INTEGRATING MASS IN THE DIGITAL MARITIME INFRASTRUCTURE

An Analysis of Standardization and Digitalization Efforts in the context of e-Navigation

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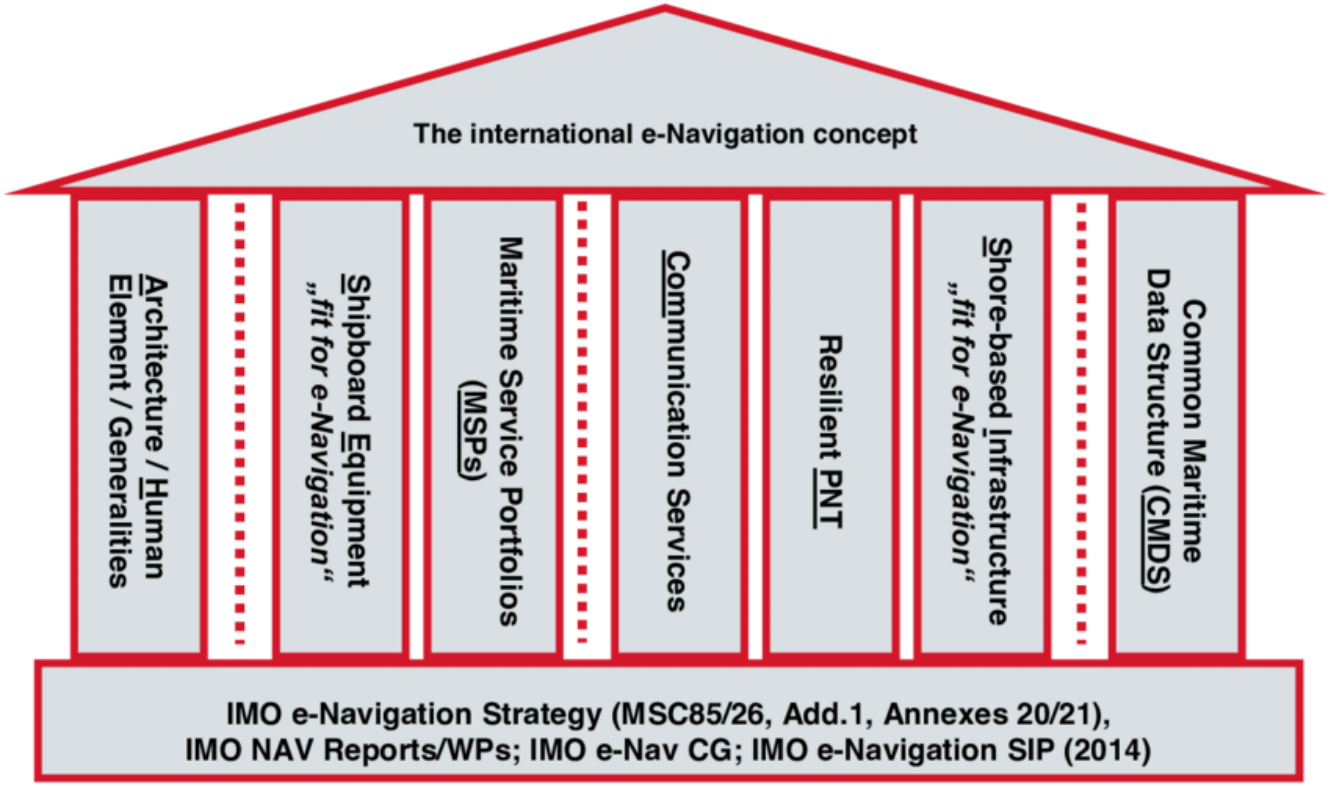
08.10.2025, Hamburg

E-Navigation: What‘s that?

- 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.“[1]

- Strategy to improve safety at sea and environmental protection
- An important aspect is the digitalization of manual processes and the creation of a digital infrastructure



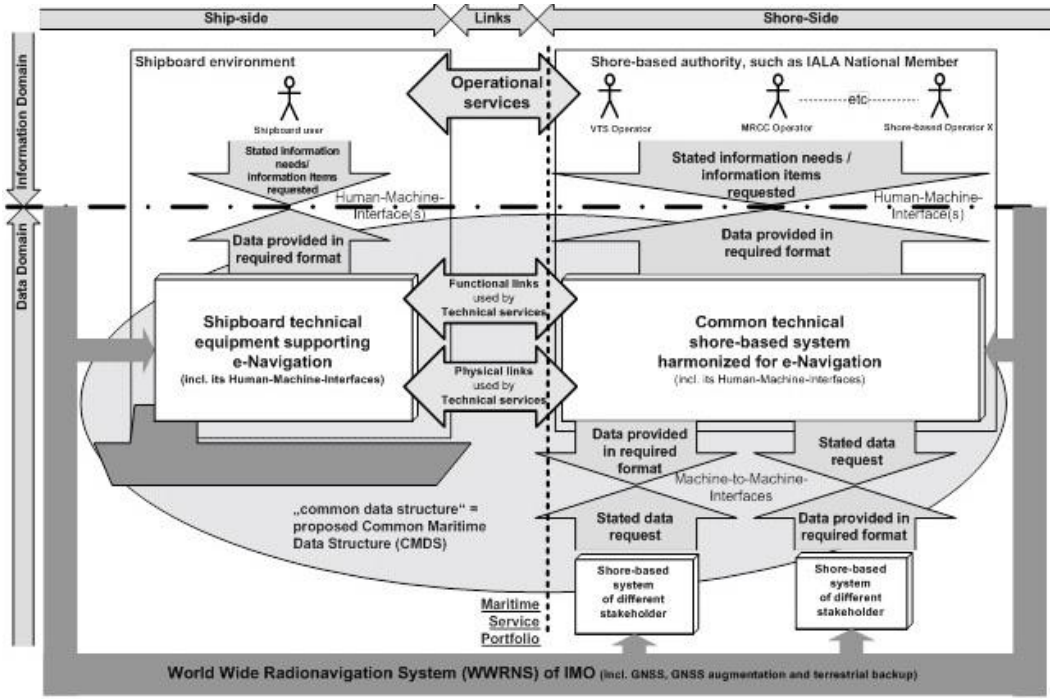
T. Porathe, "ACCSEAS Baseline and Priorities Report," 2015. Accessed on 09.09.2025

[1] E-Navigation, www.imo.org, https://www.imo.org/en/OurWork/Safety/Pages/eNavigation.aspx, Accessed on 09.09.2025

MASS & e-Navigation

- A lack of regulations and standards have been found to be a major barrier for the implementation of MASS[1]

- E-Navigation has benefits for MASS[2]



International Maritime Organization. E-Navigation Strategy Implementation Plan - Update 1; 2018. p. 23, Accessed on 09.09.2025

[1] Baldauf M, Fischer S, Kitada M, Mehdi R, Al-Quhali MA, Fiorini M. Merging Conventionally Navigating Ships and MASS - Merging VTS, FOC and SCC? TransNav 2019; 13(3): 495–501

[2] Burmeister H-C, Bruhn W, Rødseth ØJ, Porathe T. Autonomous Unmanned Merchant Vessel and its Contribution towards the e-Navigation Implementation: The MUNIN Perspective. International Journal of e-Navigation and Maritime Economy 2014; 1: 1–13

Standardization and Digital Infrastructure for MASS

Challenges for the introduction of MASS:

- MASS will be required to operate in conjunction with conventional manned vessels
  - Voice communication via VHF is not possible
- The shipping industry is of an inherent international nature
  - A need for globally accepted standards
- No human operator on board
  - Digital infrastructure is needed

S-100: The Universal Hydrographic Data Model

- Is a geostandard based on ISO 19100
- Aims to harmonize data models to improve the interoperability of maritime information systems
- Machine readability supports applications in assistance systems and MASS
- Product specifications combine features, attributes and relationships into data products

Navigating the S-100 World, Fisheries and Oceans Canada (DFO) - https://www.dfo-mpo.gc.ca/about-notre-sujet/publications/infographics-infographies/chs-s100-shc-eng.html accessed on 11.04.2025

Maritime Services

- Maritime Services (MS) harmonize the exchange of maritime data
- IMO defines 16 MS
- Each MS deals with one aspect of e-Navigation

Service	Domain	Coordinator
MS01	VTS Information service (INS)	IMO, IALA
MS02	VTS Navigational assistance service (NAS)	IMO, IALA
MS03	Traffic organization service (TOS)	IMO, IALA
MS04	Port support service (PSS)	IMO
MS05	Maritime safety information (MSI) service	IMO, IHO, WMO
MS06	Pilotage service	IMO, IMPA
MS07	Tug service	IMO, Norway
MS08	Vessel shore reporting	IMO, Norway, Singapore
MS09	Telemedical assistance service (TMAS)	IMO, IMHA
MS10	Maritime assistance service (MAS)	IMO, Norway
MS11	Nautical chart service	IMO, IHO
MS12	Nautical publications service	IMO, IHO
MS13	Ice navigation service	IMO, WMO
MS14	Meteorological information service	IMO, WMO
MS15	Real-time hydrographic and environmental information services	IMO, IHO
MS16	Search and rescue (SAR) service	IMO, Norway, Singapore

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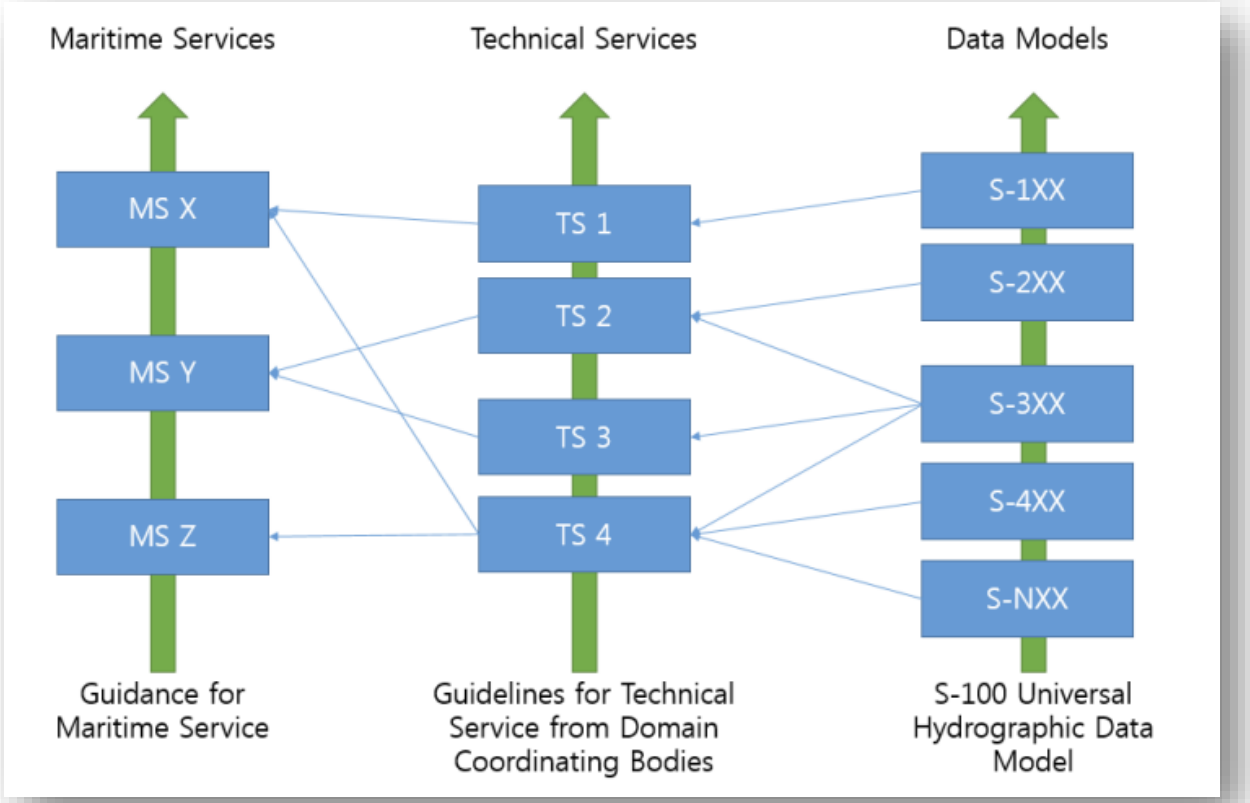
S-100 & Maritime Services

- Maritime Services: Address the different domains in e-Navigation
- Technical Services: Technical solution for the provision of data
- Data Model: S-100 data products



International Maritime Organization. Guidance On The Definition And Harmonization Of The Format And Structure Of Maritime Services In The Context Of E-Navigation; 2019. p. 6, accessed on 09.09.2025

Discussion

- E-Navigation initiated a concerted effort towards the digitalization and standardization
  - Introduction of harmonized services and a machine readable data model
- Service based architecture
  - Can be utilized to address the unique requirements of MASS
- IMO‘s Governance assures international standardization and compliance
  - Reduction of system complexity for MASS

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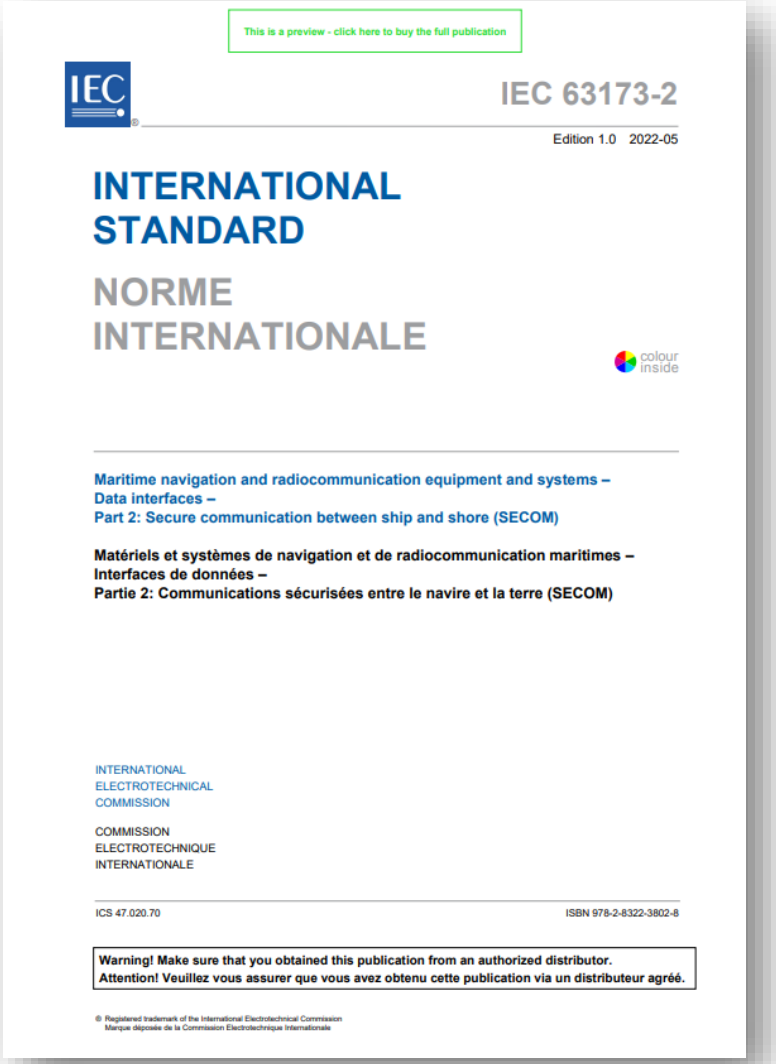
Discussion

- Current implementations within the e-Navigation framework are designed with a human operator in mind
- Maritime Technical Services may deliver superfluous information
- MASS relies on accuracy and consistency of incoming data
- Limits in the infrastructure, e.g. connectivity issues at sea

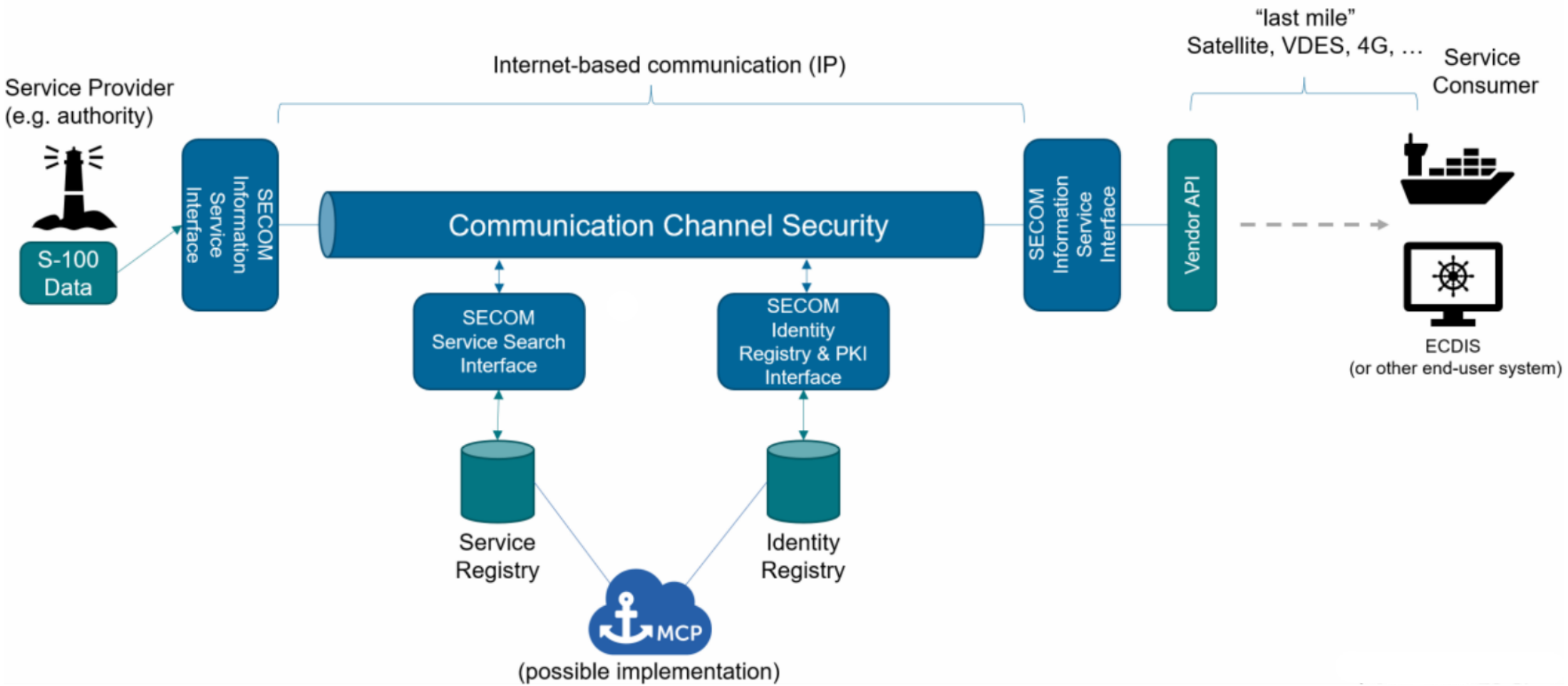
SECOM (IEC 63173-2)

- Standard for secure data exchange with Maritime Technical Services
- Contains interfaces for IP-based communication and for the discoverability of services
- Includes data protection measures
- Designed primarily for communication with S-100 data products
- Aims to facilitate interoperability and reduce the need to support many different service designs
- Interfaces for digital identity management are realized with a public key infrastructure (SECOM PKI)



IEC 63173-2, https://webstore.iec.ch/en/publication/64543, accessed on 09.09.2025

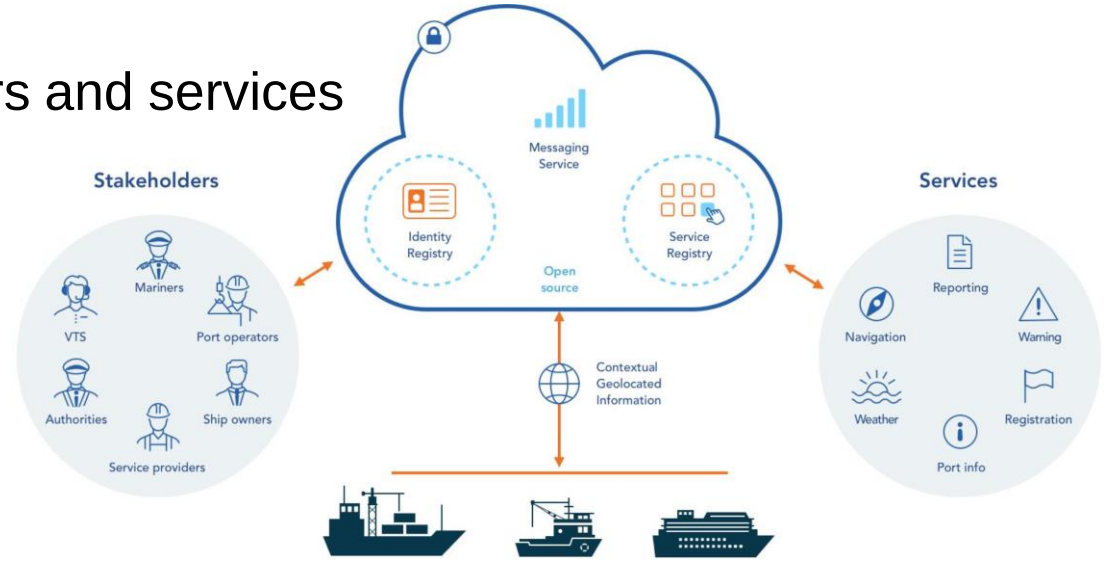
SECOM (IEC 63173-2)



Introduction of S-100 Data Services with IEC 63173-2 (SECOM), accessed on 09.09.2025

MCP - A PKI for the maritime Domain

- Is a decentralized framework that enables the efficient, secure and reliable provision of digital services and the exchange of information between authorized maritime stakeholders
- The individual components are standardized by the IALA
- Maritime Identity Registry (MIR)
  - Identity management and authentication of users and services
- Maritime Service Registry (MSR)
  - Register and discover MS
- Maritime Messaging Service (MMS)
  - Send and receive messages



The Maritime Connectivity Platform (MCP) - Conceptual Overview, https://maritimeconnectivity.net/wp-content/uploads/2023/02/MCP-Concept-v2.pdf, accessed on 09.09.2025

Conclusion

- E-Navigation offers advantages for MASS
  - Development of a more digitalized maritime infrastructure
  - Introduction of new, globally accepted standards

- However e-Navigation is designed around the needs of human operators
  - Further adoption and adaptation for MASS is needed

Imprint

Topic: **Integrating MASS in the digital Maritime Infrastructure**
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Date: 2025-10-08

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