Version: 0.9

The Maritime Connectivity Platform (MCP)

Conceptual overview

1 SUMMARY

The Maritime Connectivity Platform (MCP), formerly known as the *Maritime Cloud* is a framework for enabling efficient, secure, reliable and seamless electronic information exchange between all authorized maritime stakeholders across available communication systems.

The MCP has been created to enable maritime actors to use digital services to exchange public as well as private information. Potential commercial and non-commercial institutions can become part of the global MCP framework using their own installations of the MCP.

The MCP brings common internet standards to maritime navigation and transportation systems by applying open and vendor-neutral technologies.

The MCP was created initially to address the goals of the e-navigation initiative of IMO. The MCP also has the potential to support digitalization across a much wider maritime domain because it is an open-source solution that relies on the Internet concept of Web Services for identity management and service management and, as such, can support much more than just the IMO's Maritime Services in the context of e-navigation.

Core Components

The Core Components of the MCP are:

The Identity Registry - for secure and reliable exchange of information, it supports safe login and usage to all services, using identity information provided by trusted stakeholders. Facilitates confidentiality, integrity and authenticity in information exchange between users and between machines. Uses existing standards such as MRN, OpenID Connect and X.509 certificates.

The Service Registry - for registering, discovering and using all relevant e-Navigation and e-Maritime services, commercial and non-commercial, authorised and non-authorised, for free and against payment. It can be seen as a sophisticated yellow pages phone book. The registry can be searched using a number of different criteria including coverage area.

The Maritime Messaging Service – for allowing authorized maritime stakeholders to send and receive messages in an efficient, reliable and seamless manner within the MCP to solve problems of the current maritime wireless data communication system.

All the core components of the MCP are open-source.

Governance

The MCP is governed by the MCP Consortium (MCC). The MCC was established by the following non-profit organisations: OFFIS, Germany, KRISO, Republic of Korea, RISE, Sweden, University of Copenhagen, General Lighthouse Authorities of UK and Ireland. The Danish Maritime Authority (DMA), Swedish Maritime Administration (SMA) and the Ministry of Ocean and Fisheries of the Republic of Korea (MOF) are joining as Governmental Observers.

2 BACKGROUND

To respond to today's societal expectations on sustainability, efficiency, and safety, all the actors engaged in the marine transportation chain need to join forces and collaborate to a larger extent than ever before. This is not easy when the maritime industry comprises numerous autonomous actors arranged in a largely self-organizing ecosystem. However, if it wishes to be seen as an integrated and efficient part of the larger transportation chain, then things need to change. Pressure is now being put upon shipping companies, ports with their actors, and authorities to provide better value and greater responsiveness to their clients.

21st century clients in maritime transport require:

- safe end-to-end transport of people and goods
- Efficient transport solutions in order to minimise the impact on the marine environment
- integrated performance throughout the maritime transport chain and seamless transitions between different modes of transport
- efficiency in capacity utilization contributing to cost efficient transport
- energy efficient movements and operations
- predictable and informed movements and operations
- transport facilitators and clients that can make informed decisions that optimise their chosen means of transport

To help to achieve this, digitalization in support of maritime operations is enabling the establishment of an increasing number of useful data streams, potentially accessible for anyone with the appropriate permissions.

Automatic ship position reporting, warning of navigation hazards via electronic charts, broadcasting natural phenomena such as the status of fairways, real time reporting of currents and tide, the digital representation of existing and forecast weather, as well as remote engine performance monitoring are all providing opportunities for innovative digital applications that contribute to more efficient, safer and cost effective operations at sea and in and out of ports.

In addition, communication between different stakeholders is now done increasingly through the use of digital technologies, thereby reducing the number of manual interactions and phone calls. In recent years, empowered by diverse e-navigation initiatives, standards for sharing routes and time stamp data have been adopted, capturing both intended and completed movements as well as operations, enabling others that coordinate ship movements and port operations as well as those who provide optimization and monitoring services to take actions that all contribute to enhanced safety, efficiency, and the environmental sustainability of maritime transport activities.

Different actors have until now tended to develop their own practices and established their own supporting base of installed systems to try to improve the efficiency of their operations. As a result, many of those involved in managing and delivering maritime transport around the world, such as ports with their supporting actors, ship-terminal alliances, etc., now have their own setup, and it is unrealistic to think that everyone will convert towards and invest in using the same systems. Even if a few dominating systems prevail in the future, the overall development should nevertheless enable inter-operability between the systems that are in place so as to allow data to be shared and consumed regardless of the originating system or source. This is particularly important as more and more potentially useful data streams become available, and both data providers and consumers require access to relevant data from all systems regardless of the port or the ship or the customer or the systems that they are using.

As has been seen in many other examples of digitalization, allowing digital solutions to be developed in isolation contributes to the establishment of non-open standards, proprietary solutions and interfaces that, in turn, lead to significant sub-optimization and inefficiency. For smaller actors, it becomes costly to develop capabilities to interact in diverse networks requiring different interfaces and communication infrastructures

for the provisioning and consumption of shared data. And at the end of the day it is the clients that face the bill for any such inefficiencies – causing them to look for alternatives. Can the maritime sector really afford to allow such a situation to develop?

Thankfully, the major intergovernmental and international bodies with responsibilities for data exchange in the maritime domain, such as IMO, IHO, IEC, IALA, IPCDMC, and others including UNCTAD, are stressing and actively promoting the establishment of open standards for messaging, allowing for data streams to be used in any application and in any organizational setup. However, establishing international standards for messaging and interfaces are not enough to ensure that messages become exchanged between all involved trusted parties in the chain of operations constituting sea transport – particularly given that there will likely always be a range of different information systems in operation. There is therefore a need to support the installed base of these existing systems by providing suitable connectivity services between them. This includes mechanisms for authentication and discoverability. Such services must be a secure, trusted mechanism that enables participants to provide trusted data and services and enable the desired target groups to find and get access to that data as part of the emerging ocean of maritime related data and application services. Including global and distributed identity management and a *yellow pages* of available digital information and application services will provide opportunities for the consumer of such services. The MCP has been developed to do all this.

This short note outlines the core characteristics of the MCP concept.

3 MCP CONCEPT

The MCP has been evolving for a number of years starting around 2011. Around 2015, the development escalated significantly, when three large projects collaborated on the common use and further development of the technology. These were the EU projects *EfficienSea2* and *STM Validation Project* and the *SMART Navigation Project* funded by the Republic of Korea. During these projects an MCP testbed was established, which now has been running for several years, and more than 100 organisations have signed up to the platform.

The MCP responds to the need to enable connectivity between different involved maritime domain stakeholders and participants. It is purposely agnostic to organizational structures, onboard and onshore communication capabilities, region, type of ship and type of port so as to make it versatile, adaptable and conforming to the best practice of open standards. The concept provides a standardized way of specifying services as well as procedures together with authentication and identification procedures to ensure trust. The MCP provides guidelines on different implementation options for different providers of MCP instances, independent of whether they are authorities and/or private enterprises acting on a local, regional or global basis.

The purpose of the Maritime Connectivity Platform is to enable an open, vendor-neutral platform for the maritime sector that facilitates information exchange that is boundary-free and is secure across the various communication channels such as internet, satellite, cellular phone network and digital radio links.

The Maritime Connectivity Platform concept addresses the need for harmonization and interoperability within the maritime transport domain, as emphasised in the IMO's e- navigation strategy and beyond, making it possible to increase safety, efficiency and environmental sustainability of sea voyages berth-to-berth. At the same time, the MCP concept can enable a global communication framework for secure, reliable and seamless electronic information exchange between all authorized maritime stakeholders using available communication systems, leading to more efficient, cost-effective and reliable service delivery and business operations by all the actors.

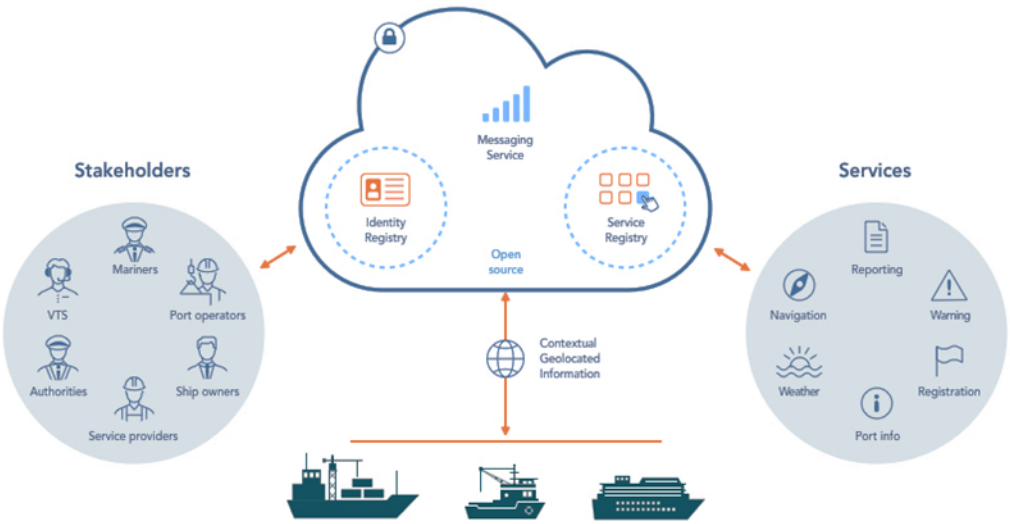

Figure 1 The Maritime Connectivity Platform Concept

3.1 Design principles

The development of the MCP concept has been guided by the following principles:

- Distributed identity management – As a global self-organized eco-system composed of numerous autonomous actors, the maritime industry requires a highly distributed approach to managing identities and authentication/authorization that meets the highest cyber security standards.
- Vendor independence – It must be possible to implement, run and maintain the MCP on various technical infrastructures without relying on any vendor specific features.
- Openness – The MCP must be open for all stakeholders and other interested parties in the maritime industry and beyond. It is a call to join forces and together take the industry into the digitalization era.
- Non-profit governance – While MCP instances could and should be run by both private and public interests, based on different business models and incentives, it is of great importance that governance of the MCP concept itself maintains its not-for-profit character.
- Service-oriented architecture – In the context of service-oriented architecture, a service usually refers to a set of related software functionalities that can be re-used for different purposes together with policies that govern and control its usage. The MCP embrace this definition but also comprises a much broader scope that also includes services, which do not rely solely on machine-to-machine communication such as services delivered over telephone calls (voice or fax), email, websites, NAVTEX and other "primitive" solutions.
- Proven technologies – The MCP concept relies on well-proven industry standard technologies, such as web-services, OpenID Connect, X.509 certificates, and so on, but will remain open for and follow the development of new emerging technologies.

3.2 Technical components

3.2.1 The Maritime Identity Registry (MIR)

The MIR is responsible for identity management and providing security functionality to the entities of the MCP. In particular, the MIR will provide the following functionality:

- Firstly, Identity Management: The MIR enables that each maritime entity (such as a device, human, organization, service, or ship) can be registered as an entity of the MCP and be equipped with a unique identity (by assigning a Maritime Resource Name (MRN)).
- Secondly, Public Key Infrastructure (PKI): The MIR ensures that each MCP entity holds a corresponding cryptographic identity, i.e. a public/private key pair and a certificate with the public key bound to their identity.
- Thirdly, the MIR provides the infrastructure for authentication, which enables authorization and secure integration of web services, based on the established internet standards (OAUTH 2.0/OpenID Connect).

While the MIR will be distributed trustworthiness will be made transparent by the definition of MCP security profiles and the audited procedures MSP instance providers need to follow to adhere to them.

3.2.2 The Maritime Service Registry (MSR)

The MSR does not provide actual maritime information but a specification of various services, the information that they carry, and the technical means to obtain it. An MSR instance contains service specifications according to a Service Specification Standard (which is identical to IALA Guideline 1128) and provisioned service instances implemented according to these service specifications.

The functionality of the MSR is twofold: service discovery and service management. It enables service providers to register their services in the MCP and allows an end-user to discover those services. Services and service instances can be searched via different criteria such as keywords, organizations, locations, or combinations, and more. The management of a service encapsulates the functions to publish a service specification and register / publish a service instance.

3.2.3 The Maritime Messaging Service (MMS)

The MMS is a messaging service intended to offer transparent seamless information transfer across different communication links in a carrier agnostic and geolocation-context sensitive manner.

The MMS primarily addresses ship-shore communication based on internet connectivity, yet any number of alternative communication services may be connected to and utilized by the MMS via dedicated gateways. As an example, a message, sent by one specific ship using INMARSAT access to the MMS, may be received via a VSAT terminal on another ship, an HF data connection on yet another ship, or a VTS operator on a DSL landline internet connection. In the current implementation the MMS enables the transfer by using the MRN of an entity as an end-point address.

Each communication service will impose technology and situation specific limitations in terms of restrictions to capabilities, bandwidth availability, size of transferrable data packages, latencies, etc. – but basic transfer of text or structured data (e.g. using XML) will be possible.

3.3 MCP Governance

In order to govern the MCP, an international consortium – the Maritime Connectivity Platform Consortium (MCC) – has been established. The MCC is a neutral and independent entity that operates in a strictly not-for-profit and transparent way. The consortium has been structured in a similar way to the World Wide Web Consortium, and thus has a small number of host members and a larger number of regular members. All members form the General Assembly – the highest authority of the MCC – in which the host members have a right of veto. All host members are (and must be) not-for-profit organisations.

The MCC was established in 2019 by the following not-for profit organizations: the General Lighthouse Authorities of UK and Ireland, the Korea Research Institute of Ships and Ocean Engineering, the Institute for Information Technology (OFFIS) of Germany, RISE Viktoria of Sweden, and the University of Copenhagen. The Danish Maritime Authority (DMA), Swedish Maritime Administration (SMA) and the Ministry of Ocean and Fisheries of the Republic of Korea (MOF) joined as governmental observers.

In addition to this, an advisory board for the consortium has been established, which has representatives from relevant international organisations and associations.

The MCC undertakes the following activities:

- Developing and maintaining all standards associated with the MCP
- Defining criteria for operating operational instances of the MCP
- Endorsing organisations to run operational instances of the MCP
- Facilitating root certification for the operational instances
- Developing and maintaining an open source MCP reference implementation
- Operating a test instance of the MCP

The consortium encourages all relevant stakeholders (commercial and non-commercial) to join the Consortium and participate in the development, governance and promotion of the MCP.

4 FURTHER INFORMATION

The MCP consortium operates and maintains a webpage for the MCP, on which all information about the consortium itself, general MCP information including standards and information about MCP instance providers can be found. The webpage can be found here: www.maritimeconnectivity.net.