulations and standards affecting their products and services.

The main body of CIRM is its Annual General Meeting (AGM), a gathering of members to decide on the organization, work items and other topics of relevant. The AGM is, since a few years, associate with the CIRM Annual Conference, a highly technical conference, where up to 150 participants from CIRM members, sister organizations and invited experts join for information sharing and to develop suggestions for CIRM in specific work groups.

The CIRM office consists out of the Secretary General (SG), the Chief Technology Officer (CTO) and a second Technical Officer (TO). Guidance and directions are given by the Board of Directors (BoD), which are elected by the AGM and are headed up by the President and two Vice Presidents, also elected by the AGM.

The BoD has created a “Technical Steering Committee”, which defines the technical work items and work guidelines for the CTO and TO, as well as a “Strategy Committee”, which defines the long term strategy of CIRM.

The technical work is mainly done through working groups (WG), which usually work on as correspondence groups. Following WG are established by the TSC:

- CIRM/BIMCO Joint Working Group on Software Maintenance
- Cyber Risk Working Group
- ECDIS Working Group
- e-Navigation Working Group
- Radiocommunications Working Group
- Radar Working Group
- S-Mode Working Group
- Service Working Group
- Type Approval Working Group
- VDR Working Group

RTCM

The Radio Technical Commission for Maritime Services (RTCM) is The Radio Technical Commission for Maritime Services (RTCM) is an international non-profit scientific, professional and educational organization. RTCM members are organizations (note individuals) that are both non-government and government. Although started in 1947 as a U.S. government advisory committee, RTCM is now an independent organization supported by its members from all over the world. Nonetheless main focus is on the US, where their standards are worked on in cooperation with US Coast Guard (USCG).

The RTCM Special Committees provide a forum to develop technical standards and recommendations in RTCMs area of concern. The output documents and reports prepared by these Committees are usually published as RTCM Standards. Current Special Committees include:

- Special Committee (SC) 101 on Digital Selective Calling (DSC)
- Special Committee (SC) 104 on Differential Global Navigation Satellite Systems (DGNSS)
- Special Committee (SC) 109 on Electronic Charting Technology
- Special Committee (SC) 110 on Emergency Beacons (EPIRBs and PLBs)
- Special Committee (SC) 112 on Ship Radar
- Special Committee (SC) 117 on Maritime VHF Interference

- Special Committee (SC) 119 on Maritime Survivor Locator Devices
- Special Committee (SC) 121 on Automatic Identification Systems (AIS) and Digital Messaging
- Special Committee (SC) 123 on Digital Message Services over Maritime Frequencies
- Special Committee (SC) 127 on Enhanced Loran (eLoran)
- Special Committee (SC) 128 on Satellite Emergency Notification Devices (SEND)
- Special Committee (SC) 129 on Portrayal of Navigation-Related Information on Shipboard Displays
- Special Committee (SC) 130 on Electro-Optical Imaging Systems
- Special Committee (SC) 131 on Multi-system Shipborne Navigation Receivers
- Special Committee (SC) 132 on Electronic Visual Distress Signaling Devices
- Special Committee (SC) 133 on Data Exchange for Navigation-Related Applications for Mobile Devices

NMEA

The National Marine Electronics Association (NMEA) is a US organization, but due to the influence of the US market their standards are often utilized in marine electronics products.

The mission of the National Marine Electronics Association is to be a worldwide, self-sustaining organization committed to enhancing the technology and safety of electronics used in marine applications and the profitability of its members, by:

- providing effective leadership to its members
- facilitating communications between members and various constituent groups
- encouraging members to establish quality processes
- furthering the education of its members and various constituent groups
- influencing the applicable legislative and regulatory processes

The standards developed and maintained by RTCM are:

- NMEA2000® Standard
This standard contains the requirements of a serial data communications network to inter-connect marine electronic equipment on vessels. The standard describes a low-cost moderate capacity bi-directional, multi-transmitter/multi-receiver instrument network to interconnect marine electronic devices.
- NMEA 0183 Standard
This Interface Standard defines electrical signal requirements, data transmission protocol and time, and specific sentence formats for a 4800-baud serial data bus.
- Installation Standards
The NMEA 0400 Installation Standards clarify and define competent installation practices applicable to vessels from 20' to 150' and up to 300 gross tons. These standards are published to aid electronics installers, technicians, electricians, surveyors, owners and/or others who may have occasion to install, service or modify the installation of electronics, electrical systems or other associated peripherals.
- Future Standard: OneNet®
NMEA is currently working on this new network interface standard based upon the IEEE 802.3 Ethernet Standard to complement and interoperate with an NMEA 2000 Network. The data rate is 100 Mbits to 10 Gbits.

IEC

The International Electrotechnical Commission (IEC) is the world's leading organization that prepares and publishes International Standards for all electrical, electronic and related technologies. The IEC is one of three global sister organizations (IEC, ISO, ITU) that develop International Standards for the world.

When appropriate, IEC cooperates with ISO (International Organization for Standardization) or ITU (International Telecommunication Union) to ensure that International Standards fit together seamlessly and complement each other. Joint committees ensure that International Standards combine all relevant knowledge of experts working in related areas.

Some 174 TCs (Technical Committees) and SCs (Subcommittees), and about 700 Project Teams (PT) / Maintenance Teams (MT) carry out the standards work of the IEC. These working groups are composed of

people from all around the world who are experts in electrotechnology. The great majority of them come from industry, while others from commerce, government, test laboratories, research laboratories, academia and consumer groups also contribute to the work. A list of TC/SC and their definitions can be found at http://www.iec.ch/dyn/www/f?p=103:6:12929102252180:::FSP_DISB,FSP_LANG_ID:NO,25

TC80

For Maritime Electronics of most important is TC80. It is tasked to prepare standards for maritime navigation and radiocommunication equipment and systems making use of electrotechnical, electronic, electroacoustic, electro-optical and data processing techniques. Due to CIRM's relevance in the field and its collaboration with IEC, especially in respect of maritime electronics test standards, CIRM is providing the Chair of TC80 and is paying for the Secretary. The work program can be found at http://www.iec.ch/dyn/www/f?p=103:23:12929102252180:::FSP_ORG_ID,FSP_LANG_ID:1271,25

Key Initiatives

e-Navigation

Introduction

The e-Navigation concept has been introduced by IMO and worked on by various stakeholders during the last few years.

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

With this the e-Navigation initiative has been the nucleus of starting digitization in shipping as it relates to regulations and international requirements.

The Context of e-Navigation

IMO is the originator of the e-Navigation idea. It was understood that harmonization of information and the common understanding between players on ships and on shore is essential to improve safety and efficiency of sea trade. This core mission of IMO will not be sufficiently covered in the rapid changing technological focused world by current tools like SOLAS. New tools need to be developed to ensure worldwide trade through regulations and enforcement of standards but allow the necessary freedom to introduce quickly safety and efficiency relevant innovation in the maritime world.

At the same time safety of navigation gets more in the focus of the shipping industry. In addition, the growing economic pressure forces shipping to look at ways to increase efficiency in multiple ways:

- Shipping industry needs to reduce costs to gain back sustainable profitability
- Ports needs to increase efficiency of ship handling to optimize the limited assets available
- Coastal states hinterland and multimodal transport capabilities are maxed out and limited financial and natural resources forces authorities to increase efficiency of the complete supply chain
- Environmental concerns are requesting reduction in ecological damage, be it through CO₂, SO_x or other emissions, pollution by ship casualties or oil spills.

e-Navigation is intended to support those needs for the shipping industry with consolidated efforts through modern technology and updated rules and regulations framework.

General Thoughts

IMO has tasked the NAV subcommittee to work on e-Navigation. Within NAV the e-Navigation Subcommittee has developed various documents and together with other stakeholders, like IALA, key decisions have been made:

- The IHO GI Registry (S-100 Concept) has been agreed as common maritime data structure (CMDS)
- The IMO has agreed to establish an IHO-IMO coordination group
- Multiple Test Beds have been conducted, are in process or are planned to validate different aspects of e-Navigation
- A “Strategic Implementation Plan” has been approved by IMO
- Maritime Services have been identified and documented

The Figure 1 is trying to illustrate different aspects of engagements in development or envisioned. It highlights the idea of data exchange between shore and ship and vice versa. This doesn't limit the view to just ship-ship or shore-shore exchange but simply lists certain key aspects of interest in a broader view.

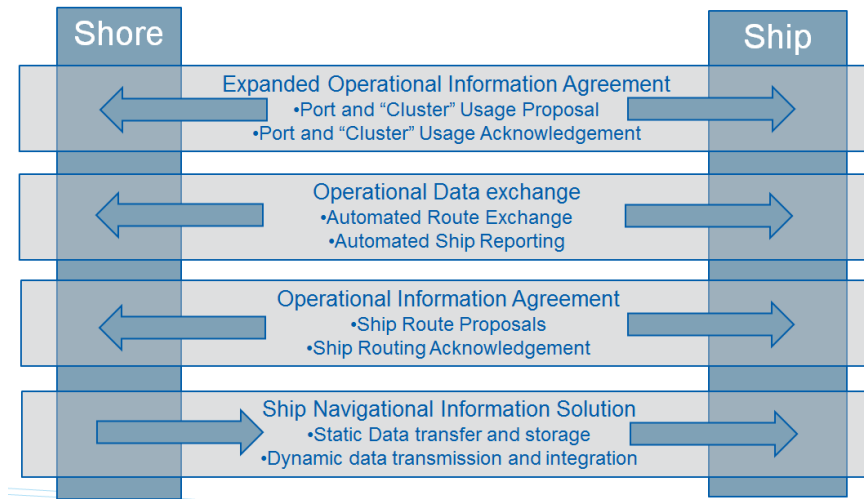


Figure 2 - Data exchange between shore and ship

This topics or solutions for issues are creating another dilemma, which e-Navigation needs to solve:

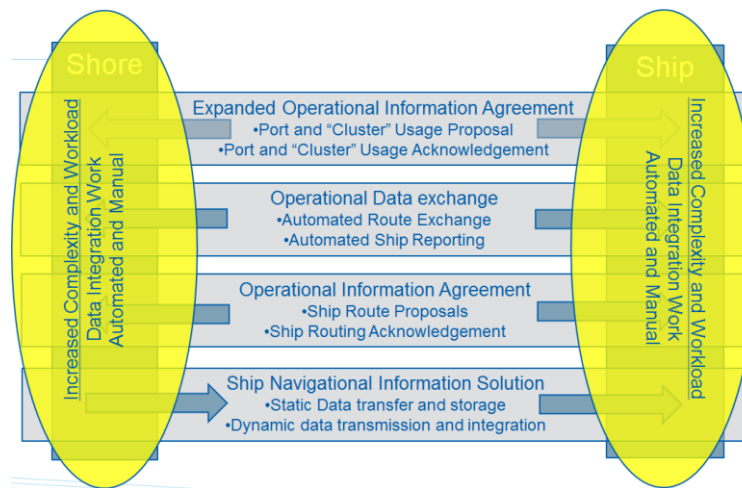


Figure 3 - The data exchange complexity

The Key Stakeholder



Figure 4 - Key Stakeholders in e-Navigation

As said multiple players are involved. Some of the key players have been involved through their associations in working on e-Navigation already. This includes IALA, ICS, CIRM, BIMCO, Intertanko, CLIA and others. Naturally the different stakeholders have different interests and looking at different angles towards e-Navigation. They also see different solutions or are primarily interested in a certain set of topics within their area of concern.

It is important for the success of e-Navigation that the different stakeholders pull together to develop solutions to serve all needs to be successful in archiving the intended results.

The Focus Areas of e-Navigation

Following focus areas can be identified:

Ship Navigational Safety Focus Area

Navigational safety and efficiency is the main concern. The ship is in the center and solutions are looking to provide the navigator with necessary tools to increase his ability to navigate the ship safely and efficiently. The coordination from shore is limited to assist the navigator. Shore side resource constrains are not necessarily addressed and key is the transmission, consolidation and harmonization of data necessary for navigational decision making on the bridge.

While the situation on non-SOLAS ships is understood as an influencing factor, they are usually not really included in the concepts developed.

Straits and Port Utilization Focus Area

Another focus area looks into the asset utilization at straits and ports. In order to optimize the limited resources in those two areas, the throughput of ships needs to be optimized. The sea traffic through condensed areas like straits needs to be as efficient as possible to allow maximum economic growth for the effected region. The port resources, like loading/offloading facilities, bunker access, human resources, etc, as they are limited, need to be utilized optimal, i.e. reduced load and unload times, reduction of idle time of port assets and others. It is also important to reduce the risk of disruptions. As accidents would have major negative effects, they need to be avoided as much as possible.

Voyage Optimization Focus Area

Some stakeholders are mainly interested in the voyage as such. The shore side constrains are only of interest in as much they influence the successful and effective execution of the intended voyage. The focus here is on the berth to berth handling of sea traffic. This sometimes gets expanded to fleets.

Coastal State Responsibility Focus Area

For other stakeholders on shore the responsibilities of coastal state are in the center of their interest on e-Navigation. With the growing sea trade volume coastal administrations are under large pressure to ensure they execute their responsibility correctly and efficiently. Port State Control Inspections, Customs clearance, immigration activities, security of coastal borders and their installations are important topics which need to be addressed with shrinking budgets, while at the same time traffic volume increases.

In this area a better understanding of incoming traffic, exact times and volume are essential aspects. Automatic ship reporting, precise ETA or "Single Window" concepts are part of this equation.

The Cluster Concept Development

As different focus areas can be seen throughout the industry another development is visible:

In order to solve regional concerns and address situation of specific interest, countries in certain areas are forming alliances to develop solutions for local needs. These "clusters" are not only working together to prepare the infrastructure to deal with specific conditions in the cluster area, they also create coastal regulations or guidelines to increase the success of the common initiatives.

One currently visible indications of the cluster concept are the different e-Navigation test beds in various regions of the world as well as regional initiatives in this arena.

Figure 4 illustrates important e-Nav clusters with currently active e-Nav projects.

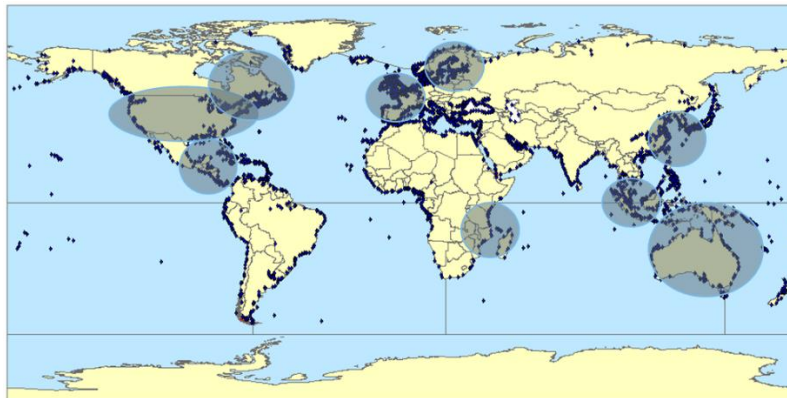


Figure 5 - e-Navigation Clusters

CMDS and the GI Registry - An Overview

The Common Maritime Data Structure (CMDS) is the desired data infrastructure supporting the IMO e-Nav initiative. It is agreed by NCSR and MSC through the introduction of this concept in the e-Navigation Strategic Implementation Plan (SIP). The specifics on CMDS have been developed by the IALA e-Nav Committee and documented in the "Overarching Architecture for e-Navigation" (The e-Navigation Architecture - the initial Shore-based Perspective).

The CMDS is building on the IHO GI Registry, often called the S-100 concept. The IHO has developed the infrastructure over the last few years and is now operational with a specific expert in the IHO secretariat. Within the GI Registry there are various domains, managed by the different domain owners. All under the governance of IHO. The concept is based on ISO 191xx set of Geospatial Standards to enable cooperation with those external standards

The structure leads to potential overlaps, which are intended to be solved through a governance process.

The IHO has created a document on how to govern the GI Registry in their S-99 Standard (Operational Procedures for the Organization and Management of the S-100 Geospatial Information Registry). But this document centers around the Hydrographic domain, so it will need extensions to support the full CMDS development.

A good example of how currently a potential conflict is resolved is on the handling of MSI (Maritime Safety Information), where both IHO and IALA is working on. The discussion on this topic concluded in a proposal for IHO to develop an S-124 Product Specification and for IALA to build their product specification (S-20x) to reference and utilize S-124..

Maritime Connectivity Platform - MCP

During the EU funded Monalisa projects and the STM Validation Project the concept of a Maritime Connectivity Platform was developed, and a test installation established to validate the concept. Besides the EU partners, with the lead of Sweden, also the Republic of Korea was interested in the concept and potential establishment.

As of February 2019, a test installation with limited ability is available and a "Maritime Connectivity Platform Consortium" (MCC) has been established. This recent development increased the credibility

of the MCP concept. With MCC an organization has been established aiming to handle the governance of MCP. This is a substantial step forward but isn't yet guarantying that a full productive instance of MCP will be established.

Three questions for MCP needs to be answered before it can be stated with confidence that MCP is the most likely solution to solve the issue of authentication, service discovery and secure connectivity:

1. Who defines and governs MCP?
2. Who will run the physical instance, or instances, of MCP?
3. What is the business concept to finance MCP?

Question one has been solved with the establishment of MCC. The other questions still need to be answered. As such my opinion is that there is a growing likelihood that MCP will be established as the connectivity platform of choice, but the answer of the open questions 2 and 3 will show the real chances of success.

It is unlikely that MCP will be the ONLY choice, as alternatives will be available, but it may develop in the most widely used system. It also seems to be likely that additional commercial services may be developed – in fact at least one is already established – which provide functions and services above and beyond those covered by MCP. Cloud based storage of data sets for data exchange beyond per-to-per or connectivity with those not established on MCP are two of those options.

Ship Reporting

Overview

Ship reporting is a very complex scenario. Three main requirements must be considered by anyone involved in ship reporting.

1. IMO FAL has defined the so called "FAL Forms" which are statutory reports a ship needs to send it.
2. Coastal administrations may require additional reports
3. Ports may have even more requirements on what a ship needs to send in on reports.

The actors

IMO:

FAL is working on digital forms and reporting requirements. They have defined requirements for electronic reporting, which may be as simple as unstructured pdfs. To further enhance the concept, maturing towards Maritime 4.0, they have created a correspondence group, headed by Jon Leon Ervik, Norwegian Coastal Administration. Besides others the CG is tasked to define requirements for MS8 "Ship Reporting".

IMO has also defined that coastal administrations need to develop and implement their reporting requirements in a "National Single Window" (NSW). High level requirements are set, and the IMO member states are requested to develop their NSW environments.

IMO FAL has established an Expert Group on Data Harmonization (EGDH) and has invited IALA (and thereby it's the Ship Reporting Task Group) to contribute to its work. The group works on enhancements to the IMO Reference Data Model.

While the main focus of FAL to date is on statutory reports - harmonized by IMO FAL in their report templates - the work done in other sections, like NCSR on CMD5 and e-Navigation, or the FAL Correspondence Group on Ship Reporting, officially called “ correspondence group to review the draft MSC circular on initial descriptions of maritime services in the context of e-navigation”, are moving above and beyond the initial FAL report templates.

It is of essence that the different definitions are harmonized. If the different groups move in different, not compatible directions by IMO RDM, IMO CMD5 and others, the IMO will not archive the desired outcome. Maritime 4.0 need alignment to be able to gain full benefits of data compatibility. But there shouldn't be a conflict, if the groups are aligning their work. The suggested details in the IMO Reference Data Model (RDM) are defining the specific terms. CMD5, for example in S-211 or S-421, are complimentary data models, which are going to a deeper technical definition level, like XML schemata and others. The definitions in the RDM can be referenced in S-211 and other CMD5 standards as well as the other way around. It is essential that these cross references take place and the current descriptions in the RDM are referencing the CMD5 data sets. Currently S-211 isn't noted, S-421 isn't nor is the MRN concept referenced. With that there is a risk that the IMO RDM moves away from the work of IMO Maritime Service definitions (e.g. MS8), developed in parallel at IMO FAL. But it is expected that the EGDH is addressing this concern.

IALA

To support IMO's e-Navigation Initiative, IALA is in the process of defining several e-Navigation Services, including Maritime Service Portfolio (MSP) #8 “Vessel Shore Reporting Service”. Specifically, the IALA ENAV Committee's Harmonization and ENAV Services Workgroups have researched ship reporting requirements and are in the process of drafting a guideline on the Vessel Shore Reporting Service. I am participating in those groups as far as I can and get funding to travel there.

The IALA's ARM Committee Work Group 2 established a Ship Reporting Task Group during IALA's ARM8 Committee meeting. The Chair of WG2 (Dave Lewald, USCG) asked Fred Pot of BM Bergmann Marine to lead the Task Group. The group is tasked to develop a guideline on Maritime Single Window. The expected outputs are:

- Ship Reporting Webservices Portal specifications and governance;
- Guideline on ship reporting web services;
- Minimum cyber security requirements for transmission of and access to ship report information;
- Guidance on migration from current ship reporting system to a harmonized and secure electronic Maritime Single Window system;

The Task Group met face-to-face during the IALA Committee ARM10 Meeting in Saint Germain en Laye, France, October 14-18. The Task Group had an intersessional call on November 19th and will have the next one on January 21st, 2020.

The members of this task group currently include:

- Minsu Jeon (IALA)
- Dave Lewald (USCG/IALA Vice Chair IALA ARM Committee)
- Jens Schröder-Fürstenberg (Germany/IHO)
- Xiujun Fu (Nanyang Technological University, Singapore)

- An Kwang (MOKPO National Maritime University, S Korea)
- Soyeong Lee (MOKPO National Maritime University, S Korea)
- Yung Yu Ho (Korea Maritime and Ocean University, College of Engineering)
- Jarle Hauge (NCA, IMO FAL, Sesame II, STM BALT SAFE)
- Jon Leon Ervik (NCA, IMO FAL)
- Michael Strandberg (DMA)

The IALA Ship Reporting Task Group is making good progress in building a consensus that web services should be used for the exchange of digital information between ships and shore-based stake holders. IMO FAL's Expert Group on Data Harmonization (EGDH) has invited IALA to contribute to its work on digital ship reporting. For this reason, it is expected that it is likely that IMO FAL will accept IALA's advice to move to a web service-based system.

It will likely take emerging countries a long time to migrate to a web service based ship reporting system so an intermediate system will be required, mostly because ship owners/operators are not likely to invest in ship-board tools that address only web service based ship reporting systems.

EU

In the EU an initiative for EU Single Window is underway and a first directive has been established. This is above and beyond maritime but includes this specific domain.

The EU Single Window environment for Customs initiative was originally part of the e-Customs Decision (Decision No 70/2008/EC) of the European Parliament and of the Council of 15 January 2008 on a paperless environment for customs and trade).

The EU Single Window environment for Customs initiative is the main project remaining under the e-Customs Decision as most of the projects which were originally covered by the e-Customs Decision are now managed under the Union Customs Code. The system is operational with nine Member States in production in 2018 (Czech Republic, Ireland, Slovenia, Latvia, Bulgaria, Poland, Cyprus, Estonia and Portugal,). Successful conformance tests have been performed by Lithuania and other Member States have expressed interest to participate in the successor of the project (called EU Customs SW – CERTEX) soon (e.g. France, Belgium, and Luxembourg).

More specifically, the EU focuses on the Maritime sector as they describe it on their publications: *In order to ensure competitiveness and efficiency of European maritime transport sector it is necessary to reduce the administrative burden on ships and to facilitate the use of digital information with the aim of improving the efficiency, attractiveness and environmental sustainability of the maritime transport and contribute to the integration of the sector to the digital multimodal logistic chain.*¹

The EU started an initiative with following goals:

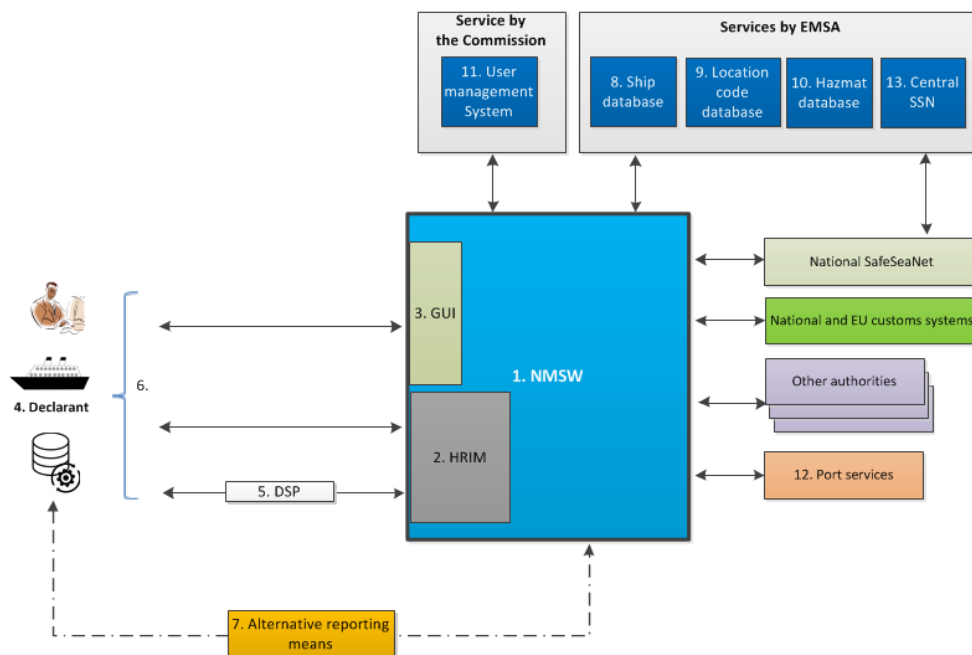
- Fully harmonized interfaces available to ship operators to provide information in the same way and format across the EU.

¹ https://ec.europa.eu/transport/modes/maritime/digital-services/e-maritime_en

- A standardized maximum data set including the information necessary for the management of port and port terminals in order to ensure true submit-only-once. Any relevant data already provided to authorities should be made available and not be required again.

To support that the EU has developed a proposal for a “European Maritime Single Window environment”.

The following figure depicts the envisioned architectural composition²:



The “Proposal for a Regulation of the European Parliament and of the Council establishing a European Maritime Single Window environment and repealing Directive 2010/65/EU” is planned to be executed in the upcoming years.

Industry Initiatives

Overview

Besides the more governmental driven initiatives, various industry activities are trying to help the shipping to migrate towards Maritime 4.0. This is driven by the need of the maritime domain to react on the demands of the other transport sectors within a multi modal supply chain. As Industry 4.0 is more and more relying on Just-In-Time logistics and extensive data sharing of all actors in the supply chain, the full advantage of Big Data Analysis is only be archivable if the shipping industry is becoming much more digitally transparent and as such is implementing digitization in all aspects. But it also requires operational changes to cater for data sharing and common situational awareness.

One of the issues with industry initiatives driven by individual actors is that some try to promote proprietary solutions, either to gain specific market advantage for only those participating, or to position specific products, like specific Port Community Systems (PCS), in a way that the users are “on the hook”. An additional downside with some initiatives, which are business driven by the originators, is that they just cover specific needs, e.g. for a specific ship line and their most important

² Council of the European Union, WK 12461/2018 INIT, 10/2018

ports. If so, they don't cater for an open and global system, guarantying interoperability. But this would be necessary to support Maritime 4.0 given that shipping is per definition global.

SRCG - Ship Reporting Correspondence Group

The Marine Fields partner BM Bergmann Marine has established this industry group with the following charter:

Establish an environment that enables industry to offer effective and affordable products and services that address ship reporting needs both for bridge teams and for shore-based stakeholders by establishing:

- A comprehensive and publicly accessible on-line Ship Report Registry
- A common Ship Report Data Model (S-2XX Product Specification)
- Encourage the establishment of a common cyber security infrastructure environment that allows:
 - Shore-based authorities to authenticate publishers of ship reports
 - Ship owners/operators to control access to ship reports

Following members are in that group:

- Airbus
- Chartworld
- Fulcrum-Maritime
- Kongsberg
- NAVTOR
- Pole Star
- Raytheon Anschütz
- Telko
- Wärtsilä
- Inmarsat (Observer)

Besides this industrial members CIRM is a non-industrial member and supports the activity.

The SRCG is meeting per correspondence and is actively cooperating with respective IALA and FAL working groups. While the members look for a long-term solution through IMO and IALA definitions, they also see a need to establish an intermediary ship reporting system that will allow shore-based stakeholders to continue to require PDF ship reports while transitioning to a fully digital ship reporting system that is based on the exchange of data elements and their values via web services.

Such a system could use a 4th generation report generator (i.e. SAP Crystal Reports or the Open Source Jasper) to generate PDF forms from database queries.

The current defined goals are:

“Establish an environment that enables industry to offer effective and affordable products and services that address ship reporting needs both for bridge teams and for shore-based stakeholders by establishing:

- A comprehensive and publicly accessible on-line Ship Report Registry

- A common Ship Report Data Model (S-2XX Product Specification)
- Encourage the establishment of a common cyber security infrastructure environment that allows:
 - Shore-based authorities to authenticate publishers of ship reports
 - Ship owners/operators to control access to ship reports³

IPCDMC

Highly inspired by the airport CDM council, the International PortCDM Council (IPCDMC) with its global reach, aims for establishing the necessary overarching guidelines, processes and procedures to make PortCDM a successful international concept to improve maritime transport as it relates to Port operations and Ports interaction with ships.

The IPCDMC is working towards data exchange and collaboration between ships and ports, ports and port and within ports.⁴ They realized that in the 60s the standardized container revolutionized shipping. They expect that the next revolution is the containerization of information – creating a safer, more efficient and environmentally friendly maritime sector.

On an international level the IPCDMC is governing PortCDM, which is a concept to support those engaged in, or associated with, port call operations. It aims to improve the efficiency and effectiveness of activities in any port by providing a framework for data sharing, enhanced collaboration, and common situational awareness.

PortCDM is an organizational concept aimed at enabling more predictable timings and operations in sea transport by building on unified and standardized data exchange protocols. PortCDM addresses the need to ensure a continuous flow of data about intentions, outcomes, and possible disruptions related to movements and service provision among all those involved in the berth-to-berth maritime transport process. It also aims at contributing to the operational aspects of a well-coordinated port as a transport hub in the larger transportation ecosystem. This results in a high degree of predictability in the planning and execution of all associated operations and activities contributing to just-in-time operations. Through its technical and operational guidelines, PortCDM enables all the actors involved to share the same situational awareness based on input from multiple sources of up-to-date spatial-temporal data. The availability of such a holistic view enables and fosters collaboration. In turn, this enables efficient and successful coordination and synchronization, which benefits everyone, not least the end customer or recipient of the goods being transported.

The PortCDM process is intended to be dynamic and transparent using standardized messaging and interfaces that trigger and prompt the various actors to review exception alerts and take actions based upon their physical capabilities, preferences, and requirements. Provided everyone is kept informed, multiple revisions or iterations to plans can take place during a single port call while at the same time minimizing the overall disruption to the final outcomes.

PortCDM does not necessarily calls for process changes but focuses on a more dynamic and effective delivery of the existing processes through greater collaboration and the availability of high quality, near real-time data to all the relevant and authorized actors in the maritime transportation

³ <http://srcg.bergmann-marine.com/charter>

⁴ <https://www.ipcdmc.org/>

ecosystem. PortCDM will be underpinned by appropriate protocols to ensure robust data integrity and access control. PortCDM comes with a framework for maturity levels supporting ports, with its actors, to successively develop their PortCDM maturity on data sharing and collaboration.

On the technical level the IPCDMC has developed the S-211 standard, a Port Call Message Format within the CMDS.

S-211 is used for port call messages by allowing standardized sharing of data on intentions and outcomes of movements, services, and administrative events on a given port call.

Building upon the foundational logic of the port call process, conceived as different inter-related events, the S-211 port call message format is a response to the lack of standards for sharing data on port call timing between involved actors. This format is a standard within the IMO common maritime data structure (CMDS), that captures several aligned standards used in maritime transports, as a means for realizing the e-navigation strategy of IMO. In that sense the port call message format is a thin, interoperable standard, and not part of a larger standardization monolith (such as the standards maintained by UN/CEFACT or WCO). It is aimed to lower the thresholds for involved parties to share business critical, but not business sensitive data. The S-211 standard allows the participants to share data about intentions (plans, estimations, actuals, requests, and recommendations) associated to movements or services. S-211 also covers the opportunities for sharing data about the process of coming to agreements of services. S-211 is unique as it is reflecting a high precision in the details that it is communicating, such as the location and timing of the arrival and departure, allowing for standardized and precise ship-to-port, port-to-ship, port-to-port, as well as port actor-to-port actor data exchange, contributing to efficient coordination of port calls being at focus within the PortCDM concept.

IPCOTF

The “International Port Call Optimization Task Force” (IPCOTF) has been evolved from two main projects, the “Avanti Project” (ACCESS TO VALIDATED NAUTICAL INFORMATION) and the Pronto Project (PORT’S RENDEZ-VOUS OF NAUTICAL AND TERMINAL OPERATION). Both project were headed by the Port of Rotterdam.

The homepage of the Port of Rotterdam defines the role as follows:

“The Port Call Optimisation Task Force (Shell, Maersk, MSC, CMA-CGM and the ports of Algeciras, Busan, Gothenburg, Houston, Rotterdam, Singapore and Ningbo Zhoushan) therefore united forces in 2014 with the International Harbour Masters’ Association, United Kingdom Hydrographic Office and GS1 to bring standards from the nautical and logistics sectors together. This ensures that the nautical data on board of vessels corresponds to the information from the port, as well as the information used in the logistics chains.”⁵

It should be noted that the Port of Rotterdam has developed commercial tool, called “Pronto”, and has established an organization PortXchange, which *“offers the latest technology and supports in the process to make port calls more efficient and save emissions”⁶*

⁵ <https://www.portofrotterdam.com/en/shipping/sea-shipping/other/port-call-optimisation>

⁶ <https://www.port-xchange.com/>

Looking at the different references and actors the differentiation between IPCOTF, Project Pronto, Product Pronto, Port of Rotterdam, PortXchange and other aspect in this scenario isn't always easy.

Tradelens

In a collaboration between the shipping line Maersk and the IT giant IBM the initiative "Tradelens" was formed.

As by there definition "TradeLens is a digital platform that empowers businesses and authorities along the supply chain with a single, secure source of shipping data, enabling more efficient global trade"⁷.

The focus is clearly on cargo, trying to improve transparency and improve operations. Given that fact that one big shipping line is dominating this initiative others seem to be a little bit hesitant.

Digital Container Shipping Association (DCSA)

DCSA is an nonprofit, independent organization established in 2019, initiated by the large container shipping lines MSC, Maersk, CMA CGM, Hapag Lloyd, One, Evergreen Line, Yang Ming, HMM and ZIM.

They describe their "vision and Mission" as follows:

"At DCSA, we envisage a digitally interconnected container shipping industry in which customers have a choice of seamless, easy-to-use services that provide the flexibility to meet their business and sustainability goals.

DCSA's mission is to drive technology standards and frameworks that will enable carriers to bring innovative solutions to market. Leveraging DCSA standards will improve a carrier's customer experience, operational efficiency, regulatory compliance and business agility."⁸

⁷ <https://www.tradelens.com/>

⁸ <https://dcsa.org/about>