Marine Navigational Services: Technical Specification for the Provision of AtoN Information Service to End-users

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# Introduction

This document is a specification for the technical service of provision of Marine Navigational Services to endusers, following the IALA guideline G1128.

In the context of e-navigation there are a number of maritime services, and each of these make reference to a number of associated technical services. The technical services themselves are described on three levels;

Service specification (this document)

Service design (one or more)

Service instance (one or more)

all the above documents are part of G1128, and are explained in that guideline.

The S-125 data model is outlined in the S-125 product specification.

According to the International Hydrographic Office, S-125 - Marine Navigational Services describe navigational features including lights and other navigation aids, both physical and virtual; temporary and seasonal marks; and local AIS application-specific messages. Navigational services information may be considered supplementary additional information that complements the S-101 ENC. This specific technical service may be referenced in other S-1xx product specifications and maritime services including MS12 - nautical publications, and possibly the newly proposed MS17 on AtoN.

This service specification may be used with the Maritime Connectivity Platform (MCP), where the MCP would provide means of authentication of service providers and service consumers as well as means of service discoverability.

## Purpose of the Document

The purpose of this service specification document is to provide a holistic overview of the service and its building blocks in a technology-independent way, according to the G1128 guideline. 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 service 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 service.

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

## Definitions

This following definitions describe terms used in this specification:

**Aid to Navigation (AtoN)** - A device, system or service, external to vessels, designed and operated to enhance safe and efficient navigation.

**Navigational Warning (NW)** - A broadcast message containing urgent information relevant to safe navigation.

**Maritime safety information (MSI)** - Navigational and meteorological warnings, meteorological forecasts and other urgent safety-related messages.

**Navaid** - An instrument, device or nautical publication carried on board a vessel for the purpose of assisting navigation.

**NAVAREA** - A geographical sea area, as shown in the appendix (IMO A.706(17) established for the purpose of co-ordinating the transmission of radio navigational warnings. Where appropriate, the term NAVAREA followed by an identifying roman nwneral may be used as a short title. The delimitation of such areas is not related to and shall not prejudice the delimitation of any boundaries between States.

**NAVAREA co-ordinator** - The authority charged with co-ordinating, collating and issuing long-range navigational warnings and NAVAREA warnings bulletins to cover the whole of the NAVAREA

**NAVTEX** - Single frequency time-shared broadcast system with automated reception and message rejection/selection facilities. Use of NAVTEX is regulated by the IMO NAVTEX Manual (IMO publication 951) .

**SafetyNET service** – Dedicated international satellite broadcast system with automated reception and message rejection/selection facilities.

**SafetyCast service** – Dedicated international mobile satellite service in the Global Maritime Distress and Safety System (GMDSS) for broadcasting navigational warnings, meteorological warnings and forecasts, and Search and Rescue (SAR) related information.

# 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 | TBD |
| ID | MRN assigned by IHO (ex: urn:mrn:iho:technicalservice:specification:basicatoninfo) |
| Version | x.x |
| Description |  |
| Keywords | Marine Navigational Service, AtoN information, S-125 |
| Architect(s) |  |
| Status | Provisional |

# Operational Context

This section describes the context of the service from an operational perspective.

## Pre S-125 Operational Context

From a practical perspective, the List of Lights is intended for use by mariners as a compendium to the navigational chart for AtoN information. In accordance with IHO S-12, The List of Lights and Fog Signals describe maritime signal installations on land or afloat producing light or sound signals (fog signals). In addition, these volumes contain information relating to certain other navigational aids: buoyage (day and night); signals (port signals, rescue signals, tide signals, etc.), radio-based aids (radio beacons, radar, radio navigation systems), etc.

IHO S-53, is concerned with drafting navigational warnings or with the issuance of meteorological forecasts and warnings under the Global Maritime Distress and Safety System (GMDSS). Maritime Safety Information (MSI) is promulgated in accordance with the requirements of IMO resolution A.705(17), as amended. Navigational Warnings are issued under the auspices of the IMO/International Hydrographic Organization (IHO) World-Wide Navigational Warning Service (WWNWS) in accordance with the requirements of IMO resolution A.706(17), as amended. Navigational Warnings (NW), including ATON casualties or changes which may impact navigational safety, are part of the Maritime Safety Information (MSI) system. This includes casualties to lights, fog signals, buoys and other aids to navigation affecting main shipping lanes as well as establishment of major new aids to navigation or significant changes to existing ones, when such establishment or change might be misleading to shipping. Currently, NW’s are promulgated as a radio broadcast and then printed in text format. The messages are standardized as SafetyNET, SafetyCast, NAVTEX broadcasts, and are in some countries accessible on the WWW or as voice broadcasts via coastal radio stations. System interfaces between NW publishers, NAVAREA (or Sub-Area) coordinator and broadcast service are not standardized, and may rely on manual processes involving e-mail, telephone, voice radio transmissions, fax, telex and manual re-entering of information from one system to another, or much more advanced solutions. Provision of NW via web is not standardized. NAVTEX, SafetyCast and SafetyNET cannot transport structured data formats for a joint NW-NM solution.

The pre-S-125 “present day” operational context of promulgation at the component level, is depicted below. A generalize assumption is made that information management systems are unique to each ATON Administration.:

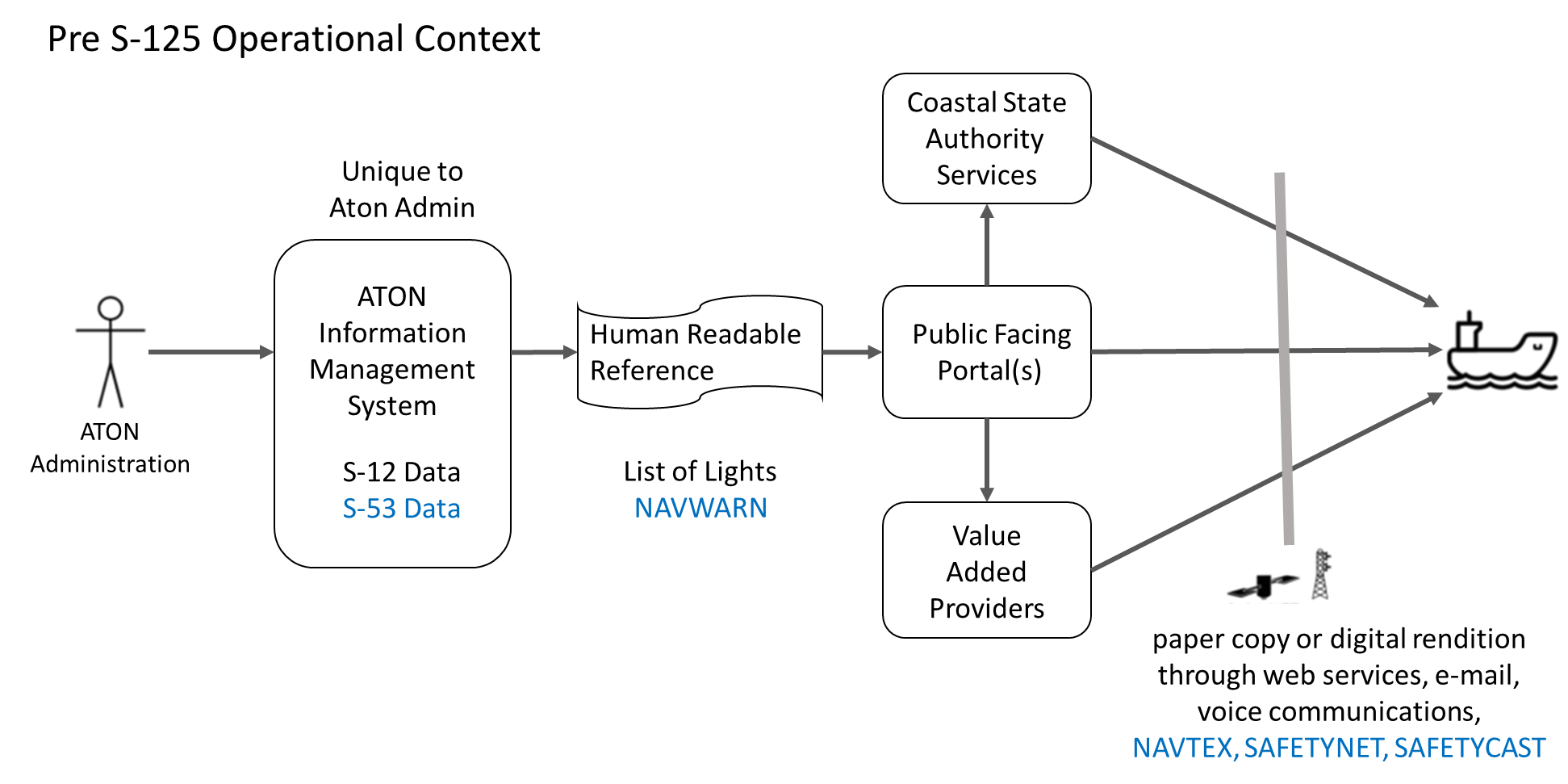


Figure 1: Pre S-125 “Present Day” Operational Context

System interfaces between AtoN Administrations, Hydrographic Officers, Nautical Publication Publishers, and dissemination methods are unique, and may rely on manual processes involving carriage of paper print copies or human readable digital renditions obtained via web services or email. Provision of the AtoN information included within the List of Lights via web services is not standardized.

## Envisioned Operational Context

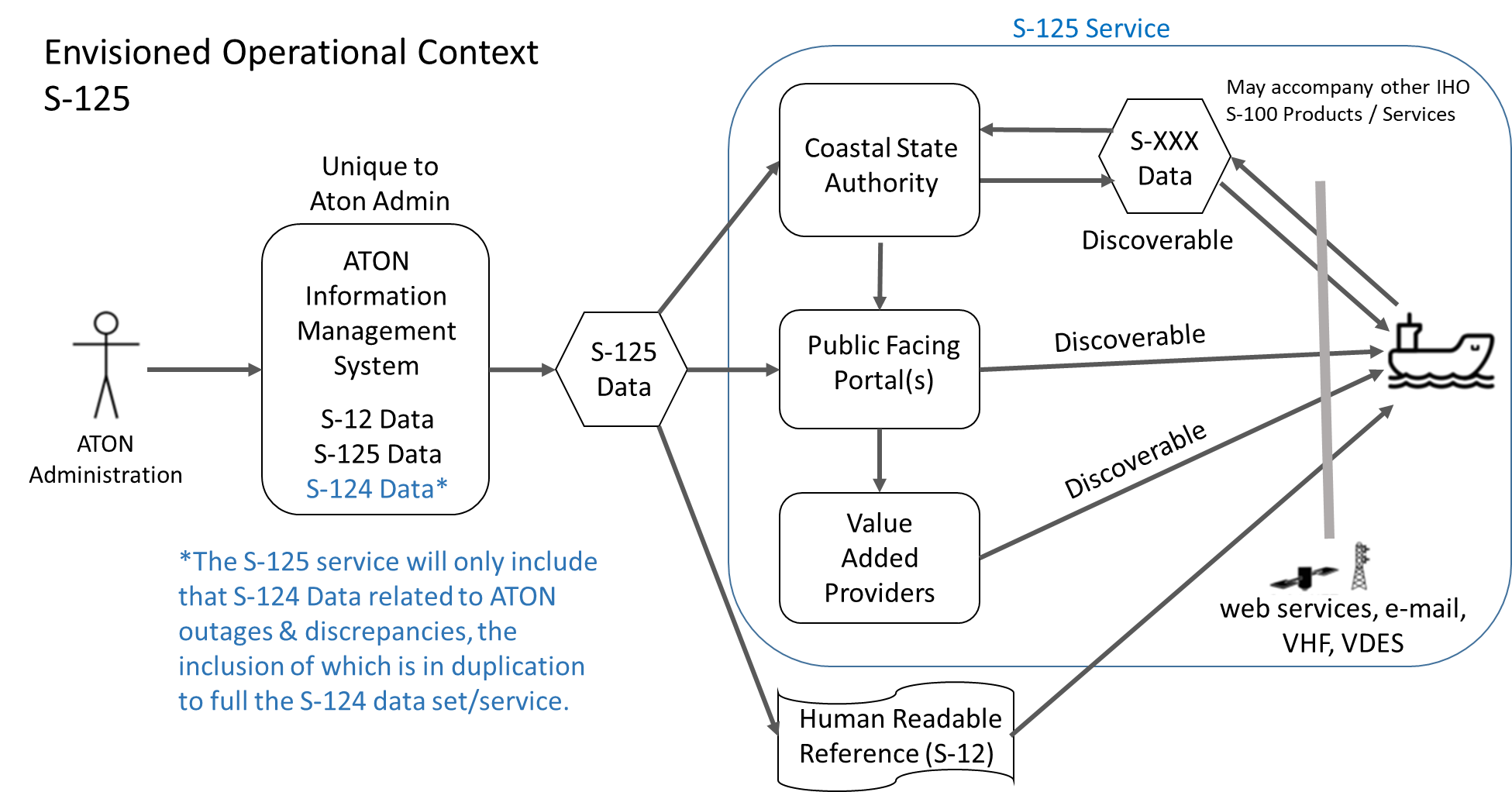


Figure 2: Envisioned S-125 Operational Context

This scenario depicts an envisaged future of S-125 data exchange Based on a standardized structured AtoN information (List of Lights) format, compatible systems will be able to exchange AtoN Data seamlessly. As depicted, each AtoN Administration may have a unique AtoN Information Management System. This system should automatically promulgate S-125 Data from the authoritative source for use by national and local authorities (e.g. Coastal State Authorities, Harbor and port authorities), the mariner public, as well as being available for use by commercial value added services providers. The provision of “S-125 Service” described in this document, is depicted as those activities after production of the S-125 data by ATON administrations in the above diagram. It is envisioned that the legacy IHO S-12 data is a sub component and replaced by S-125. Administrations may desire to continue providing S-12 format human readable “paper reference” List of Lights in addition to the S-125 Marine Navigation Services, either transitionally, or indefinitely.

AtoN Administrations will administer and publish local S-125 Data for their area of responsibility. Where appropriate should coordinate with adjacent or overlapping AtoN administrations who share responsibility within the same waterway. (e.g. Both the U.S. Coast Guard and Canadian Coast Guard maintain aids to navigation within the waterways comprising the Great Lakes.)

Relationship of S-124 to S-125

MSI Providers (National and NAVAREA Co-ordinators) are the recognised authorities for promulgating and cancelling Navigational Warnings. An AtoN outage, or discrepancy as further defined within the IHO S-53 standard, is reported as a Navigational Warning and immediately communicated by the S-124 service. Upon confirmation of the discrepancy, the responsible ATON authority will include the report of outage in the S-125 dataset. The inclusion of the reported outage as part of S-125 will be in duplication to warnings provided as part of S-124. MSI providers are responsible for the removal of any Navigational Warnings from applicable S-124, and the ATON authority is responsible for withdraw of the outage report from S-125. A Navigational Warning in S-124 will remain in force and continue to be promulgated by GMDSS broadcast services, since adding the information to the S-125 database will not, on its own, be sufficient to cancel the warning from GMDSS broadcast.

Whereas Navigation Warnings are disseminated as soon as possible via S-124, the S-125 dataset is updated on a routine cyclical basis. In this manner, time-critical Navigational Warnings regarding AtoN are rapidly disseminated to users via S-124 to provide awareness until the S-125 data set is updated. The duplication of long-term S-124 “temporary information” regarding AtoN Outages within S-125 will help lower the chance the mariner overlooks older critical navigation safety information. All in-force NAVAREA warnings should remain in S-124. The NAVAREA coordinators should be the only agency responsible for cancelling these warnings.

Relationship of S-125 to S-201

S-201 is a standard for compiling all data related to any AtoN including maintenance schedules, equipment types (such as battery and bulb types). S-201 is intended to be the means of communicating and exchanging such information with its main partners such as hydrographic offices, and in certain circumstances with IALA, within an AtoN organization or between AtoN organizations. The S-201 dataset, as a whole, is not intended for portrayal on navigation systems, like ECDIS. S-201 includes additional cartographic information to inform about AtoN services that would not be appropriate in a navigation system, such as positioning source confidence.

The S-125 product is derived from S-201 data. The S-125 service provides the machine-to-machine exchange of information for use in ECDIS/ECS and public distribution. S-125 is the digital equivalent of the extended list of lights in order to meet IMO SOLAS Chapter V requirements of having list of lights on board and serve as a continually updated list of AtoN and navaids. The organizational structure of Coastal State Authorities and Hydrographic Offices vary between nations. The authoritative source of S-201 data, including S-125, may also vary between nations. Therefore it is recommended all coastal state authorities should establish an appropriate organizational structure and designated authoritative source for S-201 and S-125 data. S-125 data serves as the AtoN compendium for charts, facilitating voyage monitoring functions by mariners, and also facilitates voyage planning by providing data related to proposed and advanced notice of changes to AtoN.

Discoverability and Dissemination

The S-125 data should be made available to public facing portals and be discoverable to mariners, Port State Authorities, and commercial value added providers. S-125 data should boost S-124 NW and ENC S-101 productions, especially by reducing the effort in the transformation of data, with the harmonization of data models. This could be accomplished by introducing efficient data exchange mechanism between authorities. It is envisioned that upon complying with applicable ship reporting requirements to Port State Authorities, a vessel would then receive available S-xxx data supporting Maritime Services (e.g. latest ENC S-101 updates, S-127 Marine Traffic Management, S-129 Under Keel Clearance, etc.) appropriate for their respective route. In terms of S-125 is means the exchange of data on recognition and navigational aspects of AtoN.

The S-125 Data received by ships will thus depend on the promulgation method of choice. If, say, a ship targets the website of a specific port authority; it may see only that data provided by the corresponding AtoN Administration. If, however, the ship queries for S-125 data via other non-governmental public portals, it will receive S-125 data from various national and local authorities relevant to its current position and planned routes. The S-125 Service detailed in this specification only caters for a small part of this promulgation regime. It exposes multiple service operations for machine to machine consumptions of all currently Aton Information from the targeted authority. It may be used by any client, such as a ship, a website or an app.

ECDIS Compatibility

Since S-125 is intended for ECDIS, it is required that S-125 comply with requirements of S-98, the Interoperability Catalogue Specification for ECDIS. This standard will govern how the various product layers will interact within an ECDIS. Within the IHO, S-98 is developed and maintained by S-100WG.

## Functional and Non-functional Requirements

The table below lists applicable functional requirements for the S-125 service.

Table 1: Requirements Tracing

|  |  |  |  |
| --- | --- | --- | --- |
| Requirement Id | Requirement Name | Requirement Text | References |
| **S-125R001** | Transmission of New datasets | Dataset with all current and valid AtoN Information. |  |
| **S-125R002** | Cancellation of dataset | Dataset which cancels, removes permanent AtoN information (e.g. an AtoN is disestablished) |  |
| **S-125R003** | Transmission of New dataset - Temporary Changes | Dataset with a new AtoN Information regarding temporary changes (e.g. 6 months of less) which will ultimately return to previous configuration. |  |
| **S-125R004** | Transmission of  New dataset – Cancellation of Temporary Changes | Dataset used to cancel previous AtoN Information regarding temporary change, restoring AtoN to permanently assigned configuration. |  |
| **S-125R005** | Transmission of New dataset – Proposed Changes to AtoN | Dataset with new AtoN Information regarding Proposed Changes to AtoN which the AtoN Administration is considering. |  |
| **S-125R006** | Transmission of New dataset – Withdraw of Proposed Changes to AtoN | Dataset used to withdrawl previous AtoN Information regarding Proposed Changes to AtoN. |  |
| **S-125R007** | Transmission of New dataset – Advance Notice of Changes to AtoN | Dataset with new AtoN Information regarding Approved Changes to AtoN which the AtoN Administration will be executing on or about a given time. |  |
| **S-125R008** | Transmission of New dataset – Withdraw of Advance Notice of Changes to AtoN | Dataset used to withdrawl previous AtoN information regarding advance notice of changes to AtoN once the changes have been executed. This data would be send simultaneous to corresponding S-125R001 representing the new permanent AtoN data. |  |
| **S-125R009** | Transmission of New Dataset –Application Specific Messages | Dataset with new Local AIS Application-Specific Messages providing maritime safety information |  |
| **S-125R010** | Transmission of New Dataset – Withdraw of Application Specific Messages | Dataset used to withdraw previous local AIS application-specific messages |  |
| **S-125R011** | Transmission of New dataset – AtoN Discrepancies & Outages | Dataset with new warnings regarding regarding AtoN discrepancies and outages. |  |
| **S-125R012** | Transmission of New dataset – Withdraw of AtoN Discrepancies & Outages | Dataset used to cancel warnings regardings AtoN discrepancies and outages |  |
| **S-125R009** | Subscription of datasets | Service consumers must be able to subscribe to new datasets and updates. |  |

The table below defines non-functional requirements for the S-125 service.

Table 2: Non-functional Requirements Definition

|  |  |
| --- | --- |
| Requirement Id | S-125NF001 |
| **Requirement Name** | Authenticity |
| **Requirement Text** | The recipient of AtoN Information data must be able to verify the authenticity of the received datasets. |
| **Rationale** |  |
| **Author** |  |

|  |  |
| --- | --- |
| Requirement Id | S-125NF002 |
| **Requirement Name** | Integrity |
| **Requirement Text** | It must be clear to both service provider and consumer whether changes have been made to the AtoN Information data after the dataset was created. |
| **Rationale** |  |
| **Author** |  |

|  |  |
| --- | --- |
| Requirement Id | S-125NF003 |
| **Requirement Name** | Availability |
| **Requirement Text** | The service must always be available with the ability to deliver AtoN Information to its consumers. |
| **Rationale** |  |
| **Author** |  |

|  |  |
| --- | --- |
| Requirement Id | S-125NF004 |
| **Requirement Name** | Performance – Time behaviour |
| **Requirement Text** | The service must provide a Response to a service consumer’s request instantly. New AtoN Information must be broadcasted to the service consumers as soon as the service provider has knowledge of these. |
| **Rationale** |  |
| **Author** |  |

|  |  |
| --- | --- |
| Requirement Id | S-125NF005 |
| **Requirement Name** | Modularity |
| **Requirement Text** | The services architecture must be constructed in such a way that individual functionality can be extended, modified or deleted, without changing the basic service architecture. |
| **Rationale** |  |
| **Author** |  |

## Other Constraints

### Relevant Industrial Standards

* *To be Developed*

### Operational Nodes

The following tables describe the operational nodes of the service.

Table 3: Operational Nodes providing the *S-124 NW* service

|  |  |
| --- | --- |
| Operational Node | Remarks |
| **AtoN Administration – AtoN Information Management System** | The AtoN Information Management System collects all AtoN Information available from its Authoritative Source (AtoN Administration). |
| **Port State Authority** | Governmental Agency responsible for overseeing vessel arrival within a respective area. Should facilitate dissemination of S-125 and other relevant S-xxx data sets |
| **Public Facing Portal (Governmental or NGO)** | S-125 and other S-xxx data sets should be made available to public facing portal by which mariners and value added service providers have access. Such portals must be discoverable. |
| **Ships** | Ships sailing in 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 4: Operational Activities supported by the *XYZ* service

|  |  |
| --- | --- |
| Operational Activity | Remarks |
| **TBD** |  |

# Service Overview

## Service Interfaces

In below description the service interfaces for the S-125 service are shown.

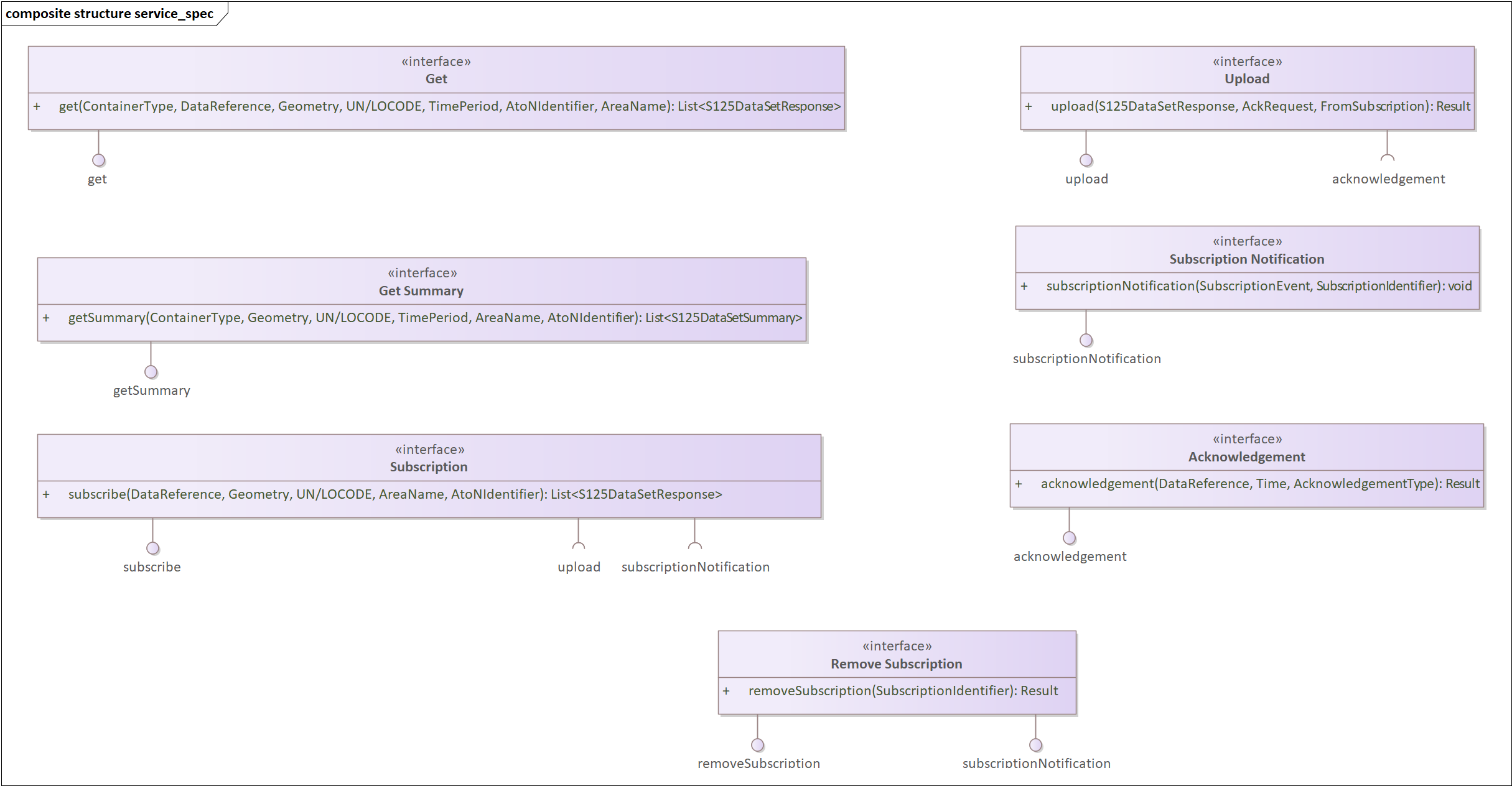


Figure 3: S-125 service Interface Definition diagram

Table 5: Service Interface overview

|  |  |  |  |
| --- | --- | --- | --- |
|  | ServiceInterface | ExchangePattern | Definition |
| PUSH | Upload | REQUEST\_CALLBACK | Interface for uploading (pushing) information to consumer  ConsumerInterface:  Acknowledgement |
| Acknowledgement | ONE\_WAY | Interface for acknowledgement |
| PULL | Get | REQUEST\_RESPONSE | Interface to ask for (pulling) information from producer |
| Get List | REQUEST\_RESPONSE | Interface to ask for (pulling) a list of information from producer |
| SUBSCRIPTION | Subscription | PUBLISH\_SUBSCRIBE | Interface to create subscription of information  ConsumerInterface:  SubscriptionNotification  Upload |
| Subscription Notification | ONE\_WAY | Interface for notification from subscription events |
| Remove Subscription | ONE\_WAY | Interface for removal of subscription(s) |
| Get Subscription List | REQUEST\_RESPONSE | Interface to retrieve a list of active subscriptions |
| HELP | Capability | REQUEST\_RESPONSE | Interface to ask for the interface capabilities |
| Description | REQUEST\_RESPONSE | Interface to ask for a short description of the service |

# Service Data Model

This section describes the logical data structures to be exchanged between providers and consumers of the service.

Note that the S-100 specification [4] describes in its Appendix 9-B how S-100 based data models shall be formulated in XML schema format.

Included in the service data model is a full description followed by specific extracts for;

* AtoN Information Features and Information types
* Enumerations
* Complex Attributes

For complete and updated documentation refer to the latest S-125 Product Specification which can be found [reference missing].

## Service Internal Data Model

As the S-125 data model used to represent the transmitted data is developed independently from this service specification, a way to store additional service metadata that is not directly related to the data model (internal service identifies, signatures, etc.) is required. For further information, refer to IALA Guideline 1157. This metadata is mostly implementation specific and therefore not discussed in this service specification. An example of how to implement this can also be found in the SECOM standard [8]. To indicate S-125 datasets that are coupled with additional service metadata, we refer to the type *S125DataSetResponse (see Figure 4)*.

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Automatisch generierte Beschreibung

Figure 4: S125DataSet coupled with service metadata.

# Service Interface Specifications

This chapter describes the details of each service interface. The following sections describe the interfaces that must be provided by the service provider. According to IEEE, an interface is “a shared boundary across which information is passed” [7]. To establish a service for the exchange of AtoN information, information is mainly provided by the service provider and is requested from the service consumer via the interfaces of the service provider. However, requirement S-125R009 states that a consumer must be able to subscribe to updates of the service. On the technical level, this may be realized in different ways. For example, the SECOM standard [8] requires the consumer to expose interfaces, to which new information can be pushed directly. Other technical designs may use a message broker as a middleware between consumer and provider, such that the consumer must not expose any public interfaces. For this reason, consumer interfaces are modelled separately at the end of this section and may be implemented by other technical means as the service provider’s interfaces.

To ensure the integrity of the transmitted information, responses or requests from the service provider must be signed digitally by the service provider independently from the signature that is applied to the S-125 dataset itself. The transmitted data may be encrypted for transport. Authentication of service consumer is left as an implementation decision to the service provider.

Furthermore, interfaces that are used internally by an AtoN information service provider to transfer datasets from an internal information management system to the specified service are not discussed, as they are specific to those systems and not relevant for consumers of the service.

The Service Interface specification covers only the static design description while the dynamic design (behaviour) is described in chapter 7. The interfaces are designed to be compliant to the SECOM standard on a basic level. However, the SECOM standard explicitly prescribes the usage of certain technologies (such as REST). Therefore, this service specification provides an abstraction layer above SECOM, that makes it possible to also realize the interfaces with different technology stacks than SECOM.

## Get Interface

The Get interface is used for pulling AtoN information from a service provider. The consumer can filter for AtoN information by its reference, geometry and time.

### Operation

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Automatisch generierte Beschreibung

Figure 5: Get Interface

### Operation Functionality

The operation can be used for retrieving and filtering AtoN information from the service provider. If no parameters are given, the return is either an empty list or all available datasets. A service provider may offer different encodings of AtoN information in accordance to the S-100 standard, which can be specified as an enumeration (XML/GML or binary). A service provider is required to offer at least one of the available encodings. If multiple query parameters are provided, only results are returned that match all requested filters.

### Operation Parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters (in)** | **Encoding** | **Mult.** | **Description** |
| ContainerType | Enumeration | 0..1 | Requested encoding of the data. If not provided, the service provider determines the standard encoding. |
| DataReference | see technical design | 0..1 | The reference can be provided as search criteria. A list of references can be retrieved via Get Summary interface.  If no references are provided, it's up to the service to decide what to return. |
| AtoNIdentifier | MRN | 0..1 | An MRN can be provided to query information related to a specific AtoN. |
| Geometry | see technical design | 0..1 | Geometry condition for geolocated information objects. This can be used to filter on geometric shapes (e.g. filter AtoN information by a bounding box). |
| AreaName | see technical design | 0..1 | Name of defined area (e.g. “German Bight”) |
| UN/LOCODE | see technical design | 0..1 | Code of defined object (e.g. “CN” for China) |
| TimePeriod | see technical design | 0..1 | Time related to validity of information objects |

|  |  |  |  |
| --- | --- | --- | --- |
| **ReturnType (out)** | **Encoding** | **Mult.** | **Description** |
| List of S125DataSetResponse | List of | 0..\* | Information object(s) in return |

### Dependency

ConsumerInterface

* No dependency.

ExchangePattern

* REQUEST\_RESPONSE

## Get Summary Interface

The Get interface is used for pulling a list AtoN information (without the actual data sets) from a service provider. The consumer can filter for AtoN information by its reference, geometry, AtoN identifier and time.

### Operation

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Automatisch generierte Beschreibung

Figure 6: Get Summary Interface

### Operation Functionality

The operation can be used for retrieving and filtering a list of AtoN information data sets from the service provider. If no parameters are given, the return is either an empty list or all available datasets. If multiple query parameters are provided, only results are returned that match all requested filters. This operation is typically used to save bandwidth and make the query process faster by retrieving a summary of the information and then only querying specific data sets from the service provider via the Get interface.

### Operation Parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters (in)** | **Encoding** | **Mult.** | **Description** |
| AtoNIdentifier | MRN | 0..1 | An MRN can be provided to query information related to a specific AtoN. |
| Geometry | see technical design | 0..1 | Geometry condition for geolocated information objects. This can be used to filter on geometric shapes (e.g. filter AtoN information by a bounding box). |
| AreaName | see technical design | 0..1 | Name of defined area (e.g. “German Bight”) |
| UN/LOCODE | see technical design | 0..1 | Code of defined object (e.g. “CN” for China) |
| TimePeriod | see technical design | 0..1 | Time related to validity of information objects |

|  |  |  |  |
| --- | --- | --- | --- |
| **ReturnType (out)** | **Encoding** | **Mult.** | **Description** |
| List of [ReferenceIdentifier, Name, Description, Size, Status] | List | 0..\* | Metadata of available AtoN information, that match the search parameters. |

### Dependency

ConsumerInterface

* No dependency.

ExchangePattern

* REQUEST\_RESPONSE

## Subscribe Interface

The purpose of the interface is to facilitate request subscription of AtoN information, filtered by specific information according to parameters, or the information decided upon by information provider.

### Operation

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Automatisch generierte Beschreibung

Figure 7: Subscribe Interface

### Operation Functionality

The Subscribe interface should be used to subscribe to AtoN information. A specific AtoN dataset is identified by the DataReference parameter. The reference identifier of AtoN information datasets can be retrieved by the Get Summary interface. If no id is specified, the consumer subscribes to updates on all datasets that match the provided query parameters. If an id is provided, the query parameters will be ignored.

### Operation Parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters (in)** | **Encoding** | **Mult.** | **Description** |
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| DataReference | see technical design | 0..1 | The reference can be provided as matching criteria. A list of references can be retrieved via Get Summary interface. |
| Geometry | see technical design | 0..1 | Geometry condition for geolocated information objects. This can be used to filter on geometric shapes (e.g. filter AtoN information by a bounding box). |
| AreaName | see technical design | 0..1 | Name of defined area (e.g. “German Bight”) |
| UN/LOCODE | see technical design | 0..1 | Code of defined object (e.g. “CN” for China) |

|  |  |  |  |
| --- | --- | --- | --- |
| **ReturnType (out)** | **Encoding** | **Mult.** | **Description** |
| Subscription Identifier | see technical design | 0..1 | Identifier for the created subscription. To be used in remove subscription.  If the subscription request corresponds to more than one information object, all information objects will be part of one subscription. |

### Dependency

ConsumerInterface

* Upload
* Subscription Notification

ExchangePattern

* PUBLISH\_SUBSCRIBE

## Remove Subscription Interface

Subscriptions can be removed either internally by the service provider, or externally by the consumer using this interface.

### Operation

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Automatisch generierte Beschreibung

Figure 8: Remove Subscription Interface

### Operation Functionality

The Remove Subscription interface should be used to request removal of Subscription(s), which were created earlier through the Subscription Interface.

### Operation Parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters (in)** | **Encoding** | **Mult.** | **Description** |
| SubscriptionIdentifier | see technical design | 0..1 | Specific identifier of the information object to remove subscription for. If no id entity provided, all subscriptions for the caller are removed. |

|  |  |  |  |
| --- | --- | --- | --- |
| **ReturnType (out)** | **Encoding** | **Mult.** | **Description** |
| Result from operation | see technical design | 0..1 | Confirmation or error message |

## Acknowledgement interface

Interface provided to cater for acknowledgement of received information.

**Note**: This may not be implemented as a separate interface as different technologies already implement this functionality on other levels (e.g., see TCP ACKs or RabbitMQ/Kafka message Acknowledgement).

### Operation

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Figure 9: Acknowledgement Interface

During upload of information, an acknowledgement can be requested, when the information has been delivered to the end system by the consumer service. The acknowledgement contains reference to the information product delivered

### Operation Functionality

The operation shall be used, for uploading an acknowledgement when uploaded information product is forwarded to parent application or message opened by the operator.

### Operation Parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters (in)** | **Encoding** | **Mult.** | **Description** |
| Reference | UUID | 1 | Reference to acknowledged object |
| Time | see technical design | 1 | Time when delivered or opened |
| AcknowledgementType | see technical design | 1 | Type of acknowledgement (technical delivery ACK, or operational “message opened” ACK) |

|  |  |  |  |
| --- | --- | --- | --- |
| **ReturnType (out)** | **Encoding** | **Mult.** | **Description** |
| result from operation | see technical design | 1 |  |

### Dependency

ConsumerInterface

* No dependency.

ExchangePattern

* ONE\_WAY

## Capability Interface

The purpose of the interface is to provide a dynamic method to ask a service instance at runtime what interfaces that are accessible and what payload formats and versions are valid.

### Operation



Figure 10: Capability Interface

### Operation Functionality

This interface should be used to get a List of available capabilities of this service. This can also include any kind of Service Metadata.

### Operation Parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters (in)** | **Encoding** | **Mult.** | **Description** |
| - |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **ReturnType (out)** | **Encoding** | **Mult.** | **Description** |
| Capability | see technical design | 1 | Description of service capabilities. S-100 sections 4a-5.7 and 14-8 may be referred here. Additionally including the accepted payload format and version, and specific requirements in payload etc. |

### Dependency

ConsumerInterface

* No dependency.

ExchangePattern

* REQUEST\_RESPONSE

## Upload interface (consumer interface)

The purpose of this interface is to upload (push) AtoN information object to a consumer. This is only the case if a consumer added subscriptions using the Subscription interface.

**Note**: This may not be implemented as a separate interface as different technologies already implement this functionality on other levels (e.g., by using a message-oriented middleware like RabbitMQ or Kafka).

### Operation

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Automatisch generierte BeschreibungFigure 11: Upload interface

This operation is used both in single uploads and uploads during subscription. The parameter <FromSubscription> indicates true/false whether upload within or outside any subscription by the consumer.

When uploading the message, an acknowledgement can be requested which is expected to be received when the uploaded message has been delivered to end system (technical acknowledgement), and, if supported, an acknowledgement when the message has been opened (read) by the end user (operational acknowledgement).

### Operation Functionality

The operation shall be used for uploading (push) information product to a consumer. The operation expects one single information product (S-124 Dataset) in specified format as payload.

### Operation Parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters (in)** | **Encoding** | **Mult.** | **Description** |
| S125DataSetResponse | See technical design | 1 | S-125 Dataset which conforms to data product specification including the service metdata (see section 5.1). |
|  |  |  |  |
| FromSubscription | Boolean | 0..1 | Flag to indicate whether the payload has been uploaded within an active subscription or not. |
| AckRequest | Boolean | 0..1 | Flag to indicate that acknowledgement is expected when delivered, and an acknowledgement when message has been opened (read) by end user.  True if acknowledgement is requested |

|  |  |  |  |
| --- | --- | --- | --- |
| **ReturnType (out)** | **Encoding** | **Mult.** | **Description** |
| result from operation | see technical design | 1 | Reference for acknowledgement |
|  |  |  |  |

### Dependency

ConsumerInterface

* Consumes the Acknowledgement service interface, if requested.

ExchangePattern

* REQUEST\_CALLBACK if Acknowledgement is requested.

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## Subscription Notification Interface (consumer interface)

The interface receives notifications when subscription is created or removed by information producer.

**Note**: This may not be implemented as a separate interface as different technologies already implement this functionality on other levels (e.g., by using a message-oriented middleware like RabbitMQ or Kafka).

### Operation

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Automatisch generierte Beschreibung

Figure 12: Subscription Notification Interface

### Operation Functionality

The interface receives notifications when subscription is created or removed, either internally by information owner, or externally on request.

### Operation Parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters (in)** | **Encoding** | **Mult.** | **Description** |
| SubscriptionIdentifier | see technical design | 1 | Identifier of the subscription. |
| SubscriptionEvent | see technical design | 1 | Type of event; Create, Delete |

|  |  |  |  |
| --- | --- | --- | --- |
| **ReturnType (out)** | **Encoding** | **Mult.** | **Description** |
| Result from operation | see technical design | 1 |  |

### Dependency

ConsumerInterface

* No dependency.

ExchangePattern

* ONE\_WAY

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# Service Dynamic Behaviour

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

Note: The specific authentication procedure that is being applied is out of scope of the service specification and is described in the technical designs of this service.

## Get interface

Usage of Get interface is shown for use cases (perspectives) below;

* Used for requesting a specific information object from the service provider. Initiated by the service consumer.

The Get interface can be used by the service consumer to request information objects (typically AtoN Information) from the service provider. For this action, the identifier of the information object can be used. This identifier can for example be retrieved from the Get Summary interface (see below).



Figure 13: Get Interface sequence diagram

## Get Summary interface

Usage of Get Summary interface is shown for use cases (perspectives) below;

* Retrieves a list of accessible information objects. Initiated by the service consumer.

The service consumer asks for a list of S-125 information objects that are accessible by the external service. If no information is accessible, an empty list will be returned.

The external service can use the given identifier in the Get interface to retrieve the complete information object or request a subscription of the information object.

Figure 14 shows a typical usage of the Get Summary interface. The service consumer requests the list of accessible information objects via the interface and directly receives a response from the service provider. Then, the service consumer selects a reference id from the list and requests detailed information (e.g. a complete S-125 dataset) with the Get interface. This information is then sent to the client as direct response of the Get request.



Figure 14 Get List Interface Diagram

The transmission of a S-125 information object can also be initiated by the service consumer using the Get command (see below).

## Acknowledgement interface

Usage of Acknowledgement interface is shown for use cases (perspectives) below.

* Acknowledging the retrieval of a message sent by either the service (e.g., in a subscription).

The Acknowledgement interface is used for confirming the retrieval of uploaded data using the Upload interface.

## Subscription interfaces

Usage of Subscription interfaces are shown for use cases (perspectives) below;

* The service consumer subscribes to an S-125 information object provided by the service provider, i.e. requests a subscription.
* The consumer is notified about changes in subscriptions (via Subscription Notification interface).
* The consumer removes a subscription of an S-124 information object (via Remove Subscription interface)

The service consumer asks for a subscription of a specific information object. Whenever an update of this object is available to the service provider, the Upload interface is used to deliver this object to the service consumer. A subscription can also be removed with the Remove Subscription interface. In this case, updates are no longer delivered to the client. Directly after a subscription is created or deleted a notification will be sent to the service consumer for confirmation.

Figure 15 illustrates the typical behaviour of subscriptions. First, a subscription is created by the service consumer with the Subscription interface, this is confirmed by the SUBSCRIPTION CREATED NOTIFICATION. Then, whenever an update for the subscribed id is available to the service provider, the Upload interface is used to push this information to the consumer. The subscription can be ended by the Remove Subscription interface and is confirmed by the SUBSCRIPTION REMOVED NOTIFICATION.



Figure 15 Subscription Requested by external service

## Capability interface

Usage of Capability interface is shown for use cases (perspectives) below;

* The service consumer retrieves all capabilities of the services provider related to S-125 information exchange.

## Upload Interface

Usage of upload interface is shown for use cases (perspectives) below;

* Upload message initiated from service provider to service consumer

The service producer may request acknowledgement, which is sent by the service consumer when the uploaded message was delivered successfully. The acknowledgement contains reference to the identity of the message given in the upload request.

The service provider also indicates whether the uploaded message is within a subscription, or if it is a one-time upload of data, hence no updates can be expected if not within a subscription.



Figure 16: Upload message initiated by service provider with acknowledgement.

# 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 Name |  | Maritime Resource Name, ENAV17-n.n.n |
| 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 draft 63173-2 ED1 | draft |  |
| 1. IALA Guideline G1128 |  | THE SPECIFICATION OF e-NAVIGATION TECHNICAL SERVICES |
| 1. Standard Glossary of Software Engineering Terminology |  | „IEEE Standard Glossary of Software Engineering Terminology“. IEEE Std 610.12-1990, Dezember 1990, 1–84. <https://doi.org/10.1109/IEEESTD.1990.101064>. |
| 1. SECOM | ED1 | IEC CD 63173-2 ED1: MARITIME NAVIGATION AND RADIOCOMMUNICATION  EQUIPMENT AND SYSTEMS –  DATA INTERFACE –  Part 2: Secure communication between ship and shore (SECOM) |

# 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-124 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-124. The data S-124 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.