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Service Specification for VTS Service for the [Digital] exchange of ships' route plans

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**Kuvaotsikkoluettelon hakusanoja ei löytynyt.**

# Introduction

This document was produced as part of the work of IALA joint VTS-ENAV task group on development of technical service specifications for VTS. The document is structured according to the IALA Guideline G1128: THE SPECIFICATION OF e-NAVIGATION TECHNICAL SERVICES. The design of the service interfaces was adapted from the standard for Secure communication between ship and shore IEC 63173-2:2022.

## Purpose of the Document

The purpose of this service specification document is to provide a holistic overview of digital VTS exchange of ships' route plans and its building blocks in a technology-independent way, according to the guidelines given in [1]. It describes a well-defined baseline of the service by clearly identifying the service version.

The aim is to document the key aspects of the VTS exchange of ships' route plans at the logical level:

* the operational and business context of the service
  + requirements for the service (e.g., information exchange requirements)
  + involved nodes: which operational components provide/consume the service
  + operational activities supported by the service
  + relation of the service to other services
* the service description
  + service interface definitions
  + service interface operations
  + service payload definition
  + service dynamic behaviour description
* service provision and validation aspects

## Intended Readership

This service specification is intended to be read by service architects, system engineers and developers in charge of designing and developing an instance of the VTS Ship route plan exchange Service.

Furthermore, this service specification is intended to be read by enterprise architects, service architects, information architects, system engineers and developers in pursuing architecting, designing and development activities of other related services.

## Inputs from Other Sources

*This section provides an overview of activities, which are dealing with similar topics and lists already finished ones that provided inputs to this activity.*

To be added short references to IEC 63173-2:2022 -SECOM, as well as S-421

# Service Identification

The purpose of this chapter is to provide a unique identification of the service and describe where the service is in terms of the engineering lifecycle.

|  |  |
| --- | --- |
| Name | VTS Service for the exchange of ships' route plans |
| ID | urn:mrn:iala:techsvc:vts:rpe  [not official designation, for example only] |
| Version | 0.1 |
| Description |  |
| Keywords | VTS, MS1, Route Exchange, Ship Traffic Management, S-421 |
| Architect(s) |  |
| Status | Provisional |

# Operational Context

According to IMO resolution A.1158(32) Guidelines for Vessel Traffic Services one of the purposes of a VTS is to monitor and manage ship traffic to ensure the safety and efficiency of ship movements. The resolution also notes that VTS may be established in association with IMO adopted ships' routing systems or mandatory ship reporting systems.

IALA Guideline G1089 Provision of a VTS states that the monitoring and management may include among other things forward planning and prioritization of ship movements to prevent congestion or dangerous situations and improve overall efficiency. This includes, among other things, providing route advise and responding to unsafe situation where ships deviate from the route.

The Maritime Service description for MS1 Vessel Traffic Services describes user needs for digital information services for the exchange of VTS information by electronic means between a VTS and vessel. Vessels using MS1 can receive information related to the management of ship traffic in a digital format that can be displayed in the navigational equipment on board. Digital information exchange may apply to elements of vessel traffic management that is not time critical.

In the context of VTS, the exchange of ship route plans refers to the exchange of information about a recommended, intended and scheduled routes between the ship and shore-based authorities. The purpose of route exchange services are to timely ensure safety of navigation by allowing other ships, port authorities, and relevant authorities to be aware of a ship's intentions and to take appropriate measures to avoid collisions or other incidents.

## Present Day Operational Context

One of the main tasks for VTS is to monitor and manage vessel traffic, including establishing a system for providing route advice and/or recommended or advisory routes to be followed. Promptly and efficiently provision of route information will ensure both ship and shore to have enough information for safe and efficient operations. The exchange of a route, including schedule may be required in situations when a vessel is:

* entering or prior to entering a VTS area.
* departing from a berth or an anchorage within a VTS area.
* entering or prior to a fairway within a VTS area.

Traditionally VTS communication and interaction with ships is almost exclusively undertaken by VHF voice communications. The move to digital communications will reduce the amount of VHF communication and provide timely information into the ship systems which will improve safe and efficient ship traffic and pave the way to future system to system communication.

## Envisioned Operational Context

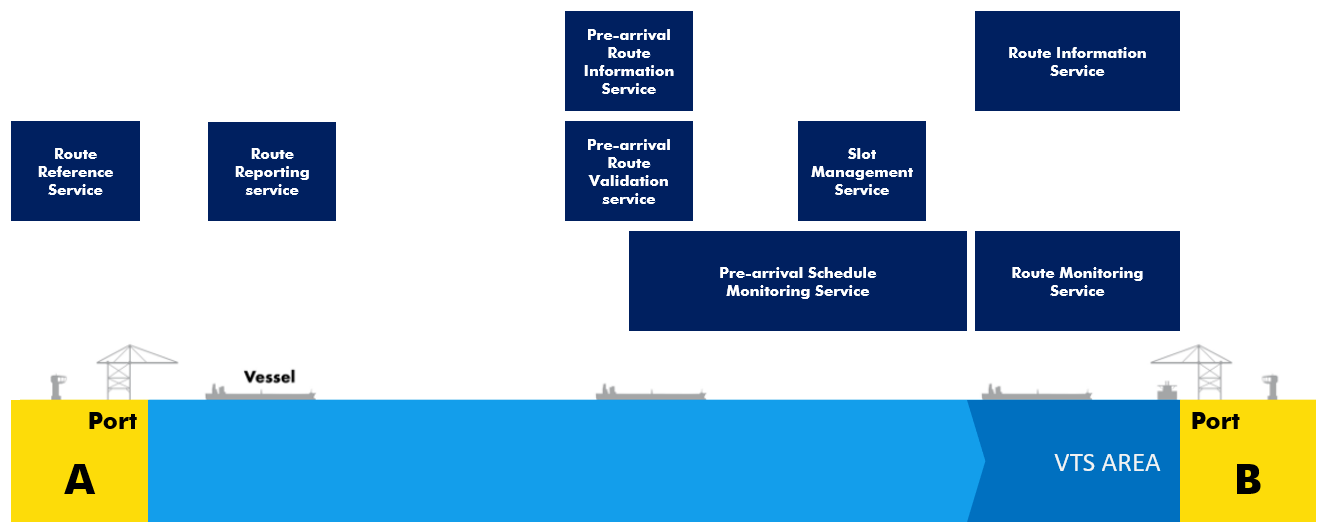
Digital exchange of vessel route plans will lead to increased safety, reduced administrative burden and more efficient operations, combined with reduced environmental impact. Route exchange will provide a common understanding of ship intentions, ensure vessel route compatibility and a clear understanding for the mariner and the VTS.

Route exchange between ships and VTS prior to entering the VTS area will improve safety in the VTS area by automated provision of digital information about the current fairway situation, potential hazards, and recommended routes to take. The interaction with the ships will lead to less confusion and will assist ships to avoid collisions and avoid other risks, which can be especially important in busy or congested areas.

Efficient route planning will also lead to environmental benefits by reducing fuel consumption and emissions. This is particularly important in areas with strict environmental regulations, as it can help ships comply with these regulations and reduce their impact on the environment.

Several maritime services regarding exchange of route and schedule information are defined at different phases of the voyage, this varies from offering reference routes prior to arrival or departure to slot management and to real time monitoring and managing of ship traffic within the VTS area.

System interfaces for digital exchange of information related to exchange of ships route plans however are not standardised yet. The following use cases will provide examples for the exchange of “Ship Route Plans” between ship’s and VTS.



NOTE: This document includes several use cases, which can be part of one or several different technical services.

**Use Case 1**

Use-case (name): Route Reference Service

Description: VTS Authorities provide reference routes to be used and support voyage planning. This use case deals only with the route. There is no schedule connected to route reference service

Actors: Vessel, ECDIS/ECS or other route planning system, VTS

Frequency of Use: Typically used in the voyage preparation process when creating a voyage plan.

Pre-conditions: The service instance is known to the ECDIS/ECS, or the ECDIS/ECS has access to a service registry in which the service instance can be discovered.

Ordinary Sequence: 1. The route is planned in ECDIS/ECS by the vessel

2. The ECDIS sends a request for pre-defined reference routes to the VTS areas through which the voyage will take place

3. VTS sends pre-defined reference routes, including conditions when the route can be used.

4. The data is rendered and available in ECDIS/ECS

5. The route is planned in ECDIS/ECS by the vessel

Post-conditions: The Vessel has connectivity to communicate with VTS services beyond line off side and VTS areas have reference routes available.

**Use Case 2**

Use-case (name): Route reporting

Description: Vessel sends prior to its arrival the intended route through the VTS area to the VTS. If the route includes schedule use case can also be used together with VTS traffic clearance service.

Actors: Vessel, ECDIS/ECS or other route planning system, VTS

Frequency of Use: Typically triggered before or when entering VTS area.

Pre-conditions: The service instance is known to the ECDIS/ECS, or the ECDIS/ECS has access to a service registry in which the service instance can be discovered.

Ordinary Sequence: 1. The route is planned in ECDIS/ECS by the vessel

2. The ECDIS sends intended route, which includes the schedule [including ETA], to VTS

3. VTS sends route received acknowledgement automatically.

4. The data is rendered and available in the VTS system

Post-conditions: The vessel's intended route is incorporated in the VTS system to enhance and update VTS traffic image.

**Use Case 3**

Use-case (name): (Pre-)arrival route validation

Description: Vessel sends prior to its arrival the intended route through the VTS area to the VTS. VTS validates the intended route or sends a recommended route to the vessel. Vessel approves the recommended route.

Actors: Vessel, ECDIS/other on board systems, VTS

Frequency of Use: Typically triggered before or when entering VTS area.

Pre-conditions: The service instance is known to the ECDIS/ECS, or the ECDIS/ECS has access to a service registry in which the service instance can be discovered.

Ordinary Sequence: 1. The route is planned in ECDIS/ECS by the vessel

2. The ECDIS sends intended route, which includes the schedule [including ETA], to VTS

3. VTS sends route received acknowledgement automatically.

4. VTS validates the route on statical an dynamical information on: draft / air draft, berth availability, service availability.

a. If the route validation confirms the planned route, VTS acknowledges the received route. The ’Acknowledged’ means that the planned route is accepted, and no changes are made in VTS system (go to point 6).

b. If the route validation identifies route issues in the planned route, VTS sends recommended route including description of route issues to the ECDIS/ECS. The “Route Issues” means that there are issues related to the planned route including description of these.

5. The recommended route is accepted by the vessel (go to point 2) or denied (go to point 1).

6. The data is rendered and available in the VTS system

Post-conditions: The vessel's intended route is incorporated in the VTS system to enhance and update VTS traffic image.

If the route cannot be agreed, VTS operator contacts the vessel by VHF.

**Use Case 4**

Use-case (name): (Pre-)arrival route information service

Description: VTS send information to the ECDIS/ECS to inform mariners of important information about navigational hazards, changes in shipping channels, and other issues that may affect the safety of their intended route.

Actors: Vessel, ECDIS/other on board systems, VTS

Frequency of Use: Typically triggered before or when entering VTS area.

Pre-conditions: The service instance is known to the ECDIS/ECS, or the ECDIS/ECS has access to a service registry in which the service instance can be discovered.

Ordinary Sequence: 1. The route is planned in ECDIS/ECS by the mariner

2. The ECDIS sends intended route, which includes the schedule [including ETA], to VTS

3. VTS sends route received acknowledgement automatically.

4. VTS sends the pertinent and relevant information regarding the planned voyage about navigational hazards, changes in shipping channels, and other issues that may affect the safety of their intended route, including:

a. Valid Navigational Warnings

b. Planned (lifting and diving) activities near the waterway with local restrictions

5. The data is rendered and available in the ECDIS and ECDIS send acknowledgement to VTS that the information has been noticed by the mariner.

6. If the information has not been acknowledged, VTS operator contacts the vessel by VHF.

Post-conditions: The vessel's intended route is incorporated in the VTS system to enhance and update VTS traffic information.

**Use Case 5**

Use-case (name): (Pre-) arrival Schedule Monitoring Service

Description: This service can be used to monitor the vessel ETA within the planned defined in the route plan.

Actors: Vessel, ECDIS/other on board systems, VTS

Frequency of Use: Triggered when vessel deviates planned schedule after Pre arrival route validation and acknowledgement.

Pre-conditions: VTS has received up to date route and schedule from the vessel through Route exchange Service

Ordinary Sequence: 1. (Pre-) arrival route validation has been acknowledged

2. VTS Monitors ship position outside VTS area on the intendent ETA, including notification of vessel deviating of intendent

3. If, during monitoring, route and schedule issues occur, VTS sends a notification of route issues to the ECDIS/ECS. (go to use case3 (Pre-)arrival route validation

Post-conditions: VTS has received up to date route and schedule from the vessel through Route exchange Service.

**Use Case 6**

Use-case (name): Slot Management Service

Description: This scenario covers the case where a VTS or other shore authorities establish a service for route exchange between the ship and shore-side actors that have an interest in the ships transit or arrival times.

Actors: Vessel, ECDIS/other on-board systems, VTS

Frequency of Use: Typically triggered before or when entering VTS area and schedule is updated.

Pre-conditions: The service instance is known to the ECDIS/ECS, or the ECDIS/ECS has access to a service registry in which the service instance can be discovered.

Ordinary Sequence: 1. The route and schedule are planned in ECDIS/ECS by the vessel. This contains planned waypoints and corresponding schedule. Some points may be locked in position or set by time, this may e.g. apply to final arrival time;

2. The ECDIS sends intended route, which includes the schedule [including ETA], to VTS

3. VTS sends route received acknowledgement automatically.

4. VTS validates the schedule

a. If the route and schedule validation confirm the planned route, VTS acknowledges the received schedule. The ’Acknowledged’ means that the planned schedule is accepted, and no changes are made in VTS system. (go to point 6)

b. If the route and schedule validation identify route issues in the planned route, VTS sends recommended route including prosed updated schedule to the ECDIS/ECS.

5. The recommended route is accepted by the vessel (go to point 2) or denied (go to point 1).

6. The data is rendered and available in the VTS system

Post-conditions: The vessel's intended route is incorporated in the VTS system to enhance and update VTS traffic image.

If in the end the route cannot automatically be agreed, VTS operator contacts the vessel by VHF.

**Use Case 7**

Use-case (name): Route Monitoring Service

Description: This service can be used to monitor that the vessel stays within the planned schedule and corridor as defined in the route plan or in the shore center system.

Actors: Vessel, ECDIS/other on board systems, VTS

Frequency of Use: Triggered when vessel deviates planned schedule and corridor and/or when issues occur on the planed track.

Pre-conditions: VTS has received up to date route and schedule from the vessel through Route exchange Service

Ordinary Sequence: 1. The route and schedule are planned in ECDIS/ECS by the mariner.

2. The ECDIS sends intended route, which includes the schedule [including ETA], to VTS

3. VTS sends route received acknowledgement automatically.

4. VTS Monitors ship position on the intendent track, including:

a. Notification of vessel deviating of intendent route and schedule

5. VTS Monitors ship position on hazardous situations including:

a. Identification of vessel exceeding course and abnormal behaviour

b. Notification of vessel not following TSS

c. Identification of vessel with risk of

d. Notification of vessel exceeding speed threshold

c. Notification of vessel exceeding collision thresholds

d. Notification of vessel below minimum distance and time to coast/ hazard

5. If, during monitoring, new route issues occur in the planned route, VTS sends a notification with a recommended route including description of route issues to the ECDIS/ECS.

6. The recommended route is accepted by the mariner (go to point 2) or denied (go to point 1).

7. The data is rendered and available in the VTS system

Post-conditions: VTS has received up to date route and schedule from the vessel through Route exchange Service. VTS has multiple DST on route and traffic management accomplished within VTS system and will give notifications on detected cautions, warnings, alarms and emergency alarm.

**Use Case 8**

Use-case (name): Route Information Service

Description: This service monitors vessel behaviour and informs a vessel on (potential) hazardous situations.

Actors: Vessel, ECDIS/other on board systems, VTS

Frequency of Use: Triggered when vessel deviates and/or when issues occur on the planed track.

Pre-conditions: VTS has received up to date route and schedule from the vessel through Route exchange Service

Ordinary Sequence: 1. The vessel enters VTS area or wants to leave berth/anchorage

2. The vessel sends route plan to VTS

3. VTS sends the pertinent and relevant information regarding the planned voyage about navigational hazards, changes in shipping channels, and other issues that may affect the safety of their intended route, including:

a. Valid Navigational Warnings

b. Planned lifting and diving activities near the waterway with restrictions

4. VTS Monitors all vessels in the area on route, position, speed and heading, including:

a. Identification of vessel exceeding course and abnormal behaviour

b. Notification of vessel not following TSS

c. Identification of vessel with risk of

d. Notification of vessel exceeding speed threshold

e. Notification of vessel exceeding collision thresholds

f. Notification of vessel below minimum distance and time to coast/ hazard

5. If, during monitoring, issues occur, VTS sends a notification including description of issues to the ECDIS/ECS.

6. The data is available in the ECDIS and ECDIS send acknowledgement to VTS that the information has been noticed by the mariner.

7. Status of acknowledgement is available in the VTS system

8. If the status of Vessels situation does not change. VTS operator will use VHF to contact the vessel

Post-conditions: VTS has received up to date route and schedule from the vessel through Route exchange Service. VTS has multiple DST on route and traffic management accomplished within VTS system and will give notifications on detected cautions, warnings, alarms and emergency alarm.

## Functional and Non-functional Requirements

*This section lists all (functional and non-functional) requirements applicable to the service being described. A tabular list of requirements shall be added here. If external requirements documents are available, then the tables shall refer to these requirements, otherwise the requirements shall be documented here.*

*The service must be linked to at least one requirement. At least one of the following tables shall be presented in this section. The first table lists references to requirements available from external documents. Make sure you document the sources from where the requirements are coming from. The second table lists new requirements defined for the first time in this service specification document.*

The table below lists applicable existing requirements for the Ship route plan exchange service.

Table X: Requirements Tracing

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| Requirement Id | Requirement Name | Requirement Text | References |
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Functional requirements

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| **Requirement Name** |  |
| **Requirement Text** |  |
| **Rationale** |  |
| **Author** |  |

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| --- | --- |
| Requirement Id |  |
| **Requirement Name** |  |
| **Requirement Text** |  |
| **Rationale** |  |
| **Author** |  |

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| Requirement Id |  |
| **Requirement Name** |  |
| **Requirement Text** |  |
| **Rationale** |  |
| **Author** |  |

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| Requirement Id |  |
| **Requirement Name** |  |
| **Requirement Text** |  |
| **Rationale** |  |
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| Requirement Id |  |
| **Requirement Name** |  |
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Non-functional requirements

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| **Requirement Text** |  |
| **Rationale** |  |
| **Author** |  |

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| --- | --- |
| Requirement Id |  |
| **Requirement Name** |  |
| **Requirement Text** |  |
| **Rationale** |  |
| **Author** |  |

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| **Requirement Text** |  |
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| Requirement Id |  |
| **Requirement Name** |  |
| **Requirement Text** |  |
| **Rationale** |  |
| **Author** |  |

## Other Constraints

### Relevant Industrial Standards

*To be added a table of applicable industrial standards*

### Operational Nodes

The following tables describe the operational nodes of the service.

Table x: Operational Nodes providing the Ship route exchange service

|  |  |
| --- | --- |
| Operational Node | Remarks |
| **Vessel** | Vessels sailing in a service coverage area. |
| **VTS centres** | VTS centres responsible for a service coverage area. |

### Operational Activities

*Optional. If an operational model exists and provides sufficient details about operational activities, then this section shall include a mapping of the service to the relevant operational activities.*

Table x: Operational Activities supported by the *XYZ* service

|  |  |
| --- | --- |
| Operational Activity | Remarks |
|  |  |

# Service Overview

# Service Data Model

# Service Interface Specifications

# Service Dynamic Behaviour

This section describes the interactive behaviour between service interfaces and service consumers.

Before the exchange of information is initiated, the service consumer retrieves the identity of the service provider from the service infrastructure and performs authentication procedure. If not authenticated, the service request is rejected. The specific authentication procedure is out of scope of the service specification and is described in the technical designs of this service.

# References

| Nr. | Version | Reference |
| --- | --- | --- |
| 1. Service Documentation Guidelines | 01.00 | SG\_Annex\_A\_Service\_Documentation\_Guidelines |
| 1. Document ID | xx.yy | Deliverable abc |
| 1. Maritime Resource Names | ED 1.0 | IALA R1023 MARITIME RESOURCE NAMES |
| 1. S-100 Universal Hydrographic Data Model | 2.0.0 | S-100 –  UNIVERSAL HYDROGRAPHIC DATA MODEL  <http://www.iho.int/iho_pubs/standard/S-100/S-100_Ed_2/S_100_V2.0.0_June-2015.pdf> |
| 1. IEC 63173-2 ED1 | 1.0 | Maritime navigation and radiocommunication equipment and systems –  Data interfaces –  Part 2: Secure communication between ship and shore (SECOM) |
| 1. IALA Guideline G1128 |  | THE SPECIFICATION OF e-NAVIGATION TECHNICAL SERVICES |
| 1. S-211 Port Call Message | 1.0 | IALA Port Call Message Product Specification |
| 1. MMS |  |  |
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# Acronyms and Terminology

## Acronyms

|  |  |
| --- | --- |
| Term | Definition |
| API | Application Programming Interface |
| MC | Maritime Cloud |
| MEP | Message Exchange Pattern |
| MRN | Maritime Resource Name |
| NAF | NATO Architectural Framework |
| REST | Representational State Transfer |
| SOA | Service Oriented Architecture |
| SOAP | Simple Object Access Protocol |
| SSD | Service Specification Document |
| UML | Unified Modelling Language |
| URL | Uniform Resource Locator |
| VTS | Vessel Traffic Service |
| WSDL | Web Service Definition Language |
| XML | Extendible Mark-up Language |
| XSD | XML Schema Definition |

## Terminology

|  |  |
| --- | --- |
| Term | Definition |
| External Data Model | Describes the semantics of the “maritime world” (or a significant part thereof) by defining data structures and their relations. This could be at logical level (e.g., in UML) or at physical level (e.g., in XSD schema definitions), as for example standard data models, or S-100 based data produce specifications. |
| Message Exchange Pattern | Describes the principles how two different parts of a message passing system (in our case: the service provider and the service consumer) interact and communicate with each other. Examples:  In the Request/Response MEP, the service consumer sends a request to the service provider in order to obtain certain information; the service provider provides the requested information in a dedicated response.  In the Publish/Subscribe MEP, the service consumer establishes a subscription with the service provider in order to obtain certain information; the service provider publishes information (either in regular intervals or upon change) to all subscribed service consumers. |
| Operational Activity | An activity performed by an operational node. Examples of operational activities in the maritime context are: Route Planning, Route Optimization, Logistics, Safety, Weather Forecast Provision, … |
| Operational Model | A structure of operational nodes and associated operational activities and their inter-relations in a process model. |
| Operational Node | A logical entity that performs activities. Note: nodes are specified independently of any physical realisation.  Examples of operational nodes in the maritime context are: Maritime Control Center, Maritime Authority, Ship, Port, Weather Information Provider, … |
| Service | The provision of something (a non-physical object), by one, for the use of one or more others, regulated by formal definitions and mutual agreements. Services involve interactions between providers and consumers, which may be performed in a digital form (data exchanges) or through voice communication or written processes and procedures. |
| Service Consumer | A service consumer uses service instances provided by service providers. All users within the maritime domain can be service customers, e.g., ships and their crew, authorities, VTS stations, organizations (e.g., meteorological), commercial service providers, etc. |
| Service Data Model | Formal description of one dedicated service at logical level. The service data model is part of the service specification. Is typically defined in UML and/or XSD. If an external data model exists (e.g., a standard data model), then the service data model shall refer to it: each data item of the service data model shall be mapped to a data item defined in the external data model. |
| Service Design Description | Documents the details of a service technical design (most likely documented by the service implementer). The service design description includes (but is not limited to) a service physical data model and describes the used technology, transport mechanism, quality of service, etc. |
| Service Implementation | The provider side implementation of a dedicated service technical design (i.e., implementation of a dedicated service in a dedicated technology). |
| Service Implementer | Implementers of services from the service provider side and/or the service consumer side. Anybody can be a service implementer but mainly this will be commercial companies implementing solutions for shore and ship. |
| Service Instance | One service implementation may be deployed at several places by same or different service providers; each such deployment represents a different service instance, being accessible via different URLs. |
| Service Instance Description | Documents the details of a service implementation (most likely documented by the service implementer) and deployment (most likely documented by the service provider). The service instance description includes (but is not limited to) service technical design reference, service provider reference, service access information, service coverage information, etc. |
| Service Interface | The communication mechanism of the service, i.e., interaction mechanism between service provider and service consumer. A service interface is characterised by a message exchange pattern and consists of service operations that are either allocated to the provider or the consumer of the service. |
| Service Operation | Functions or procedure which enables programmatic communication with a service via a service interface. |
| Service Physical Data Model | Describes the realisation of a dedicated service data model in a dedicated technology. This includes a detailed description of the data S-211 to be exchanged using the chosen technology. The actual format of the service physical data model depends on the chosen technology. Examples may be WSDL and XSD files (e.g., for SOAP services) or swagger (Open API) specifications (e.g., for REST services). If an external data model exists (e.g., a standard data model), then the service physical data model shall refer to it: each data item of the service physical data model shall be mapped to a data item defined in the external data model.  In order to prove correct implementation of the service specification, there shall exist a mapping between the service physical data model and the service data model. This means, each data item used in the service physical data model shall be mapped to a corresponding data item of the service data model. (In case of existing mappings to a common external (standard) data model from both the service data model and the service physical data model, such a mapping is implicitly given.) |
| Service Provider | A service provider provides instances of services according to a service specification and service instance description. All users within the maritime domain can be service providers, e.g., authorities, VTS stations, organizations (e.g., meteorological), commercial service providers, etc. |
| Service Specification | Describes one dedicated service at logical level. The Service Specification is technology-agnostic. The Service Specification includes (but is not limited to) a description of the Service Interfaces and Service Operations with their data S-211. The data S-211 description may be formally defined by a Service Data Model. |
| Service Specification Producer | Producers of service specifications in accordance with the service documentation guidelines. |
| Service Technical Design | The technical design of a dedicated service in a dedicated technology. One service specification may result in several technical service designs, realising the service with different or same technologies. |
| Service Technology Catalogue | List and specifications of allowed technologies for service implementations. Currently, SOAP and REST are envisaged to be allowed service technologies. The service technology catalogue shall describe in detail the allowed service profiles, e.g., by listing communication standards, security standards, stacks, bindings, etc. |
| Spatial Exclusiveness | A service specification is characterised as “spatially exclusive”, if in any geographical region just one service instance of that specification is allowed to be registered per technology.  The decision, which service instance (out of a number of available spatially exclusive services) shall be registered for a certain geographical region, is a governance issue. |

1. Service Specification XML

This appendix contains the formal definition of the service specification.

To be done.

1. Service JSON schema