NW-NM Service Specification v0.1

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Document status

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0.1	26.04.2016	POP	Initial version

Review

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“This project has received funding from the *European Union’s Horizon 2020 research and innovation programme* under grant agreement No 636329”.

Contents

"This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 636329".

“This project has received funding from the *European Union’s Horizon 2020 research and innovation programme* under grant agreement No 636329”.

1 Introduction

1.1 Caveat

This specification has been written at an early stage of the EfficienSea 2 project, where the NW-NM model, API and implementation (project *Niord*) is nowhere near completion. The main purpose of the document is to serve as a discussion paper at an upcoming E2 conference.

Compared with the Service Specification Guidelines [1], this specification has adopted the following changes:

- Since the NW-NM service is comprised of a single service operation (at the time of writing), chapters 6 and 7 has been merged into one.

1.2 NW-NM

Navigational Warnings (NW) and temporary / preliminary Notice to Mariners (NM T&P) have many similarities and few differences. They largely serve the same purpose, with the main differences being down to the current speed, quality assurance and methods of promulgation.

Navigational Warnings (NW) are part of the Maritime Safety Information (MSI) system. Currently, NW's are promulgated in text via SafetyNET, NAVTEX, and is in some countries accessible on the WWW or as voice broadcasts via coastal radio stations.

Notices to Mariners (NM) are promulgated weekly in order to keep nautical charts and publications, as far as possible, up to date. Temporary (T) and Preliminary (P) NMs advise mariners of important matters affecting navigational safety, including new hydrographic information (in advance of new editions or chart updates), changes to routing measures and aids to navigation, and other important categories of data. NM T&P's are today promulgated on paper weekly, fortnightly or monthly and are often accessible on the WWW in PDF format. Not all ENCs include T&P information currently.

As part of EfficienSea 2, a combined NW-NM model, and promulgation thereof, is being developed and tested. This involves the specification of an NW-NM service and implementation of an NW-NM service instance that can be integrated with the Maritime Cloud eco system.

The requirements for the NW-NM service is further detailed in the the project document "NW-NM service description and requirements gathering" [2].

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1.3 Purpose of the document

The purpose of this service specification document is to provide a holistic overview of the MW-NM service and its building blocks in a technology-independent way, according to the guidelines given in the Service Description Guidelines [1].

1.4 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 NW-NM 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.

1.5 Inputs from other projects

An approach to NW-handling and promulgation via AIS was tested during the initial EfficienSea project. The EPD was used to test and evaluate portrayal of NW's on a ECDIS-like device.

This was further developed in the ACCSEAS project, which also developed a combined MSI-NM model and interchange format, see [4], plus an authoring system and promulgation via the Maritime Cloud Messaging Service (please refer to www.maritimecloud.net).

The MSI-NM interchange format devised in the ACCSEAS project was furthermore used as input for IHO, targeting he S-124 NW specification - see [5].

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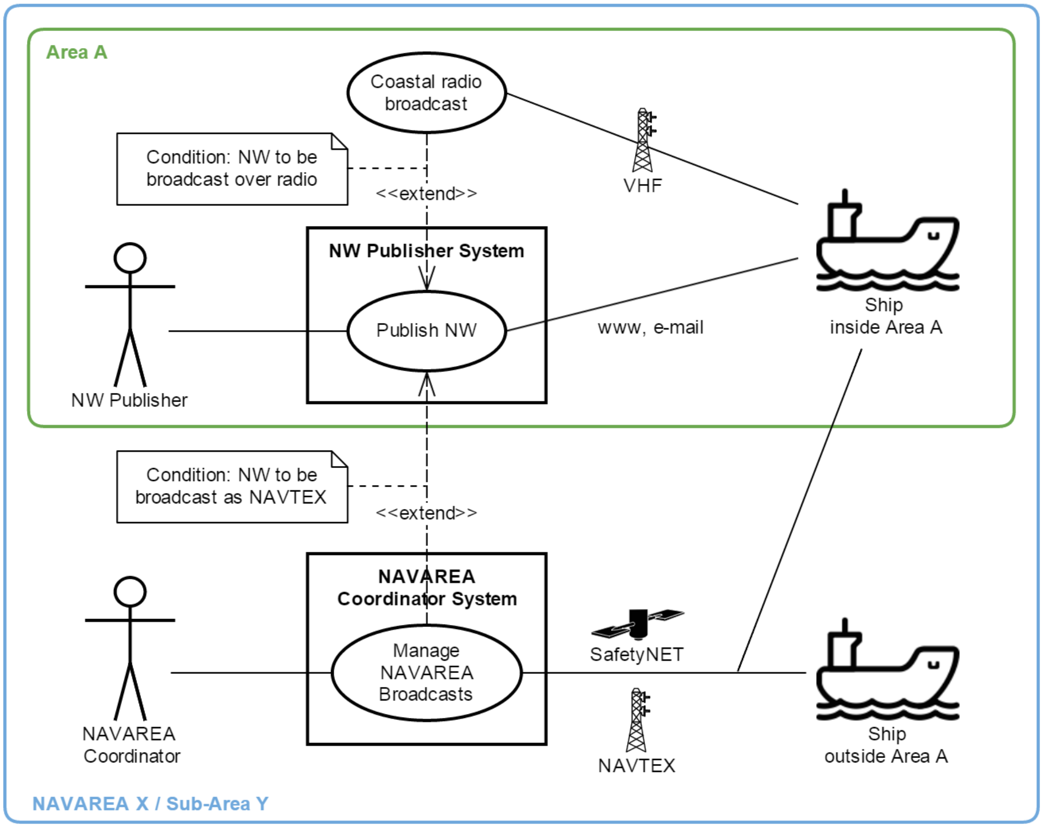
2 Service identification

Name	NW-NM T&P Maritime Cloud Service
ID	urn:mrnx:mcl:service:nw-nm
Version	0.1
Description	The NW-NM service specification defines a combined NW-NM T&P model along with the actual service API used for accessing NW-NM data, as registered in the Maritime Cloud service catalogue.
Keywords	NW, NM, Navigational Warnings, Notices to Mariners, MSI, Maritime Cloud Service.
Architect(s)	e-Navigation Team Danish Maritime Authority Carl Jacobsens Vej 31 DK-2500 København K Telephone: +45 40 72 61 08 Email: mcb@dma.dk
Status	Identified.

3 Operational context

3.1 Present Day Operational Context

Todays NW broadcast regime, i.e. the operational context of NW promulgation at the component level, is depicted below:



Please note, NM T&P provision is currently via ordinary mail, or downloadable as PDF via a webpage of the NM provider.

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 or NM via web is not standardized. NAVTEX and SafetyNET cannot transport structured data formats for a joint NW-NM solution.

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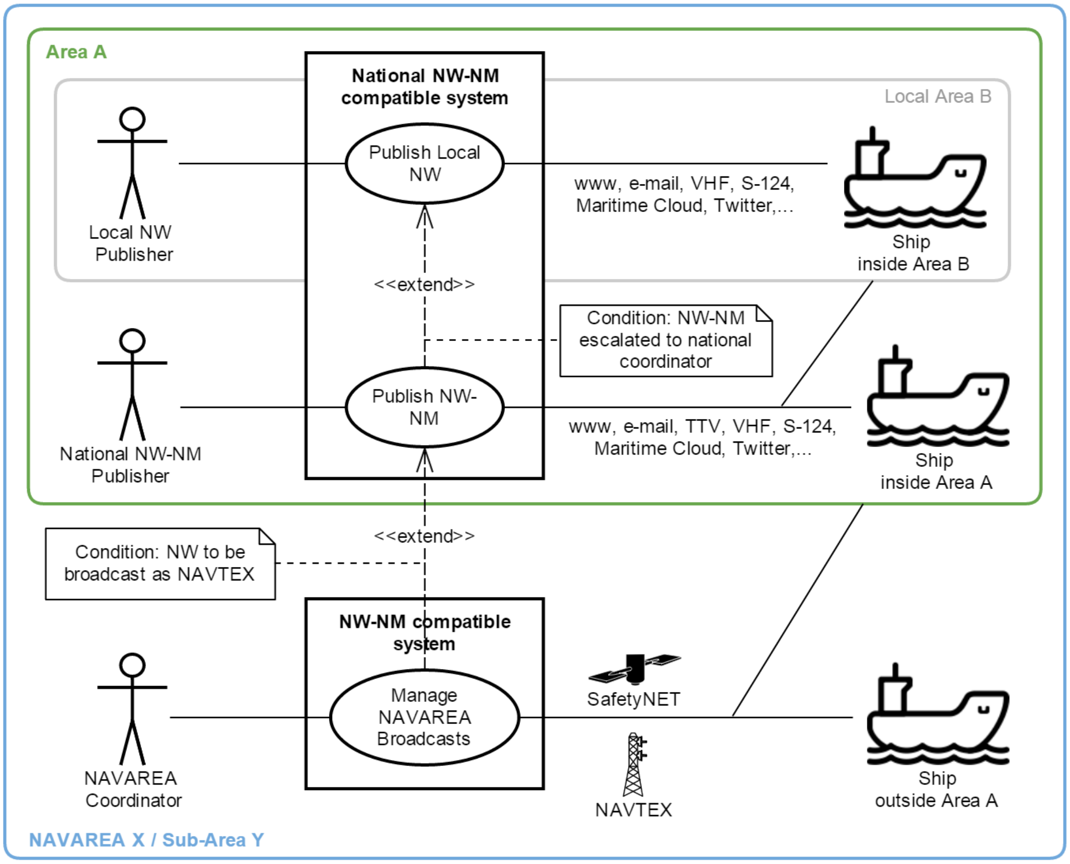
3.2 EfficienSea 2 Envisaged Operational Context



Area A
National NW-NM compatible system
Publish Local NW
Local Area B
Local NW Publisher
www, e-mail, VHF, S-124, Maritime Cloud, Twitter,...
Ship inside Area B
<<extend>>
Condition: NW-NM escalated to national coordinator
Publish NW-NM
National NW-NM Publisher
www, e-mail, TTV, VHF, S-124, Maritime Cloud, Twitter,...
Ship inside Area A
<<extend>>
Condition: NW to be broadcast as NAVTEX
NW-NM compatible system
Manage NAVAREA Broadcasts
NAVAREA Coordinator
SafetyNET
NAVTEX
Ship outside Area A
NAVAREA X / Sub-Area Y

This Scenario depicts an envisaged future NW & NM T&P promulgation regime, as explored in EfficienSea 2.

Based on a standardized structured NW-NM format, compatible NW-NM systems will be able to exchange NW and NM T&P seamlessly. As depicted, each country may have a national NW-NM system, used by local authorities (e.g. harbor and port authorities) as well as the national authorities and agencies (e.g. national maritime safety agencies or hydrographic offices).

Local authorities will administer and publish local NW for their area of responsibility, whereas the national authorities will cater for NW and NM T&P on the national level. Local authorities should have the ability to escalate NW to the national coordinator.

The NW-NM 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 the local NW published by this authority. If, however, the ship query for NW-NM via the Maritime Cloud, it will receive NW-NM from national and local authorities relevant to its current position and planned routes.

The NW-NM Service detailed in this specification only caters for a small part of this promulgation regime. It exposes a single service operation to fetch all currently published (*in*

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force) NW and NM message from the targeted authority. It may be used by any client, such as a ship, a website or an app.

3.3 Functional and Non-functional Requirements

The table below defines additional requirements for the NW-NM service.

Table 1: Requirements Definition

Requirement Id	**urn:mrn:mcl:requirement:nw-nm:1**
Requirement Name	Combined NW-NM model
Requirement Text	The data model should encapsulate a combined NW-NM model.
Rationale	Navigational Warnings (NW) and temporary / preliminary Notice to Mariners (NM T&P) have many similarities and few differences. They largely serve the same purpose, with the main differences being down to the current speed, quality assurance and methods of promulgation

Requirement Id	**urn:mrn:mcl:requirement:nw-nm:2**
Requirement Name	Return all published NW-NM messages.
Requirement Text	The NW-NM service should make it possible to retrieve all published NW-NM messages from the given service provider.

3.4 Other Constraints

3.4.1 Relevant Industrial Standards

The NW-NM model needs to cater for the IHO-IMO-WMO S-53 standard [S-53] on MSI (including NW) and the IHO S-4 standard [S-4] which covers NM T&P.

3.4.2 Operational Nodes

Table 2: Operational Nodes providing the NW-NM service

Operational Node	**Remarks**
National NW-NM Publisher	Typically, the national maritime safety agencies or hydrographic offices will produce the NW and NM messages and publish via various channels, including the NW-NM Service. Additionally, local authorities (e.g. harbor authorities) may publish local NW's via the national system.
NAVAREA (and Sub-AREA) publishers.	NAVAREA (or Sub-Area) coordinators will receive eligible NW messages from the national agencies and publish these in their area of responsibility.

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Table 3: Operational Nodes consuming the NW-NM service

Operational Node	Remarks
Ships, websites and apps	All sorts of clients can be envisaged to consume the published NW-NM messages. Examples may be an ECDIS on a ship, or a safety related sailing App.

3.4.3 Operational Activities

Table 4: Operational Activities supported by the NW-NM service

Operational Activity	Remarks
Showing published NW-NM messages on an ECDIS.	An ECDIS may first look for NW-NM service instances for a relevant area in the Maritime Cloud Service Registry. If one or more NW-NM services instances have been resolved, it will call the operation to retrieve all published NW-NM messages, and display these on an ECDIS.

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4 Service overview

4.1 Service Interfaces

The NW-NM service consists of a single service, exposing a single operation to query the currently published NW-NM messages (Request/Reply Message Exchange Pattern).

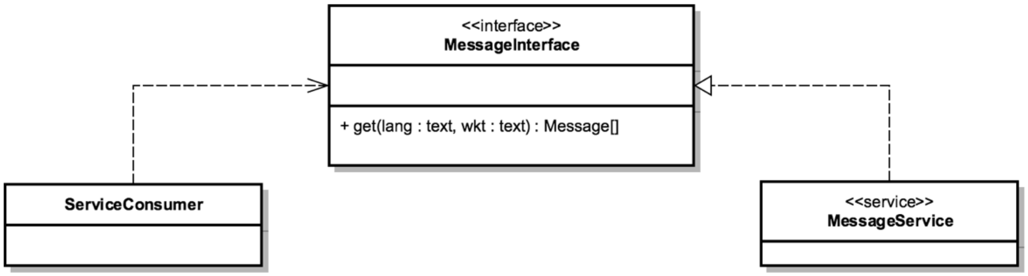

Figure 1: NW-NM Service Definition Diagram

ServiceInterface	Role (from service provider point of view)	ServiceOperation
MessageInterface	Provided	get(lang, wkt)

The returned data model is detailed in chapter 5 and the service operation in chapter 6.

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5 Service Data Model

This section describes the logical data structures of the NW-NM service. The combined NW-NM model needs to cater for the IHO-IMO-WMO S-53 standard on MSI (including NW) and the IHO S-4 standard which covers NM T&P.

The overarching idea has been to generalize the constituent parts and fields of NW and NM T&P messages, and make the format both backwards compatible and future-proof by e.g. adding support for:

- Multi-language support. All messages must be localizable to any number of languages, including the base data they reference (e.g. areas). The pattern adopted to support this, is to let all classes with localizable attributes (such as *Message*) have an associated list of description entities (*MessageDesc*) which contains a language code and the localizable fields. The description entities are yellow in the UML diagram below.

- Rich text support. NM's in particular, can contain a rich layout containing features such as tables, links, embedded pictograms, etc. By supporting HTML descriptions this can be accommodated.

- New identifier format. The S-4 and S-53 standards loosely specifies a numbering scheme for NWs and NMs. However, the numbering scheme does not guarantee uniqueness in a combined NW-NM model, let alone a system that may contain messages from multiple authorities. Thus, the NW-NM data model introduces *message series* and adds a unique MRN (maritime resource name) to each message.

- Base data. Part of a combined MSI-NM model is to define a relationship between messages and base data such as charts, categories and areas. Previous proposals have opted for rigid solutions with a fixed number of area and category levels, and with enumerated category values.

The UML detailing the Message class, and its related classes, is given below:

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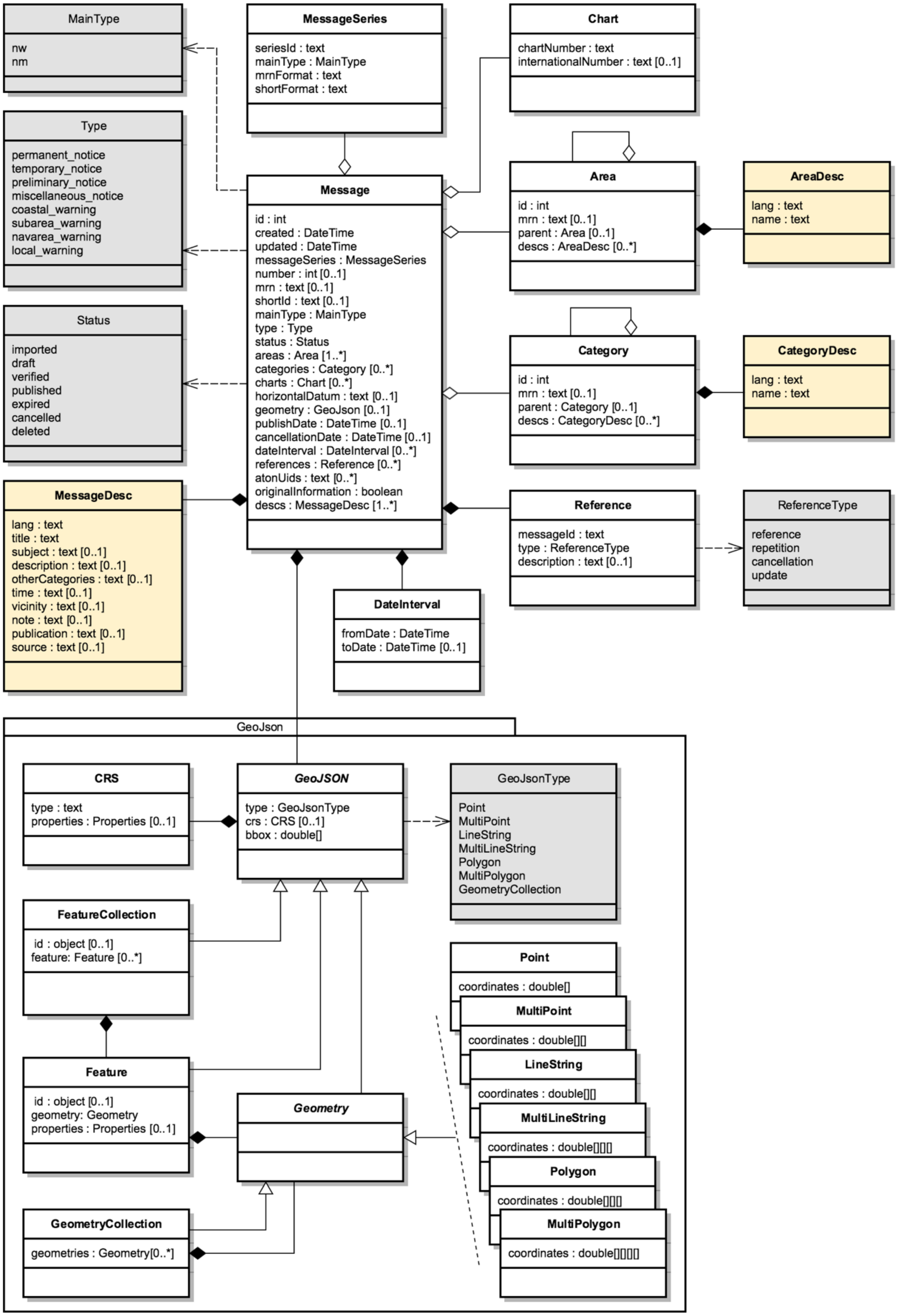

Figure 2: Message UML class diagram

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The use of aggregation vs composition connectors above is mostly academic, since the UML is not a database model but merely an interchange format. However, the aggregation connector is used to signal that the associated entity represents base data in the producing system, and is not tied to the life cycle of the Message.

The remainder of the chapter will detail the individual classes.

5.1 MessageSeries

According to IHO, NW and NM messages must be numbered. For NW, it is e.g. mandated that:

> *Navigational warnings in each series should be consecutively numbered throughout the calendar year, commencing with 1/YY at 0000 UTC on 1 January.*

The numbering scheme does not guarantee uniqueness in a combined NW-NM model, let alone a system that may contain messages from multiple countries and authorities. Thus, *message series* have been introduced in the NW-NM data model to group messages as appropriate. A country may e.g. have separate message series for NW and NM. However, they may also introduce separate message series to allow, say, local harbour authorities to maintain their own message series for local NWs, or, as is the case with Canada, divide the country into five regions, each with their own message series.

Each message series will also define the format used to generate a MRN (maritime resource name) and a short-ID for the message upon publication. The MRN must be globally unique (but is not very legible for an end-user), and the short-ID should be unique within the domain it is used in.

Attribute Name	Type	Description
seriesId	String	The ID of the message series in the implementing system.
mainType	MainType	Either NW or NM.
mrnFormat	String	The MRN format used to assign a globally unique MRN to the message upon publication. Example: “urn:mrn:iho:nw:dk:dma:${year}:${number}”
shortFormat	String	The short-ID format used to assign a short ID to the message upon publication. The short-ID should be legible for end-users. Example: “NW-${number-3-digits}-${year-2-digits}”

5.2 Chart

A message can be assigned a list of *charts*. The charts are maintained administratively as base data in the producing system.

Attribute Name	Type	Description
chartNumber	String	Mandatory regional chart number (and identifier).
internationalNumber	String	Optional international chart number.

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5.3 Area

Existing IHO standards for NW and NM both provide support for specifying multiple area levels (*general area* and *locality* for NW; *general region, sub-region* and *specific location* for NMs).

However, in the NW-NM system, this has been generalized, and areas are administratively maintained in a hierarchical area tree (with each area having a localized name) of arbitrary depth. A message can be assigned a list of these areas, and by implication, the parent areas of the selected area.

Additionally, a message can be assigned a localized textual *vicinity* description (part of the *MessageDesc* class – see 5.11), for detailed location information not defined in the area tree.

Attribute Name	Type	Description
id	Int	Internal system ID of the area
mrn	String	Optionally, an area may be assigned a globally unique MRN (maritime resource name). Adopting MRNs for areas would make interchange of message data between two NW-NM systems more robust.
parent	Area	Non-root areas will reference their parent areas. Example: Randers Havn -> Kattegat -> Danmark
descs	AreaDesc[]	The list of localizable attributes for an area. See 5.4.

5.4 AreaDesc

The AreaDesc class contains the list of localizable attributes for an area.

Attribute Name	Type	Description
lang	String	The ISO-2 language code.
name	String	The localized name of an area.

5.5 Category

Categories are administratively maintained in a hierarchical category tree (with each category having a localized name) of arbitrary depth. A message can be assigned a list of these categories, and by implication, the parent categories of a selected category.

At the top level, the categories will have entries such as *Aids to Navigation, Drifting Objects, Obstruction,* etc., which is the categorization used in the IHO standards. The sub-categories will represent the types of hazard relevant to the parent category. Examples of category lineages (top-down):

- AtoN -> Floating AtoN -> Buoy -> Buoy Established
- AtoN -> Light -> Light Unlit
- Obstruction -> Diving Operation

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Additionally, a message can be assigned a localized textual *otherCategories* description (part of the *MessageDesc* class – see 5.11), for arbitrary category information not defined in the category tree.

Attribute Name	Type	Description
id	Int	Internal system ID of the category
mrn	String	Optionally, a category may be assigned a globally unique MRN (maritime resource name). Adopting MRNs for categories would make interchange of message data between two NW-NM systems more robust.
parent	Category	Non-root category will reference their parent categories.
descs	CategoryDesc[]	The list of localizable attributes for a category. See 5.6.

5.6 CateogryDesc

The CategoryDesc class contains the list of localizable attributes for a category.

Attribute Name	Type	Description
lang	String	The ISO-2 language code.
name	String	The localized name of a category.

5.7 Reference

The Reference class provides a typed, weak reference to a message.

Attribute Name	Type	Description
messageId	String	An identifier of the reference message. If the messageId is recognized to be an MRN or short-ID of another message, it can e.g. be used to hyperlink to that message. However there are no requirements as to the format of the message ID.
type	ReferenceType	The type of the reference. One of the values "reference", "repetition", "cancellation" or "update".
description	String	An optional description of the reference.

5.8 DateInterval

A message will have an associated list of (possibly open-ended) date-time intervals, as defined by the DateInterval class. This defines the period of time for which the hazard described by the message applies.

Additionally, a message can be assigned a localized textual *time* description (part of the *MessageDesc* class – see 5.11).

Attribute Name	Type	Description
fromDate	DateTime	The start date-time of a date interval.
toDate	DateTime	An optional end date-time of a date interval.

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5.9 GeoJSON

The GeoJSON package is an implementation of an external data model, as defined at http://geojson.org/geojson-spec.html. The classes will not be detailed in this chapter.

GeoJSON was picked as the representation of a message geometry, because it is widely adopted by client libraries, and, unlike e.g. WKT, the GeoJSON Feature class has associated properties that can be used to store various information, that may be used in the portrayal of the messages.

The NW-NM system thus defines the following GeoJSON Feature properties, that a client may use for improved portrayal (but is not mandated to do so):

Property Name	Description
name:<<lang>>	Contains a language specific name that can be displayed for the geometry of the entire Feature. Example: name:en = Area of reduced depth.
name:<<x>>:<<lang>>	Contains a language specific name that can be displayed for the x'th coordinate of the geometry of the Feature. Example: name:12:en = yellow spar buoy with topmark.
parentFeatureId radius radiusType	These properties are mostly used by the producing system to let a geometry be defined from another geometry. As an example, an *affected area* may be defined as a buffered geometry with a radius of 200 meters around, say, the position of a wreck (this being the parent geometry). Clients may choose to adjust the portrayal of Features containing these properties, to signal that the feature represents an affected areas, and not the hazard itself.

5.10Message

The Message class represents either an NW or an NM message.

It has been a deliberate, if slightly controversial, choice to let NWs and NMs share the same Message class, rather than having a separate sub-class for each type. The main rationale for this is that NWs and NMs T&P are expected to converge in the future, once promulgation is handled completely via electronic means.

Attribute Name	Type	Description
id	Int	Internal system ID of the message
created	DateTime	The timestamp the message was created in the system.
updated	DateTime	The timestamp the message was last updated in the system.
messageSeries	MessageSeries	The message series of the message. See 5.1.
number	Int	The sequence number of a published message. See 5.1.
mrn	String	The MRN (maritime resource name) of a published message. See 5.1.
shortId	String	The short-ID of a published message. See 5.1.
mainType	MainType	The main type of the message, either NW or NM. In reality this attribute is redundant, since the main type is also defined by the associated message series, and may be

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Attribute Name	Type	Description
		implied by the message type.
type	Type	The sub-type of the message. One of: • permanent_notice • temporary_notice • preliminary_notice • miscellaneous_notice • coastal_warning • subarea_warning • navarea_warning • local_warning
status	Status	The status of the message. One of: • draft: • verified • published • expired • cancelled • deleted It is up to the producing system to manage the message life cycle, and enforce rules, such as: • Messages are created as drafts. • They can be assigned a secondary draft status, verified, to signal that they are ready for publication. • Only draft and verified messages can be deleted or published. • A published message can be cancelled manually or expired by the system if all associated date-intervals have passed.
areas	Area[]	A list of the areas of a message. See 5.3.
categories	Category[]	A list of the categories of a message. See 5.5.
charts	Chart[]	A list of the charts of a message. See 5.2.
horizontalDatum	String	The horizontal datum for the message. If unspecified, assume WGS-84.
geometry	GeoJSON	The GeoJSON geometry of the message. See 5.9.
publishDate	DateTime	The timestamp for when the message was published – or should be published.
cancellationDate	DateTime	The timestamp for when the message was cancelled.
dateIntervals	DateInterval[]	The list of (possibly open-ended) date intervals for which the hazard of the message applies. See 5.8.
references	Reference[]	A list of message references. See 5.7.
atonUids	String[]	A list of persistent AtoN unique IDs relevant to the message.
originalInformation	Boolean	If the message was based on original information or not.
descs	MessageDesc[]	The list of localizable attributes for a Message. See 5.11.

5.11MessageDesc

The MessageDesc class contains the list of localizable attributes for a message.

Attribute Name	Type	Description
lang	String	The ISO-2 language code.
title	String	A complete title line to show for a message. Typically composed by concatenating the area lineage, vicinity and subject of a message. Example: “Denmark. The North Sea. Hanstholm SW. AIS buoyage established.”
subject	String	The subject of the message. Example: “AIS buoyage established”
description	String	A description of the message. The type of the description field is mandated to be HTML, and thus allows for fairly advanced layout and typography, and may contain elements such as tables, links, images, etc.
otherCategories	String	May be used for localized arbitrary category information not defined in the category tree. See 5.5.
time	String	Can be used for a localized textual time description, as a supplement to the message date intervals. See 5.8.
vicinity	String	May be used for localized arbitrary area information not defined in the area tree. See 5.3.
note	String	A supplementary message note.
publication	String	Publications relevant to the message.
source	String	The source of the message hazard information.

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6 Service interface specifications

This chapter describes the details of the NW-NM service interface.

6.1 Service Interface MessageService

The NW-NM service is comprised of a single service (MessageService) and operation, which follows the Request/Reply Message Exchange Pattern. Sequence diagram:

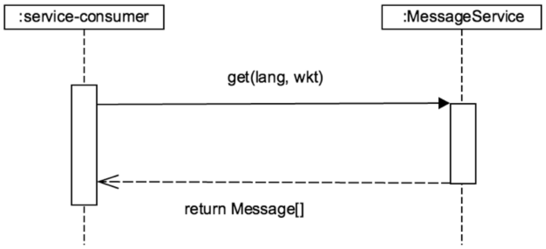

Figure 1: NW-NM Service Sequence Diagram

6.1.1 Operation get()

The get() operation returns the list of all published NW and NM messages. The returned result can be controlled using the following parameters:

Parameter	Type	Description
lang	String	An optional ISO-2 language code. If specified, only this language variant is returned for localized entities such as Message, Area and Category. However, if, say, “en” is requested and an entity only has a “da” language description entity, then this is returned instead. A client may want to flag this to the end user.
wkt	String	Optional Well-Known Text representation of a geometry. If specified, only messages intersecting the geometry will be returned.
Return	**Type**	**Description**
	Message[]	The list of matching published NW and NM.

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7 References

Nr.	Reference
[1] Service Description Guidelines	E2_Deliverable D3.4 – Service Specification Template, version 1.0
[2] NW-NM Service Description	E2 – 3.1.3 NW-NM service description and requirements gathering, version 0.1
[3] Maritime Cloud	Documented at www.maritimecloud.net
[4] MSI-NM in the ACCSEAS project	ACCSEAS MSI-NM Annex, version 1.0
[5] MSI-NM S-100 proposal	ACCSEAS MSI-NM S-100 Product Specification input paper, version 1.0.
[S-4]	Regulations of the IHO for International Charts and Chart Specifications of the IHO. Edition 4.3.0, August 2012, International Hydrographic Bureau, Monaco.
[S-53]	Manual on Maritime Safety Information (MSI). Special Publication No. 53, July 2009 Edition. International Hydrographic Bureau, Monaco.
[S-100]	Universal Hydrographic Data Model. IHO Special Publication No. S-100, Edition 1.0.0, January 2010. International Hydrographic Bureau, Monaco.

8 Acronyms and Terminology

8.1 Acronyms

Term	Definition
API	Application Programming Interface
DMA	Danish Maritime Authority
ECDIS	Electronic Chart Display Information Systems
ENC	Electronic Navigational Chart
EPD	e-Navigation Prototype Display
IHO	International Hydrographic Organisation
MC	Maritime Cloud
MEP	Message Exchange Pattern
MRN	Maritime Resource Name
MSI	Maritime Safety Information
NAF	NATO Architectural Framework
NM	Notices to Mariners
NW	Navigational Warning
REST	Representational State Transfer
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

8.2 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.
Navigational Warnings	Navigational Warnings (NW) are part of the Maritime Safety Information (MSI) system. Currently, NW’s are promulgated in text via SafetyNET, NAVTEX, and is in some countries accessible on the WWW or as voice broadcasts via coastal radio stations.
Niord	Anglified name of the Norse God Njord, associated with the sea and seafaring. Also the name of the EfficienSea 2 sub-project implementation of the NW-NM service and authoring system. See http://niord.org
Notices to Mariners	Notices to Mariners (NM) are promulgated weekly in order to keep nautical charts and publications, as far as possible, up to date. Temporary (T) and Preliminary (P) NMs advise mariners of important matters affecting navigational safety, including new hydrographic

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	information (in advance of new editions or chart updates), changes to routing measures and aids to navigation, and other important categories of data. NM T&P's are today promulgated on paper weekly, fortnightly or monthly and are often accessible on the WWW in PDF format. Not all ENCs include T&P information currently.
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 contractual provision of something (a non-physical object), by one, for the use of one or more others. 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 Implementer	Implementers of services from the service provider side and/or the service consumer side. Everybody can be a service implementer but mainly this will be commercial companies implementing solutions for shore and ship.
Service Instance	The implementation of a dedicated service in a dedicated technology. One service specification may result in several service instances, being implemented with different or same technologies.
Service Instance Description	Documents the details of a service instance (most likely documented by the service implementer). The service instance description includes (but is not limited to) a service instance model and describes the used technology, transport mechanism, quality of service, etc.
Service Instance Model	Describes the implementation of a dedicated service instance in a dedicated technology. This includes a detailed description of the data payload to be exchanged by this service instance. The actual format of the service instance 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 instance model shall refer to it: each data item of the service instance model shall be mapped to a data item defined in the external data model.

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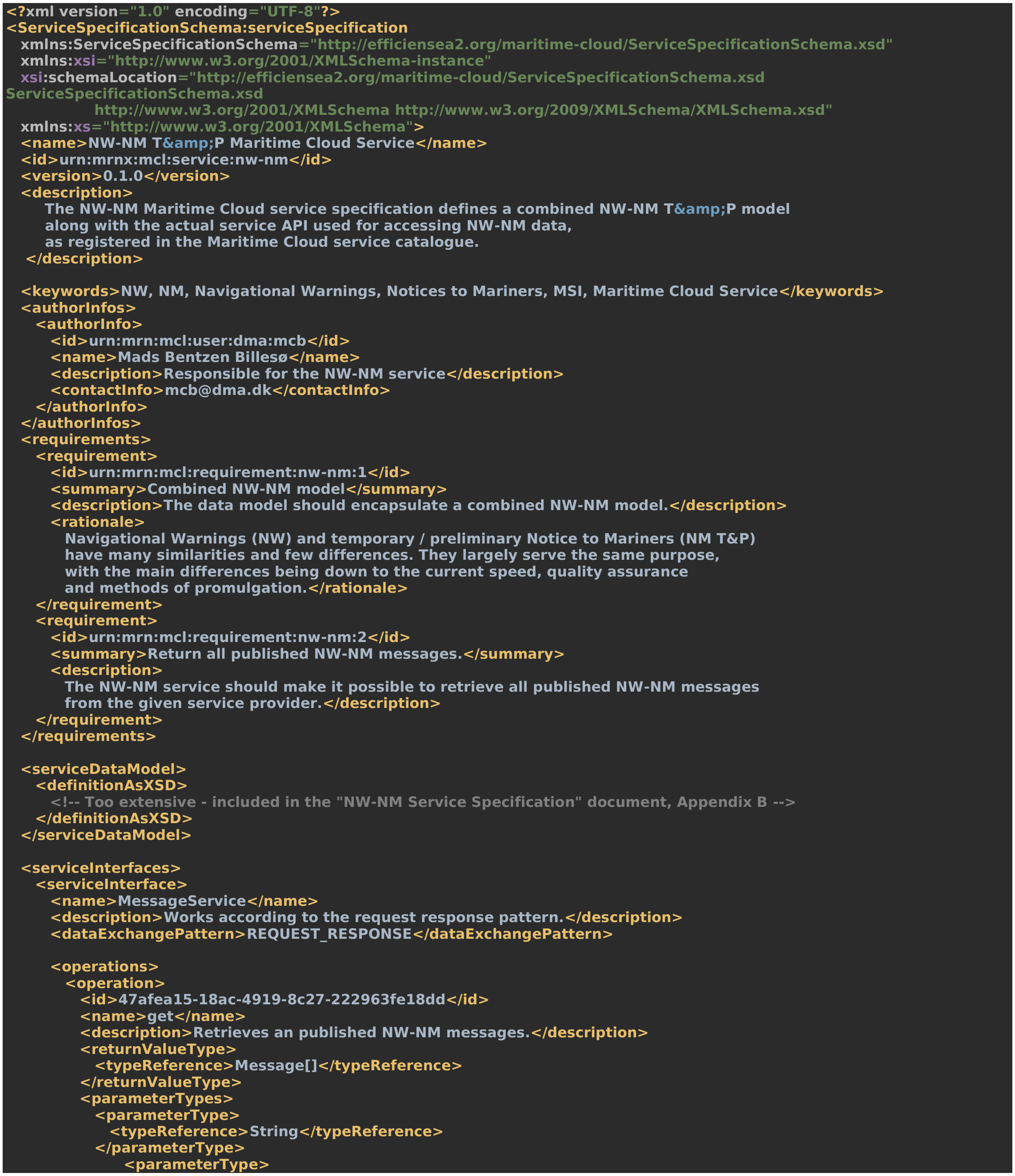
	In order to prove correct implementation of the service specification, there shall exist a mapping between the service instance model and the service data model. This means, each data item used in the service instance model shall be mapped to a corresponding data item of the service data model. (In case of existing mappings to a common external (standard) data model from both the service data model and the service iInstance model, such a mapping is implicitly given.)
Service Interface	The mechanism by which a service communicates.
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 payload. The data payload description may be formally defined by a Service Data Model.
Service Specification Producer	Producers of service specifications in accordance with the service description guidelines.
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.

Appendix A Service Specification XML

This appendix contains the formal XML definition of the service specification. The <definitionAsXSD/> element, being rather substantial, has been included separately in Appendix B.



```
<?xml version="1.0" encoding="UTF-8"?>
<ServiceSpecificationSchema:serviceSpecification
  xmlns:ServiceSpecificationSchema="http://efficiensea2.org/maritime-cloud/ServiceSpecificationSchema.xsd"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://efficiensea2.org/maritime-cloud/ServiceSpecificationSchema.xsd
ServiceSpecificationSchema.xsd
            http://www.w3.org/2001/XMLSchema http://www.w3.org/2009/XMLSchema/XMLSchema.xsd"
  xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <name>NW-NM T&amp;P Maritime Cloud Service</name>
  <id>urn:mrnx:mcl:service:nw-nm</id>
  <version>0.1.0</version>
  <description>
     The NW-NM Maritime Cloud service specification defines a combined NW-NM T&amp;P model
     along with the actual service API used for accessing NW-NM data,
     as registered in the Maritime Cloud service catalogue.
   </description>

  <keywords>NW, NM, Navigational Warnings, Notices to Mariners, MSI, Maritime Cloud Service</keywords>
  <authorInfos>
    <authorInfo>
      <id>urn:mrn:mcl:user:dma:mcb</id>
      <name>Mads Bentzen Billesø</name>
      <description>Responsible for the NW-NM service</description>
      <contactInfo>mcb@dma.dk</contactInfo>
    </authorInfo>
  </authorInfos>
  <requirements>
    <requirement>
      <id>urn:mrn:mcl:requirement:nw-nm:1</id>
      <summary>Combined NW-NM model</summary>
      <description>The data model should encapsulate a combined NW-NM model.</description>
      <rationale>
        Navigational Warnings (NW) and temporary / preliminary Notice to Mariners (NM T&P)
        have many similarities and few differences. They largely serve the same purpose,
        with the main differences being down to the current speed, quality assurance
        and methods of promulgation.</rationale>
    </requirement>
    <requirement>
      <id>urn:mrn:mcl:requirement:nw-nm:2</id>
      <summary>Return all published NW-NM messages.</summary>
      <description>
        The NW-NM service should make it possible to retrieve all published NW-NM messages
        from the given service provider.</description>
    </requirement>
  </requirements>

  <serviceDataModel>
    <definitionAsXSD>
      <!-- Too extensive - included in the "NW-NM Service Specification" document, Appendix B -->
    </definitionAsXSD>
  </serviceDataModel>

  <serviceInterfaces>
    <serviceInterface>
      <name>MessageService</name>
      <description>Works according to the request response pattern.</description>
      <dataExchangePattern>REQUEST_RESPONSE</dataExchangePattern>

      <operations>
        <operation>
          <id>47afea15-18ac-4919-8c27-222963fe18dd</id>
          <name>get</name>
          <description>Retrieves an published NW-NM messages.</description>
          <returnValueType>
            <typeReference>Message[]</typeReference>
          </returnValueType>
          <parameterTypes>
            <parameterType>
              <typeReference>String</typeReference>
            </parameterType>
                <parameterType>
```

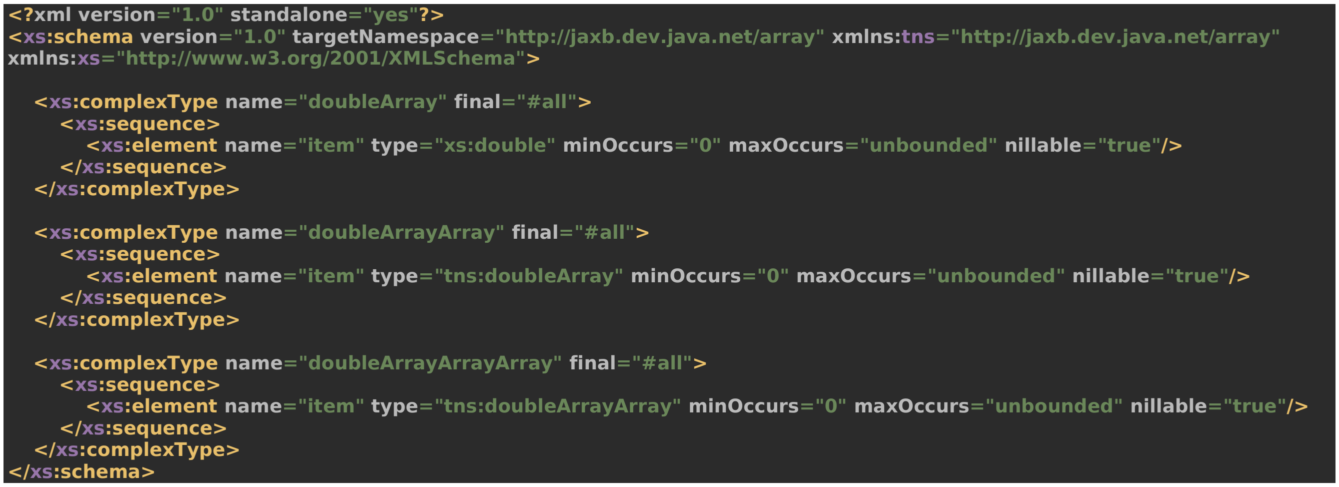
```
                 <typeReference>String</typeReference>
              </parameterType>
         </parameterTypes>
       </operation>
     </operations>
    </serviceInterface>
  </serviceInterfaces>

</ServiceSpecificationSchema:serviceSpecification>
```

Appendix B Message XSD

The NW-NM message model consists of two XSD, schema1.xsd and schema2.xsd.

schema1.xsd



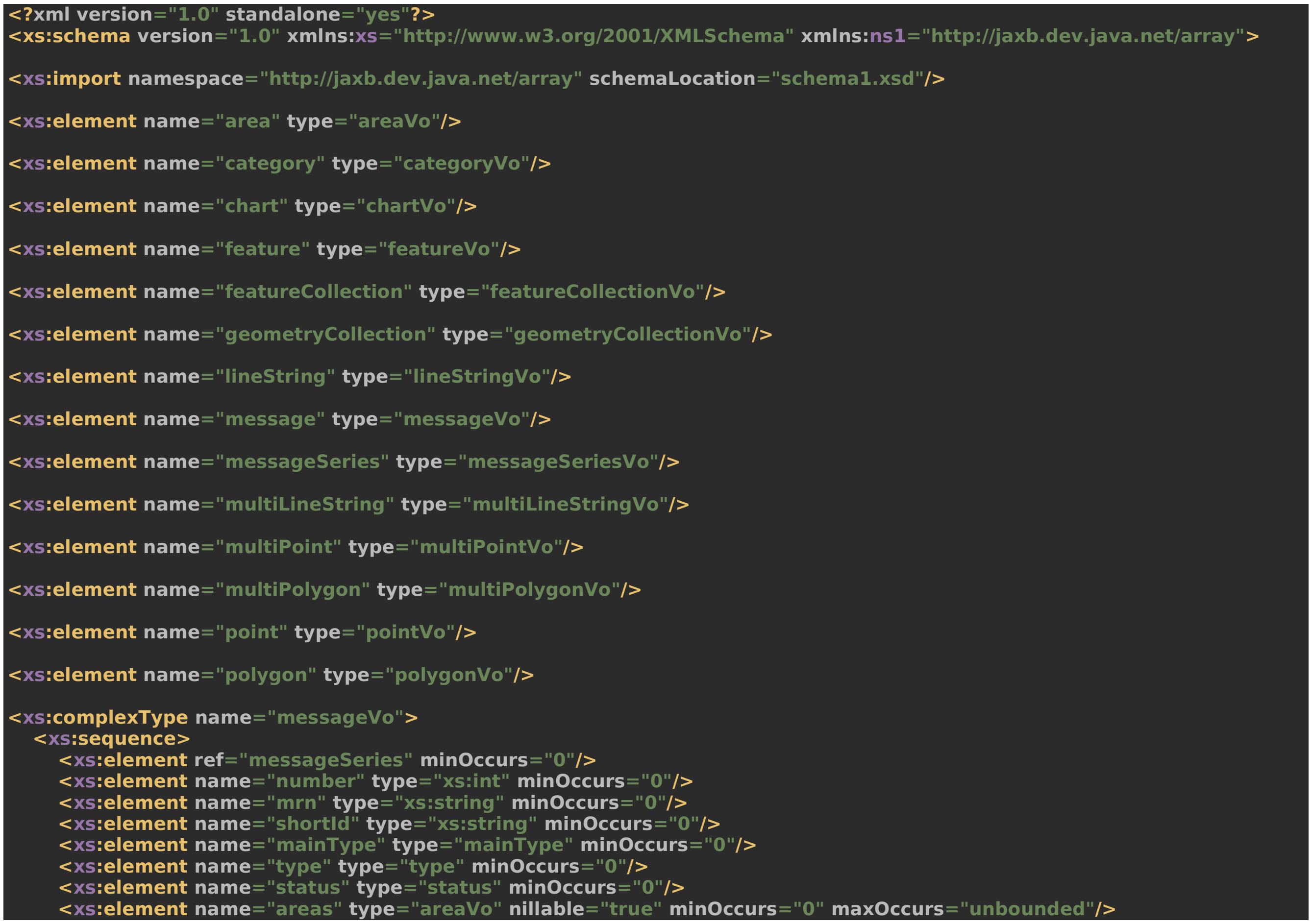
```
<?xml version="1.0" standalone="yes"?>
<xs:schema version="1.0" targetNamespace="http://jaxb.dev.java.net/array" xmlns:tns="http://jaxb.dev.java.net/array"
xmlns:xs="http://www.w3.org/2001/XMLSchema">

  <xs:complexType name="doubleArray" final="#all">
    <xs:sequence>
      <xs:element name="item" type="xs:double" minOccurs="0" maxOccurs="unbounded" nillable="true"/>
    </xs:sequence>
  </xs:complexType>

  <xs:complexType name="doubleArrayArray" final="#all">
    <xs:sequence>
      <xs:element name="item" type="tns:doubleArray" minOccurs="0" maxOccurs="unbounded" nillable="true"/>
    </xs:sequence>
  </xs:complexType>

  <xs:complexType name="doubleArrayArrayArray" final="#all">
    <xs:sequence>
      <xs:element name="item" type="tns:doubleArrayArray" minOccurs="0" maxOccurs="unbounded" nillable="true"/>
    </xs:sequence>
  </xs:complexType>
</xs:schema>
```

schema2.xsd



```
<?xml version="1.0" standalone="yes"?>
<xs:schema version="1.0" xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns:ns1="http://jaxb.dev.java.net/array">

<xs:import namespace="http://jaxb.dev.java.net/array" schemaLocation="schema1.xsd"/>

<xs:element name="area" type="areaVo"/>

<xs:element name="category" type="categoryVo"/>

<xs:element name="chart" type="chartVo"/>

<xs:element name="feature" type="featureVo"/>

<xs:element name="featureCollection" type="featureCollectionVo"/>

<xs:element name="geometryCollection" type="geometryCollectionVo"/>

<xs:element name="lineString" type="lineStringVo"/>

<xs:element name="message" type="messageVo"/>

<xs:element name="messageSeries" type="messageSeriesVo"/>

<xs:element name="multiLineString" type="multiLineStringVo"/>

<xs:element name="multiPoint" type="multiPointVo"/>

<xs:element name="multiPolygon" type="multiPolygonVo"/>

<xs:element name="point" type="pointVo"/>

<xs:element name="polygon" type="polygonVo"/>

<xs:complexType name="messageVo">
  <xs:sequence>
    <xs:element ref="messageSeries" minOccurs="0"/>
    <xs:element name="number" type="xs:int" minOccurs="0"/>
    <xs:element name="mrn" type="xs:string" minOccurs="0"/>
    <xs:element name="shortId" type="xs:string" minOccurs="0"/>
    <xs:element name="mainType" type="mainType" minOccurs="0"/>
    <xs:element name="type" type="type" minOccurs="0"/>
    <xs:element name="status" type="status" minOccurs="0"/>
    <xs:element name="areas" type="areaVo" nillable="true" minOccurs="0" maxOccurs="unbounded"/>
```

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```
    <xs:element name="categories" type="categoryVo" nillable="true" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element name="charts" type="chartVo" nillable="true" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element name="horizontalDatum" type="xs:string" minOccurs="0"/>
    <xs:element name="geometry" type="featureCollectionVo" minOccurs="0"/>
    <xs:element name="startDate" type="xs:dateTime" minOccurs="0"/>
    <xs:element name="endDate" type="xs:dateTime" minOccurs="0"/>
    <xs:element name="publishDate" type="xs:dateTime" minOccurs="0"/>
    <xs:element name="cancellationDate" type="xs:dateTime" minOccurs="0"/>
    <xs:element name="dateIntervals" type="dateIntervalVo" nillable="true" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element name="references" type="referenceVo" nillable="true" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element name="atonUids" type="xs:string" nillable="true" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element name="originalInformation" type="xs:boolean" minOccurs="0"/>
    <xs:element name="descs" type="messageDescVo" nillable="true" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:attribute name="created" type="xs:dateTime"/>
  <xs:attribute name="id" type="xs:int"/>
  <xs:attribute name="updated" type="xs:dateTime"/>
  <xs:attribute name="version" type="xs:int"/>
</xs:complexType>

<xs:complexType name="messageSeriesVo">
  <xs:sequence>
    <xs:element name="seriesId" type="xs:string" minOccurs="0"/>
    <xs:element name="mainType" type="mainType" minOccurs="0"/>
    <xs:element name="mrnFormat" type="xs:string" minOccurs="0"/>
    <xs:element name="shortFormat" type="xs:string" minOccurs="0"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="areaVo">
  <xs:sequence>
    <xs:element name="mrn" type="xs:string" minOccurs="0"/>
    <xs:element name="type" type="areaType" minOccurs="0"/>
    <xs:element name="parent" type="areaVo" minOccurs="0"/>
    <xs:element name="geometry" type="geometry" minOccurs="0"/>
    <xs:element name="children" type="areaVo" nillable="true" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element name="descs" type="areaDescVo" nillable="true" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:attribute name="id" type="xs:int"/>
  <xs:attribute name="siblingSortOrder" type="xs:double" use="required"/>
</xs:complexType>

<xs:complexType name="geometry" abstract="true">
  <xs:sequence>
    <xs:element name="bbox" type="xs:double" nillable="true" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element name="crs" type="crs" minOccurs="0"/>
    <xs:element name="type" type="xs:string" minOccurs="0"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="crs">
  <xs:sequence>
    <xs:element name="properties">
      <xs:complexType>
        <xs:sequence>
          <xs:element name="entry" minOccurs="0" maxOccurs="unbounded">
            <xs:complexType>
              <xs:sequence>
                <xs:element name="key" minOccurs="0" type="xs:string"/>
                <xs:element name="value" minOccurs="0" type="xs:anyType"/>
              </xs:sequence>
            </xs:complexType>
          </xs:element>
        </xs:sequence>
      </xs:complexType>
    </xs:element>
    <xs:element name="type" type="xs:string" minOccurs="0"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="pointVo">
  <xs:complexContent>
    <xs:extension base="geometry">
      <xs:sequence>
        <xs:element name="coordinates" type="xs:double" nillable="true" minOccurs="0" maxOccurs="unbounded"/>
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>

<xs:complexType name="multiPointVo">
  <xs:complexContent>
```

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```
      <xs:extension base="geometry">
         <xs:sequence>
            <xs:element name="coordinates" type="ns1:doubleArray" nillable="true" minOccurs="0"
maxOccurs="unbounded"/>
         </xs:sequence>
      </xs:extension>
   </xs:complexContent>
</xs:complexType>

<xs:complexType name="lineStringVo">
   <xs:complexContent>
      <xs:extension base="geometry">
         <xs:sequence>
            <xs:element name="coordinates" type="ns1:doubleArray" nillable="true" minOccurs="0"
maxOccurs="unbounded"/>
         </xs:sequence>
      </xs:extension>
   </xs:complexContent>
</xs:complexType>

<xs:complexType name="multiLineStringVo">
   <xs:complexContent>
      <xs:extension base="geometry">
         <xs:sequence>
            <xs:element name="coordinates" type="ns1:doubleArrayArray" nillable="true" minOccurs="0"
maxOccurs="unbounded"/>
         </xs:sequence>
      </xs:extension>
   </xs:complexContent>
</xs:complexType>

<xs:complexType name="polygonVo">
   <xs:complexContent>
      <xs:extension base="geometry">
         <xs:sequence>
            <xs:element name="coordinates" type="ns1:doubleArrayArray" nillable="true" minOccurs="0"
maxOccurs="unbounded"/>
         </xs:sequence>
      </xs:extension>
   </xs:complexContent>
</xs:complexType>

<xs:complexType name="multiPolygonVo">
   <xs:complexContent>
      <xs:extension base="geometry">
         <xs:sequence>
            <xs:element name="coordinates" type="ns1:doubleArrayArrayArray" nillable="true" minOccurs="0"
maxOccurs="unbounded"/>
         </xs:sequence>
      </xs:extension>
   </xs:complexContent>
</xs:complexType>

<xs:complexType name="geometryCollectionVo">
   <xs:complexContent>
      <xs:extension base="geometry">
         <xs:sequence>
            <xs:choice minOccurs="0" maxOccurs="unbounded">
               <xs:element ref="point"/>
               <xs:element ref="multiPoint"/>
               <xs:element ref="lineString"/>
               <xs:element ref="multiLineString"/>
               <xs:element ref="polygon"/>
               <xs:element ref="multiPolygon"/>
               <xs:element ref="geometryCollection"/>
            </xs:choice>
         </xs:sequence>
      </xs:extension>
   </xs:complexContent>
</xs:complexType>

<xs:complexType name="featureVo">
   <xs:sequence>
      <xs:element name="bbox" type="xs:double" nillable="true" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element name="crs" type="crs" minOccurs="0"/>
      <xs:choice>
         <xs:element ref="point"/>
         <xs:element ref="multiPoint"/>
         <xs:element ref="lineString"/>
         <xs:element ref="multiLineString"/>
         <xs:element ref="polygon"/>
         <xs:element ref="multiPolygon"/>
      <xs:element ref="geometryCollection"/>
    </xs:choice>
    <xs:element name="id" type="xs:anyType" minOccurs="0"/>
    <xs:element name="properties">
      <xs:complexType>
        <xs:sequence>
          <xs:element name="entry" minOccurs="0" maxOccurs="unbounded">
            <xs:complexType>
              <xs:sequence>
                <xs:element name="key" minOccurs="0" type="xs:string"/>
                <xs:element name="value" minOccurs="0" type="xs:anyType"/>
              </xs:sequence>
            </xs:complexType>
          </xs:element>
        </xs:sequence>
      </xs:complexType>
    </xs:element>
    <xs:element name="type" type="xs:string" minOccurs="0"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="featureCollectionVo">
  <xs:sequence>
    <xs:element name="bbox" type="xs:double" nillable="true" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element name="crs" type="crs" minOccurs="0"/>
    <xs:element ref="feature" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element name="id" type="xs:anyType" minOccurs="0"/>
    <xs:element name="type" type="xs:string" minOccurs="0"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="areaDescVo">
  <xs:sequence>
    <xs:element name="name" type="xs:string" minOccurs="0"/>
  </xs:sequence>
  <xs:attribute name="lang" type="xs:string"/>
</xs:complexType>

<xs:complexType name="categoryVo">
  <xs:sequence>
    <xs:element name="mrn" type="xs:string" minOccurs="0"/>
    <xs:element name="parent" type="categoryVo" minOccurs="0"/>
    <xs:element name="children" type="categoryVo" nillable="true" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element name="descs" type="categoryDescVo" nillable="true" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
  <xs:attribute name="id" type="xs:int"/>
</xs:complexType>

<xs:complexType name="categoryDescVo">
  <xs:sequence>
    <xs:element name="name" type="xs:string" minOccurs="0"/>
  </xs:sequence>
  <xs:attribute name="lang" type="xs:string"/>
</xs:complexType>

<xs:complexType name="chartVo">
  <xs:sequence>
    <xs:element name="chartNumber" type="xs:string" minOccurs="0"/>
    <xs:element name="internationalNumber" type="xs:int" minOccurs="0"/>
    <xs:element name="geometry" type="geometry" minOccurs="0"/>
    <xs:element name="horizontalDatum" type="xs:string" minOccurs="0"/>
    <xs:element name="scale" type="xs:int" minOccurs="0"/>
    <xs:element name="name" type="xs:string" minOccurs="0"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="dateIntervalVo">
  <xs:sequence>
    <xs:element name="fromDate" type="xs:dateTime" minOccurs="0"/>
    <xs:element name="toDate" type="xs:dateTime" minOccurs="0"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="referenceVo">
  <xs:sequence>
    <xs:element name="messageId" type="xs:string" minOccurs="0"/>
    <xs:element name="type" type="referenceType" minOccurs="0"/>
    <xs:element name="description" type="xs:string" minOccurs="0"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="messageDescVo">
```

```
    <xs:sequence>
      <xs:element name="title" type="xs:string" minOccurs="0"/>
      <xs:element name="subject" type="xs:string" minOccurs="0"/>
      <xs:element name="description" type="xs:string" minOccurs="0"/>
      <xs:element name="otherCategories" type="xs:string" minOccurs="0"/>
      <xs:element name="time" type="xs:string" minOccurs="0"/>
      <xs:element name="vicinity" type="xs:string" minOccurs="0"/>
      <xs:element name="note" type="xs:string" minOccurs="0"/>
      <xs:element name="publication" type="xs:string" minOccurs="0"/>
      <xs:element name="source" type="xs:string" minOccurs="0"/>
    </xs:sequence>
    <xs:attribute name="lang" type="xs:string"/>
</xs:complexType>

<xs:simpleType name="mainType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="NW"/>
      <xs:enumeration value="NM"/>
    </xs:restriction>
</xs:simpleType>

<xs:simpleType name="type">
    <xs:restriction base="xs:string">
      <xs:enumeration value="PERMANENT_NOTICE"/>
      <xs:enumeration value="TEMPORARY_NOTICE"/>
      <xs:enumeration value="PRELIMINARY_NOTICE"/>
      <xs:enumeration value="MISCELLANEOUS_NOTICE"/>
      <xs:enumeration value="COASTAL_WARNING"/>
      <xs:enumeration value="SUBAREA_WARNING"/>
      <xs:enumeration value="NAVAREA_WARNING"/>
      <xs:enumeration value="LOCAL_WARNING"/>
    </xs:restriction>
</xs:simpleType>

<xs:simpleType name="status">
    <xs:restriction base="xs:string">
      <xs:enumeration value="IMPORTED"/>
      <xs:enumeration value="DRAFT"/>
      <xs:enumeration value="VERIFIED"/>
      <xs:enumeration value="PUBLISHED"/>
      <xs:enumeration value="EXPIRED"/>
      <xs:enumeration value="CANCELLED"/>
      <xs:enumeration value="DELETED"/>
    </xs:restriction>
</xs:simpleType>

<xs:simpleType name="areaType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="COUNTRY"/>
      <xs:enumeration value="FIRING_AREA"/>
    </xs:restriction>
</xs:simpleType>

<xs:simpleType name="referenceType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="REFERENCE"/>
      <xs:enumeration value="REPETITION"/>
      <xs:enumeration value="CANCELLATION"/>
      <xs:enumeration value="UPDATE"/>
    </xs:restriction>
</xs:simpleType>
</xs:schema>
```