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| IALA Guideline |

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GUIDELINE ON the selection of platforms for the Provision OF maritime services IN THE CONTEXT OF E-NAVIGATION

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# Introduction

This guideline provides information to IALA members – especially for national members - for the selection of harmonised and suitable platforms for the provision of Marine Aids to Navigation (AtoN) services including VTS in the context of e-navigation as recommended by the Recommendation R-1019. For this purpose, regional, national and global platforms have to be considered.

Most elementary part of the selection process for a system are definition of the specific requirements. Therefore, this document concentrates on the requirements for platforms which support the provision of Maritime Services in the context of e-Navigation. The document presents an overview of relevant requirements that a platform must fulfil for the distribution of AtoN and VTS services. The annex of this document introduces a platform technology as an example to illustrate the fulfilment of the requirements stated in this document.

## Scope

A platform is system that facilitates (provides services for) the secure and reliable exchange of information and services between stakeholders. An interoperability between all platform participants can be achieved through standardized requirements for the development of the services. A distributed ecosystem of Maritime Services is foreseen in the maritime domain due to the international and decentralised nature of shipping. Although the focus is to enable VTS and AtoN services in the context of e-navigation, it is the vision that these platforms should accommodate all Maritime Services in the context of e-navigation and beyond (e-maritime, autonomous ships, etc).

The exact definition of a platform in this context is indirectly given by the requirements for the platform which is described in chapter 2 of this document.

This is one of several guidelines associated with Recommendation R-1019 (Provision of Maritime Services in the context of e-Navigation in the domain of IALA). In particular this document describes how IALA members can meet the following recommendations in R1019:

* *Ensure that a communications infrastructure to provide such digital maritime services is available in their area of responsibility.*
* *Ensure harmonisation and interoperability, by considering international standards and guidance for:*
  1. *Digital maritime services.*
  2. *The communications infrastructure.*
  3. *System design and cybersecurity (e.g. availability, integrity and confidentiality).*
* *Ensure their services are developed and harmonised with other and authenticated maritime services that are the responsibility of other domain coordinating bodies.*

It is the intention that these platforms together with various communication channels will comprise the communication infrastructure mentioned above.

## Background

As in other domains, the digitalisation is advancing rapidly also in the maritime domain. The shipping industry is witness to increasing levels of digitisation and automation on board and ashore, growing electronic exchange of information and the advent of digital maritime services. These trends will lead to:

1. The need for increased and improved connectivity (on board and ashore).
2. Approaches to exchange relevant information securely and timely despite a volatile connectivity.
3. Increased safety and efficiency of shipping and enhanced environmental protection.
4. New maritime services using the opportunities of digitisation.
5. A higher intention to exchange services and information with other stakeholders.

## An example – the provision of navigational warnings

In the case of navigational warnings, the current way of receiving this is mainly by NAVTEX. Here, providers of the information have an infrastructure with radio equipment and antennas enabling the transmission of this information on the frequency allocated to this purpose. On the receiver side, the user purchases a NAVTEX receiver, enabling the reception of this information on that specific frequency.

So, finding the information is simply a matter of listening to the right frequency - and the authenticity (proof of identity) of the information provider is to some extend given by the fact that the provider has the equipment which is able to transmit the signal - although some rogue entity in principle could have the same equipment and transmit malicious information for some devious purpose. Strictly speaking the information provider is not authorised (the identity of the information provider is not proven) and the integrity of the information provided is not guaranteed (i.e. it is not guaranteed that the information has not been hampered with).

Using contemporary technology, a provider would expose a service on the internet, and the service consumer would connect to that service and receive the data - i.e. the navigational warnings. This of course requires that the recipient is connected to the internet - which is another discussion when it comes to vessels.

Having the provider of navigational warnings deliver the information over the internet means that the provider needs to be authenticated. On the internet anyone can provide anything from anywhere very easily, requiring nothing more than a connected computer - or even a smartphone. So, authentication becomes essential.

Also, it is very difficult to find the correct information from authorised providers on the internet - it is not just a matter of tuning into a specific frequency - and thus service discoverability becomes an issue. In particular because users (vessels) will need to connect to different providers depending on where they are in the world or where they are planning to go, and thus requires navigational warnings (and other relevant information) for those areas. Transmitting the information using NAVTEX gives a kind of regional relevance because the NAVTEX transmitters have a certain coverage, but on the internet, information are (in principal) equally available from anywhere in the world.

This example illustrates the need for harmonised platforms to provide such feature.

# FUnctionalisties of platforms for maritime services in the context of e-navigation

Platforms for maritime services must as a minimum fulfil the following features:

1. Authenticity and authorisation (c.f. section 2.1)
2. Interoperability (c.f. section 2.2)
3. Management of Service specification management (c.f. section 2.3)

By ensuring the raised functionalities, a secure and trustworthy communication can be assured during the exchange of services. Additionally, the use of current technological trends within the platform should simplify and enable the development of modern maritime services. The defined functionalities are explained in more detail below.

## Authenticity and Authorisation

**Authentication** is any process in which a system verifies the identity of a user (human or machine) who wishes to access it (i.e. to confirm whether you are who you claim to be, like a passport). This corresponds to the written signature and official stamp on paper. In facilitating connectivity between Maritime Services, authenticity is vital for establishing a trustworthy communication. As such a platform is committed to facilitate means of identification and functions for management of identities.

In managing identities **authorisation** is also important, authorisation is the process of determining a set of permissions that is granted to a specific trusted identity. Platform support for authorisation is required since there is a need to limit possibilities of administration of other organisations artefacts in a platform intended for hosting multiple organisations.

## Interoperability

Interoperability in the context of shipping is quite unique in the sense that a ship might call an arbitrary port and still expect to be served with the same level of service as calling a scheduled port. This puts special requirements on interoperability, there needs to be mechanisms in place to handle episodic tight coupling between Maritime actors.

Interoperability in the context of platforms means:

1. The ability of two or more systems or applications to exchange information and to mutually use the information that has been exchanged[[1]](#footnote-1).
2. Orchestrate services to enable them to operate together effectively.
3. Compatible with other systems and services in platforms.
4. Ability for seamless information exchange across different systems.
5. Vendor agnostic.
6. Provide means for facilitating dynamic information exchange across different systems

To achieve interoperability, the independent systems must be harmonized with each other. Harmonized means minimising redundant or conflicting standards or solutions. It also means that platforms need to operate the same fundamental principles (i.e. service oriented architecture and IP based). Harmonisation is a key aspect in supporting inter platform communication since there will not be one single platform implementing Maritime Services, rather a variety of different platforms possibly specialized in various areas of the maritime industry. So, in requiring harmonisation there need to be clear and precise Application Programming Interface (API) definitions for inter platform services like authentication, service discovery and synchronisation of entities etc.

### Platforms vs. Platform – the need for a decentralisation

Due to the global characteristics of the maritime domain it is necessary to achieve nearly global coverage with the offered services. So that safety-critical services can be obtained at anytime from anywhere in the world. Security-critical services are pointless if they can only be used in certain places on earth on global routes.

To achieve this, a decentralized platform architecture is essential. Only in this way each authority does have the option of setting up its own platform instance with individual regulations e.g. to comply with national legal requirements. Additionally, each instance provider gets the opportunity to trust only certain authorities and organisations. While the concept of a single central platform is less complex and easier to implement, a centralized solution will not be able to be trusted by everyone. Not everyone trusts everyone else with everything. Therefore, there need to be several platforms (or instances of the same platform) so that each stakeholder can on a case by case basis chose which platform should be used. This can increase the trust and acceptance for the platform so that as many stakeholders as possible can also benefit from the offered services.

However, the decentralized architecture of the platforms makes it even more important to harmonize them with each other so that they can be exchanged by stakeholders seamlessly e.g. when entering other sea areas. The platform instances needed to support the maritime services needs to be harmonised and interoperable as described in section 2.2 and 2.3. This level of harmonisation and interoperability needs to be absolutely perfect – in the sense that the platforms must outwards behave in exactly the same way, and be interfaced in exactly the same way (see 2.8). This is because users (and machines) should be able to use these platforms interchangeable. For instance – an ECDIS on a vessel should be able to authenticate a service using any platform without the software on the ECDIS needing to be changed in any way. Due to the strong harmonisation, the platforms in this document could be considered as a single decentralised platform.

Thus – the requirements could be met by a single decentralised platform.

## Service Specification management features

**Service discoverability** is another key feature of a platform, to enable searching for relevant services in a catalogue of published services. Since efficient service discovery most likely is handled by machine to machine communication service descriptions are required to be standardized and machine readable. The IALA Guideline G1128 describes such a format. Furthermore, the quality published services can be evaluated in using a commonly description as G1128 specifies.

The platforms need to provide a service registry with the following functionality:

1. Register and retrieve specification of services (described in accordance with IALA Guideline G1128).
2. Ability to register artefacts described in G1128 (service specification, service design and service instance).
3. Ability to search a service registry using various criteria, such as key words, organisations and geographical coverage of service instances.
4. Ability to endorse services according to agreed levels of quality and importance

These functional requirements enable the unbiased selection of maritime service offers for service consumers. If services are described in a standardised way (with G1128), a service consumer with a need for a special service can query a service registry with its search criteria, obtain a list of available services, automatically select a service and contact a specific service instance. This automates the process of service setup and configuration and provides a centralized and standardised way of querying for maritime services. Service providers can use these functionalities to promote their services and make them available to a larger set of consumers.

# Properties of platforms for maritime services in the context of e-navigation

Platforms should have at least the following properties in the maritime domain:

1. Efficiency, Robustness and Resilience (c.f. section 3.1)
2. Cybersecurity (c.f. section 3.2)
3. Open and standardised Interfaces (c.f. section 3.3)

## Efficiency, Robustness and Resilience

Efficiency[[2]](#footnote-2) represents the performance relative to the amount of resources used under stated conditions.

Robustness[[3]](#footnote-3) means the ability to cope with errors and function in less than optimum conditions, like a volatile connectivity on sea. It also means the ability to reliably deliver information via unreliable physical communication channels.

Resilience[[4]](#footnote-4) is the ability to provide and maintain an acceptable level of service in the face of faults and challenges to normal operations.

A common standard for all platforms with regard to efficiency, robustness and resilience must be established - so that stakeholders can have a homogeneous experience which ever platform that are currently utilising.

## Cybersecurity

Cybersecurity is the practice of protecting systems, networks and programs from digital attacks.[[5]](#footnote-5) In general there are many aspects of cyber security, and there are existing guidelines on cybersecurity within the maritime domain from organisations like IMO, CIRM and BIMCO. However, certain elements of cybersecurity need to be handled by platforms such as the ones discussed in this document. This pertains to confidentiality, integrity and availability.

**Confidentiality** means the definition an enforcement of appropriate access levels of information.[[6]](#footnote-6) This includes the management of identities and their access rights and as an execution of the access control: the encryption of confidential data. Confidentiality ensures that no one else than the intended recipient can read and understand the content of the document. Confidentiality corresponds to the sealed envelope.

**Integrity** means the protection of data against modification or deletion by unauthorized parties.6Integrity corresponds to the difficulties in changing printed text on paper.

**Availability** means that all accessible parts of a system must be protected in such a way that the provision of information is working properly at any time. 6

**Non-repudiation** is the assurance that someone cannot deny the validity of something. Non-repudiation is a legal concept that is widely used in information security and refers to a service, which provides proof of the origin of data and the integrity of the data.[[7]](#footnote-7)

Platforms need to have mechanisms for the identification and authentication of users, devices, objects and services. Additionally, there must also be mechanisms to inform involved parties about abuse of registered identities and stop entities from communicating with these.

Furthermore, it is also important that the platform facilitate traceability for non-repudiation purposes when transferring messages between services. This is important for messages which might have a significant impact on legal liability. For instance, protection against a ship’s false denial of having created the route content and of having sent the route to a provider of route optimisation services. Although the platform should facilitate this, it is solely up to the service provider and service consumer whether to implement such functionality or not, the platform should not impose such requirements by introducing centralized functions for traceability. Also, platforms should make use established, publicly available security standards and protocols such as X.509, OAuth 2.0, TLS as well as encryption techniques such as ECDSA or RSA as these promote interoperability and have already been exposed to public penetration testing for longer periods.

## Open and standardised Interfaces (API’s)

An API specifies how software components should interact. An API is the messenger that delivers your request to the provider from whom you are requesting a service. It can also be thought of as a user interface for machines (rather than humans).

It is important that the APIs of platforms are standardised to facilitate interoperability.

APIs are used interchangeably with web services[[8]](#footnote-8). The difference is that a web service facilitates interaction between two machines over a network. An API acts as an interface between two different applications so that they can communicate with each other.

An API also decouples the actual application from the outside world thus wrapping the functionality of the application which can facilitate changes in the application without affecting information exchange across different systems.

# GOvernance and Management of Platform instances

## Governance

Governance is tied to the requirement of mechanisms to verify trustworthy peers. Sound governance means adherence to the following principles:

1. Vendor agnostic
2. Non-political
3. Not-for-profit
4. Open and transparent decision-making

The rationales for the above statements are summarized below:

* For a platform to qualify as a generally accepted platform, the governance body is required to be a Non-Profit entity that meets cost pricing principles.
* Furthermore, in order to gain global recognition, the governing body should not be nationally bound. Therefore, a Non-Government Organisation (NGO) setup would be appropriate.
* Finally, to avoid any competitive obstacles between different maritime stakeholders, a non-proprietary standardized governance solution is preferable with observers from industry, research and governments.
* A core responsibility of the governing body is to ensure a chain of trust among the entities registered on the platform. This implies that the governing body ensures that all identities are validated to the same level of assurance. Thus, there is a unified trust in all identities in the platform.

## Management

The above-mentioned governance is for governing all the standards and procedures for the harmonised platforms. In addition to this, each platform instance needs to be managed and operated. This naturally needs to be done according to the overall standards and procedures as set forth by the governing body. The management task would include validating entities registered on the platform (organisations, devices, people...), registering, maintaining and endorsing service specification etc.

# Platforms in the context of e-navigation

As described in 2.3, the platforms need to handle technical e-navigation services following IALA Guideline 1128. As also mentioned in that section, these services are specified on three levels (service specification, service design and service instance), and the platforms needs to handle the service descriptions on these independent levels.

In the context of e-navigation, IMO resolution MSC.467(101) ‘guidance on the definition and harmonisation of the format and structure of maritime services in the context of e-navigation’ - defines services in the context of e-navigation. This circular resolution defines four levels of services: Maritime Services (in the context of e-navigation) and technical services – with the technical services having three levels – corresponding to the three levels described in G1128 (figure 2 and 3 in G1128). Thus – the platforms referenced in this document are intended to manage the three levels of the technical services defined in the IMO resolution, and in this way the platforms would also support e-navigation at large.

# Acronyms

**API** Application Programming Interface

**ECDSA** Elliptic Curve Digital Signature Algorithm

**G1128** IALA Guideline G1128 – The Specification of e-Navigation Technical Services

**IP** Internet Protocol

**NGO** Non Governmental Organisation

**OAuth** OAuth is a standard protocol for authorisation.

**PKI** Public Key Infrastructure

**RSA** RSA is a public-key cryptosystem.

**TLS** – Transport Layer Security

**X.509** X.509 is a standard for PKI for the creation of digital certificates.

ANNEX: Examples of platforms

# Maritime Connectivity Platform

The Maritime Connectivity Platform (MCP – [www.maritimeconnectivity.net](http://www.maritimeconnectivity.net)) is concept of a communication framework enabling efficient, secure, reliable and seamless electronic information exchange between all authorized maritime stakeholders across available communication systems. It is presented here solely for the purpose of illustration how a mature platform fulfils the above mentions requirements. So, this is only an example for a today’s candidate for consideration.

The MCP supports digitalisation across a wide 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 Maritime Services in the context of e-navigation. The MCP is vendor neutral and brings common internet standards to maritime navigation and transportation systems. Its platform structure enables easy and secure access to its users and supports machine-to-machine communication via a public and standardised API. The existence of multiple MCP instances operated by independent parties is part of the concept. Interoperability of Maritime Services in a Service-oriented architecture and the MCP instances is ensured by the standardisation of the MCP components by the MCP consortium.

One of the core intentions of the MCP is to support secure and efficient Web Service based communication for Maritime Services. Web Services are services based on IP-communication, mainly HTTP(S). Especially in the maritime industry IP communication is opening opportunities for applying more standards to the communication and getting away from proprietary technologies. With the new developments in IP-providing services communication with an exhaustive availability (satellite) or with a very high bandwidth (LTE), a new generation of Maritime Services is coming. IP-based communication also enables to employ the standard security protocols built on top of IP and the layers above it (such as TCP) and therefore leads to a better abstraction from low-level communication channels. The MCP is defined by a set of standard specifications. Independent implementations of this standards provide an infrastructure for the deployment of secure, interoperable Web Services and aims at the integration of existing standards for the exchange of maritime data such as S-100 datasets.

The MCP consists of specifications for three basic components - the "Maritime Identity Registry", the "Maritime Service Registry" and the "Maritime Message Service" (c.f. Figure 1) which can be used as parts of an e-Navigation platform.

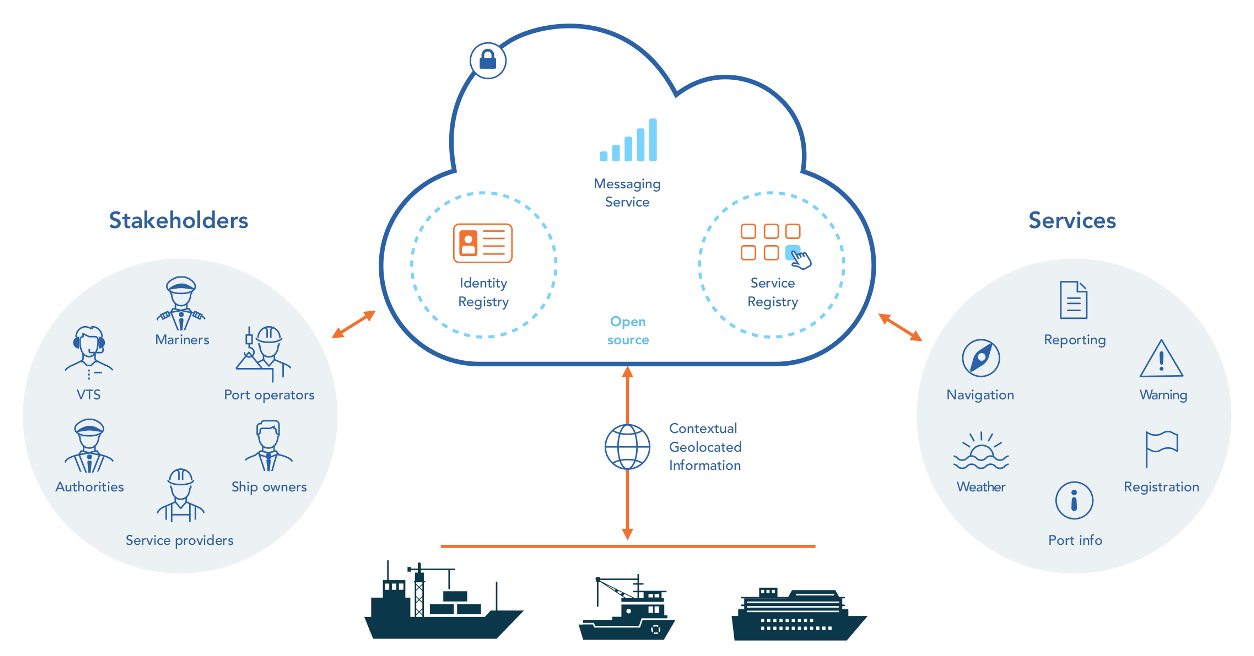


Figure 1 MCP Components for setting up a platform for the provision of maritime services in the context of e-Navigation

Further information can be retrieved from https://maritimeconnectivity.net/.

1. ITU Rec.Y.101 [↑](#footnote-ref-1)
2. ISO 25010 [↑](#footnote-ref-2)
3. ISO 22300-2018 [↑](#footnote-ref-3)
4. ISO 22300-2018 [↑](#footnote-ref-4)
5. https://www.cisco.com/c/en/us/products/security/what-is-cybersecurity.html [↑](#footnote-ref-5)
6. The CIA Triad, Chad Perrin, <https://www.techrepublic.com/blog/it-security/the-cia-triad/>, 12.02.2020 [↑](#footnote-ref-6)
7. FAQ Cryptomathic, <https://www.cryptomathic.com/products/authentication-signing/digital-signatures-faqs/what-is-non-repudiation> [↑](#footnote-ref-7)
8. https://medium.com/@programmerasi/difference-between-api-and-web-service-73c873573c9d [↑](#footnote-ref-8)