



**BSI Standards Publication**

# **Maritime navigation and radiocommunication equipment and systems — Data interface**

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Part 1: S-421 route plan based on S-100

## National foreword

This British Standard is the UK implementation of EN IEC 63173-1:2021. It is identical to IEC 63173-1:2021.

The UK participation in its preparation was entrusted to Technical Committee EPL/80, Maritime navigation and radiocommunication equipment and systems.

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English Version

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100  
(IEC 63173-1:2021)

Matériels et systèmes de navigation et de  
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Partie 1: Plan de route S-421 basé sur la S-100  
(IEC 63173-1:2021)

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für die Seeschifffahrt - Digitale Schnittstellen - Teil 1: S-421  
Routenplan auf Grundlage von S-100  
(IEC 63173-1:2021)

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## European foreword

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In the official version, for Bibliography, the following notes have to be added for the standards indicated:

|                    |      |                                     |
|--------------------|------|-------------------------------------|
| IEC 61174          | NOTE | Harmonized as EN 61174              |
| IEC 62288          | NOTE | Harmonized as EN 62288              |
| ISO 19115 (series) | NOTE | Harmonized as EN ISO 19115 (series) |

## Annex ZA

(normative)

### Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: [www.cenelec.eu](http://www.cenelec.eu).

| <u>Publication</u> | <u>Year</u> | <u>Title</u>                                             | <u>EN/HD</u> | <u>Year</u> |
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| S-100              | 2018        | IHO Universal Hydrographic Data Model<br>(edition 4.0.0) | -            | -           |

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**MARITIME NAVIGATION AND RADIOCOMMUNICATION  
EQUIPMENT AND SYSTEMS – DATA INTERFACES –****Part 1: S-421 route plan based on S-100**

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IEC 63173-1 has been prepared by IEC technical committee 80: Maritime navigation and radiocommunication equipment and systems. It is an International Standard.

The text of this International Standard is based on the following documents:

|             |                  |
|-------------|------------------|
| FDIS        | Report on voting |
| 80/997/FDIS | 80/1000/RVD      |

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/standardsdev/publications](http://www.iec.ch/standardsdev/publications).

A list of all parts in the IEC 63173 series, published under the general title *Maritime navigation and radiocommunication equipment and systems – Data interfaces*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under [webstore.iec.ch](http://webstore.iec.ch) in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

**IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.**

## INTRODUCTION

The voyage plan is a key element of a vessel's voyage and can be used to optimize safety and processes, as well as for the interaction of participants and stakeholders.

The core element of the voyage plan is the route.

The exchange of routes (whether it be between ship-to-ship, ship-to-shore or shore-to-shore) may improve

- situational awareness,
- reduction in the number of accidents and incidents (by proactively de-conflicting routes),
- resource utilization by knowing the intentions of other actors,
- secured passages by knowing the intentions of other actors,
- predictability of arrivals and departures by early information sharing,
- planning for involved actors leading to reduced idle time for resources, and
- just-in-time operations by enabling stakeholders and service providers to be efficiently organized for handling vessel movements, port resources, and hinterland connections.

This document has been registered with the IHO S-100 registry as product specification S-421. A S-100 product specification is a description of the features, attributes and relationships of an application and their mapping to a dataset. It is a complete description of all the elements required to define a particular geographic data product.

IHO S-97 describes readiness levels of product specifications to show a progression from an idea to regular use. S-421 is currently at the initial level 1 pending demonstration in a real-world environment.

S-100 uses camelCase for naming. CamelCase names are made up of words joined together without spaces and capitalised within the compound using a limited set of English letters. Feature and information types begin with uppercase A-Z and attributes and values begin with lowercase a-z.

# MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – DATA INTERFACES –

## Part 1: S-421 route plan based on S-100

### 1 Scope

This part of IEC 63173 specifies an S-100 compliant product specification for route plan intended for exchange of information. It specifies the content, structure, and metadata needed for creating fully S-100 compliant route plan information and its portrayal within an S-100-based application. The IHO manages all numbers for S-100 compliant product specifications and has assigned S-421 for this route plan IEC standard.

This document specifies only a data format for the route plan exchange. This document does not specify a data format of vessel monitoring and logging information. This information can be provided by other mechanisms or be specified in other standards.

The format of the route plan exchange includes some limited vessel static information. When more static information is required, it can be obtained by other methods such as AIS.

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

S-100:2018, *IHO Universal Hydrographic Data Model* (edition 4.0.0)

### 3 Terms and definitions

For the purposes of this document, the following terms, definitions and abbreviated terms apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

#### 3.1

##### **active route**

route which is currently monitored for the voyage which may contain the schedule information

#### 3.2

##### **actor**

human or machine that takes part in the route plan exchange process

#### 3.3

##### **feature**

abstraction of real-world phenomena

Note 1 to entry: A feature may occur as a type or an instance. A feature type or a feature instance should be used when only one is meant as described in S-100.

### **3.4 feature catalogue**

catalogue containing definitions and descriptions of the feature types, feature attributes, and feature associations occurring in one or more sets of geographic data as defined in S-100

### **3.5 planned route**

candidate route for the active route of the voyage

Note 1 to entry: The schedule information may be set by the ship.

### **3.6 portrayal**

presentation of information to humans as defined in S-100

Note 1 to entry: This document is restricted to the portrayal of geographic information.

### **3.7 portrayal catalogue**

collections of defined portrayals for a feature catalogue as defined in S-100

Note 1 to entry: Content of the portrayal catalogue includes portrayal functions, symbols, and portrayal context parameters.

### **3.8 recommended route**

route recommended by external actors (e.g. national authorities or commercial organizations) to own ship for the planned route of the voyage

### **3.9 recommended time**

time set by external actors to own ship for the planned route of the voyage

### **3.10 reference route**

route without any vessel-specific information that can assist in the creation of a route plan for a particular vessel

### **3.11 route information**

all related route objects specified in this document

### **3.12 waypoint**

reference point in physical space used for purposes of navigation

Note 1 to entry: It describes the geographical components of the route.

## **4 Abbreviated terms**

|     |                                                |
|-----|------------------------------------------------|
| ENC | electronic navigational chart                  |
| GML | geography markup language                      |
| IEC | International Electrotechnical Commission      |
| IHO | International Hydrographic Organization        |
| IMO | International Maritime Organization            |
| ISO | International Organization for Standardization |
| ETA | estimated time of arrival                      |

ETD estimated time of departure

EUT equipment under test

## 5 General description

### 5.1 General data product description

The data product of a route plan is described as specified in Table 1.

**Table 1 – Informal description of the data product**

| Field            | Description                                                                                                                                                                                                                                                                                                                  |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Title            | Route plan                                                                                                                                                                                                                                                                                                                   |
| Abstract         | This data product describes real-world route plan and its related information.                                                                                                                                                                                                                                               |
| Content          | The product specification defines all requirements to which route plan data products shall conform. Specifically, it defines the data product content in terms of features and attributes within the feature catalogue. The display of features is defined by the symbols and rule sets contained in the portrayal catalogue |
| Spatial extent   | Description:<br>East bounding longitude: 180°<br>West bounding longitude: –180°<br>North bounding latitude: 90°<br>South bounding latitude: –90°                                                                                                                                                                             |
| Specific purpose | The purpose of a route plan dataset is to provide official route plan data to an S-100 based application for the safe and efficient passage and route of vessels to destinations.                                                                                                                                            |

### 5.2 Data product specification metadata

Table 2 uniquely identifies this document and provides information about its creation and maintenance. For further information on dataset metadata, see 11.4.

**Table 2 – Data product specification metadata**

| Field          | Description                                                                                                                                                                  |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Title          | Route plan                                                                                                                                                                   |
| S-100 version  | 4.0.0                                                                                                                                                                        |
| Version        | 1.0                                                                                                                                                                          |
| Language       | English                                                                                                                                                                      |
| Classification | Unclassified                                                                                                                                                                 |
| Contact        | International Electrotechnical Commission<br>3, rue de Varembé<br>P.O. Box 131<br>CH – 1211 Geneva 20 – Switzerland<br>Telephone: +41 22 919 02 11<br>Fax: + 41 22 919 03 00 |
| URL            | www.iec.ch                                                                                                                                                                   |
| Identifier     | S-421                                                                                                                                                                        |
| Maintenance    | Changes to the product specification S-421 coordinated by IEC TC 80                                                                                                          |

### 5.3 Product specification maintenance

This document for route plan complies with the maintenance schedule and policy in IEC.

### 5.4 Specification scopes

The product specification scope of the route plan is specified in Table 3.

**Table 3 – Route plan product specification scope**

| Field      | Description |
|------------|-------------|
| Scope ID   | Product     |
| Level      | 006-series  |
| Level name | Route plan  |

### 5.5 Dataset identification

The dataset identification information for this document is specified in Table 4.

**Table 4 – Dataset identification**

| Field                       | Description                                                                                                                                                                                                                                                                                                         |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Title                       | Route plan                                                                                                                                                                                                                                                                                                          |
| Alternate Title             | Route plan exchange                                                                                                                                                                                                                                                                                                 |
| Abstract                    | The route plan for the radiocommunication and navigational equipment and system shall be produced in accordance with the rules defined in this document. This document contains all the information necessary to enable users to produce a consistent route plan and to use that data efficiently in an application |
| Topic category              | Transportation (ISO 19115 domain code 018)                                                                                                                                                                                                                                                                          |
| Geographic description      | Areas specific to marine navigation                                                                                                                                                                                                                                                                                 |
| Spatial resolution          | Varies. The spatial resolution varies according to the application.                                                                                                                                                                                                                                                 |
| Purpose                     | Route plan exchange                                                                                                                                                                                                                                                                                                 |
| Language                    | English (mandatory), other (optional)                                                                                                                                                                                                                                                                               |
| Classification              | Unclassified                                                                                                                                                                                                                                                                                                        |
| Spatial representation type | Vector                                                                                                                                                                                                                                                                                                              |
| Point of contact            | Producing agency                                                                                                                                                                                                                                                                                                    |
| Use limitation              | Not to be used for navigation on land                                                                                                                                                                                                                                                                               |

## 6 Data content and structure

### 6.1 General

The route plan is a feature-based product. The content information is described in terms of a general feature model and a feature catalogue.

IMO has defined in MSC.232(83) minimum requirements for route planning in ECDIS. A route consists of both straight and curved segments. The route includes user selectable limits for checking navigational hazards. Further, a route includes user selectable cross track limits for automatic off-track alarms. In this document, curved segments are defined by radius-controlled turns in each waypoint. Also, the checking and cross track limit of starboard and port is defined in each waypoint.

IMO has defined voyage planning in A.893(21) and A.999(25). IMO voyage planning goes beyond this document and therefore this document does not use "voyage plan" for a route plan which contains some, but not all elements required for an IMO voyage plan.

This document uses the term "annotated route plan" for a plan which, in addition to route plan, contains some elements of the IMO voyage plan as georeferenced text or document (see Annex C).

The route plan contains elements intended for both mandatory and optional implementation. The optional elements to implement in this document do not describe all functionality which could be built around them. If a manufacturer wishes to implement at least some of the optional elements, he can provide a viewer or editor for these elements. This document specifies a standardized transfer format, and some use cases are described in Annex A.

## 6.2 Application schema

Route plan information conforms to the general feature model (GFM) from S-100, Part 3. The GFM is the conceptual model and the implementation is defined in the feature catalogue. The route plan information application schema is realized in the feature catalogue and the product specification only contains specific examples.

Figure 1 shows the route plan application schema which illustrates all objects and the associations among objects. The route plan is defined to be flexible and easily expandable. All objects in the schema have an attribute which has RouteExtensions data type. The mandatory and optional fields are specified with the descriptions of the attributes.



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### 6.3 Preservation of unknown content

Actors that either retransmit an unmodified route plan or modify and transmit an existing route shall ensure that any data that the actor does not require or understand is preserved. This data might include optional elements that the actor does not use, or RouteExtensions that have been added by other actors.

### 6.4 Geometry

The IHO S-100 model includes multiple geometries. This route plan exchange standard supports level 1 geometry which supports isolated and curve primitives from IHO (see Clauses 7-4.3.1 in S-100). In this document, each point represents a waypoint. The geometry of the route based on the waypoint is as described in 7.2.8.

### 6.5 Coordinate reference systems

The coordinate reference system used for this document is World Geodetic System 1984 (WGS 84).

The specification is given in Table 5.

**Table 5 – Route plan coordinate reference systems**

| Field                                          | Description                                               |
|------------------------------------------------|-----------------------------------------------------------|
| Horizontal coordinate reference system         | EPSG:4326 (WGS84)                                         |
| Projection                                     | None                                                      |
| Temporal reference system                      | Gregorian calendar                                        |
| Coordinate reference system registry           | EPSG Geodetic Parameter Registry                          |
| Date type (according to ISO 19115 (all parts)) | 002- publication                                          |
| Responsible party                              | International Organisation of Oil and Gas Producers (OGP) |
| URL                                            | <a href="http://www.iogp.org">http://www.iogp.org</a>     |

## 7 Feature catalogue

### 7.1 General

The route plan feature catalogue describes the feature types, information types, attributes, attribute values, associations and roles which may be used in a route plan dataset.

The route plan feature catalogue is available in a machine-readable printed version which conforms to the S-100 XML feature catalogue schema and can be downloaded from the CIRM<sup>1</sup> website (<http://cirm.org/s-421>). It is also available in Annex D as a human readable version.

When there are conflicts in the texts, tables, data model (see Figure 1) or schema, the machine-readable files shall take precedence.

The "Implementation" column in the object attribute tables has two alternatives: mandatory and optional.

<sup>1</sup> Comité International Radio-Maritime, the International Association for Marine Electronic Companies, [www.cirm.org](http://www.cirm.org)

- Mandatory means that the attribute, when provided, shall always be implemented and shall always be possible to support, i.e. process and/or interpret, for example view, edit and associated functionality.

NOTE This is not the same as that the attribute is mandatory to exchange.

- Optional means that it is voluntary for the receiver to implement support for that attribute.

The multiplicity column in the tables describes the number of elements that can be provided. Even though mandatory is in the implementation column, the value in the multiplicity column may be zero to one or zero to many, i.e. the attribute can be omitted even if the value of implementation column is mandatory. For example, routeInfoValidityStart has Implementation mandatory but has multiplicity of 0..1. This is a requirement to support it but no requirement to provide it. The routeInfoStatus has multiplicity 1 and the attribute shall thus be supported and shall have a value.

Tables in Annex A specify the objects and attributes used for a specific use case. Fields in tables marked "mandatory" specify fields that shall contain a value when exchanged in the specific use case. All actors that support the use case shall implement and process all fields (mandatory and optional) that are specified in that use case.

## 7.2 Feature types

### 7.2.1 Geographic

Geographic (geo) feature types form the principal content of the dataset and are fully defined by their associated attributes and information types.

### 7.2.2 Meta

Meta features contain information about other features within a data set. Information defined by meta features override the default metadata values defined by the data set descriptive records.

### 7.2.3 Route

The Route object attributes are given in Table 6.

The version of route plan has a format X.Y. First value X of routeFormatVersion is updated when a significant change(s) is done in the route format structure. This includes

- 1) when the status of some recognizable element (e.g. XTD) is changed from Optional to Mandatory,
- 2) when new elements to the route format are added,
- 3) when some elements in the route format are deleted, and
- 4) where there are some changes to the XSD schema.

The second value Y of routeFormatVersion is updated when "typographical" changes are done, which do not affect the format itself. This includes

- 5) when there are additional explanations in the description of the format, and
- 6) when unrecognizable updates (i.e. add, delete and update) are made.

### 7.2.4 RouteActionPoints

The feature RouteActionPoints shall contain at least one RouteActionpoint object.

### 7.2.5 RouteActionPoint

The RouteActionPoint is intended to add elements of the associated voyage plan (see IMO A.893 (21)) into the basic route plan consisting of the waypoints and legs between the waypoints. The RouteActionPoint has the flexibility to use either point with radius, line with specified distance or area as a method to activate actions associated with waypoints or legs, or notes where a waypoint or leg cannot be used, for example to activate ship reporting when crossing a line or to act based on voyage planning when within a radius from a point (see Table 7, Table 8 and Table 9). Further examples of the use cases of RouteActionPoint are:

- instruction to report to a ship reporting system about entering the area using VHF (ship reporting);
- instruction to report to a ship reporting system via Website (ship reporting);
- instruction to report to entering into a VTS area (ship reporting);
- note about being too close to no-go area defined by the master (voyage plan);
- note about being aware of squat effect if the speed is more than 18 kn (voyage plan);
- note about being in area which require pilot (voyage plan);
- instruction to confirm pilot order (voyage plan);
- instruction to change used fuel to be compliant with a MARPOL area (voyage plan);
- instructions to reduce ballast water when sailing over a shallow area (voyage plan);
- instructions to perform check of position using line of position (LOP) method (voyage plan);
- instruction to select Radar and ECDIS setting suitable for area ahead (voyage plan).

**Table 6 – Route object attributes**

| Attribute Name     | Description                                                                    | Data type       | Multiplicity | Implementation | Remarks                                                                                                                                                                                                                                                   |
|--------------------|--------------------------------------------------------------------------------|-----------------|--------------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| routeFormatVersion | The version of this route format                                               | String          | 1            | Mandatory      | Describe when these numbers are changed,<br>Format: X.Y<br>X: Major version<br>Y: Minor version                                                                                                                                                           |
| routeID            | Unique route identifier                                                        | String          | 1            | Mandatory      | Unique identifier of the route                                                                                                                                                                                                                            |
| routeEditionNo     | Route edition number                                                           | Integer         | 1            | Mandatory      | This number is increased by one whenever the route information has changed. Exceptions for not increasing the number of routeEditionNo are changes when only routeInfoDescription, routeWaypointLegIssue or routeInfoStatus attributes have been changed. |
| routeExtensions    | Additional proprietary information for the route specified by the manufacturer | RouteExtensions | 0..*         | Optional       |                                                                                                                                                                                                                                                           |

**Table 7 – RouteActionPoints object attributes**

| Attribute Name              | Description                                                                            | Data Type       | Multiplicity | Implementation | Remarks |
|-----------------------------|----------------------------------------------------------------------------------------|-----------------|--------------|----------------|---------|
| routeActionPointsExtensions | Additional proprietary information for the action points specified by the manufacturer | RouteExtensions | 0..*         | Optional       |         |

Table 8 – RouteActionPoint object attributes

| Attribute Name                            | Description                                                                                                                                                                                                                                                    | Data Type                            | Multiplicity | Implementation         | Remarks                                                                      |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------|------------------------|------------------------------------------------------------------------------|
| routeActionPointID                        | Identifier of the action point. The identifier shall be unique in the route.                                                                                                                                                                                   | Integer                              | 1            | Mandatory              | Positive integer                                                             |
| routeActionPointName                      | Name of action point                                                                                                                                                                                                                                           | String                               | 0..1         | Optional               |                                                                              |
| routeActionPointExternalReference         | External reference information related to the action point                                                                                                                                                                                                     | String                               | 0..1         | Optional               |                                                                              |
| geometry                                  | Geographical position of the action point in degrees<br>Examples :<br><geometry><br><S100:pointProperty><br><S100:Point gml:id="RTE.APT.1.PT"<br>srsName="EPSG:4326"><br><gml:pos>12.0 56.0</gml:pos><br></S100:Point><br></S100:pointProperty><br></geometry> | GM_Point,<br>GM_Curve,<br>GM_Surface | 1            | Mandatory              | For value range see IHO S-100<br>The minimum resolution is 0,000 1°          |
| routeActionPointRadius                    | Distance from the action point within which action shall be taken.                                                                                                                                                                                             | Real                                 | 0..1         | Mandatory for GM_Point | Unit: NM<br>Positive real                                                    |
| routeActionPointTimeToAct                 | Time before or after the action point                                                                                                                                                                                                                          | Real                                 | 0..1         | Mandatory              | Unit: minutes<br>Negative values: time before<br>Positive values: time after |
| routeActionPointRequiredAction            | The action required for this action                                                                                                                                                                                                                            | Enumeration                          | 1            | Mandatory              | See Table 9                                                                  |
| routeActionPointRequiredActionDescription | Human readable description of the action required for this action point                                                                                                                                                                                        | String                               | 1            | Mandatory              |                                                                              |
| routeActionPointExtensions                | Additional proprietary information for the <b>RouteActionPoint</b> specified by the manufacturer                                                                                                                                                               | RouteExtensions                      | 0..*         | Optional               |                                                                              |

**Table 9 – Definition of RouteActionPointRequiredAction**

| Enumeration value | Description  | Remarks                                                                    |
|-------------------|--------------|----------------------------------------------------------------------------|
| 1                 | User defined | Action is available in the field routeActionPointRequiredActionDescription |
| 2                 | Report       | Report from vessel to shore                                                |
| 3                 | UKCM         | UKCM report                                                                |
| 4                 | Note         | Additional information related to the route                                |
| 5 to 9            | Reserved     | Reserved for future use                                                    |

**Table 10 – RouteWaypoints object attributes**

| Attribute name          | Description                                                                        | Data type       | Multiplicity | Implementation | Remarks |
|-------------------------|------------------------------------------------------------------------------------|-----------------|--------------|----------------|---------|
| routeWaypointExtensions | Additional proprietary information for the waypoints specified by the manufacturer | RouteExtensions | 0..*         | Optional       |         |

### 7.2.6 RouteWaypoints

The feature RouteWaypoints described in Table 10 shall contain two or more RouteWaypoint objects, when the value of the RouteInfoStatus is other than “Acknowledged”, “Terminated”, “Errors”, “Service started” or “Service ended” (see 7.3.6).

NOTE The listed cases (Terminated, Errors, Service started and Service ended) are events, and the RouteInfo object alone is sufficient to communicate the event.

The sailing order shall be determined by the appearance order of RouteWaypoint objects and shall be the same as the order of the references in RouteWaypoints object.

### 7.2.7 RouteWaypoint

The routeWaypointID (see Table 11) shall be unique within a route, i.e., there shall be no waypoints with the same ID within one route. The routeWaypointID field for a waypoint is not related to the order of waypoints. The waypoint identifiers permit references to the geometry (rather than the succession order) from other objects, for example from the RouteScheduleElement.

The routeWaypointTurnRadius attribute shall contain a non-negative number smaller or equal to 5 NM, since a larger value of this parameter is not practical, and the upper limit provides a higher “junk” detection probability. This field shall be accurate to at least one decimal place. This field presentation precision may vary from 0,1 NM to 0,01 NM. If turn radius is not decided, the value is zero (0,0), for example first waypoint, last waypoint and recommended waypoints from shore.

NOTE It is essential that this route has a strictly defined geometry, and the turn radius, in its waypoint, has a considerable effect on this geometry, and therefore is not indefinite.

The RouteWaypoint objects contain data related to the geometry of the route. The geometry shall contain the latitude and longitude values expressed in degrees. Coordinates shall be presented with at least five decimal places. These values may vary from 0,000 1° (with a precision in the order of 10 m) to 0,000 000 1° (with a precision in the order of 1 cm) depending on the application area.

Figure 2 and Figure 3 show examples of deleting and inserting waypoints and how routeWaypointID is used, alongside how the waypoints in a route are presented to the end user.

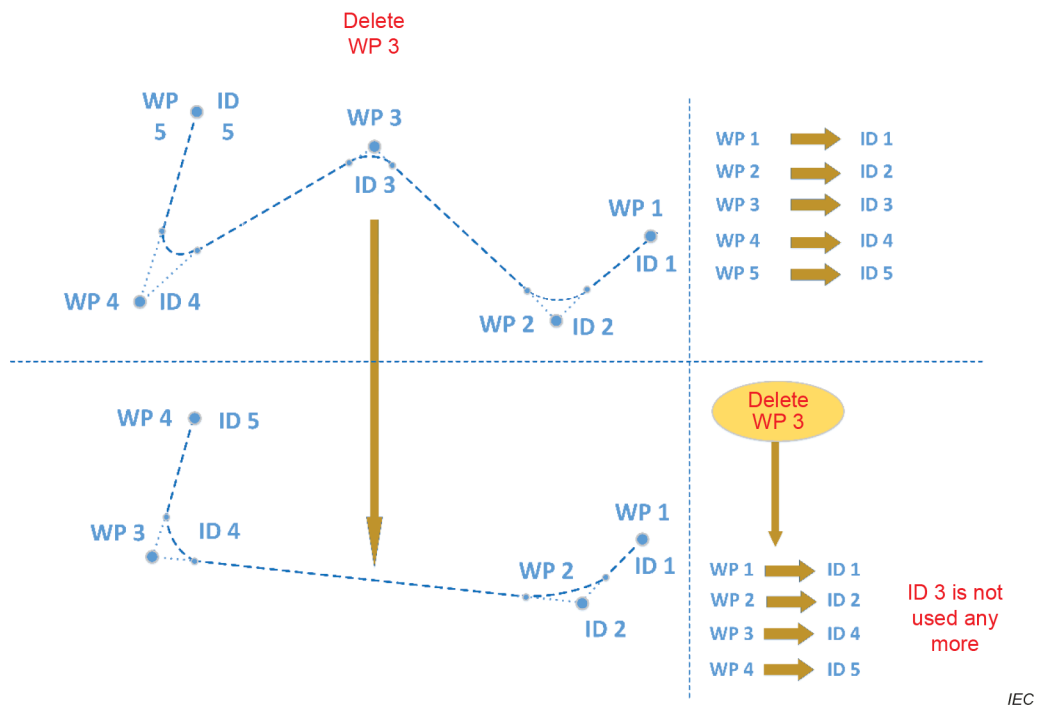


Figure 2 – RouteWaypointID usage examples: Delete

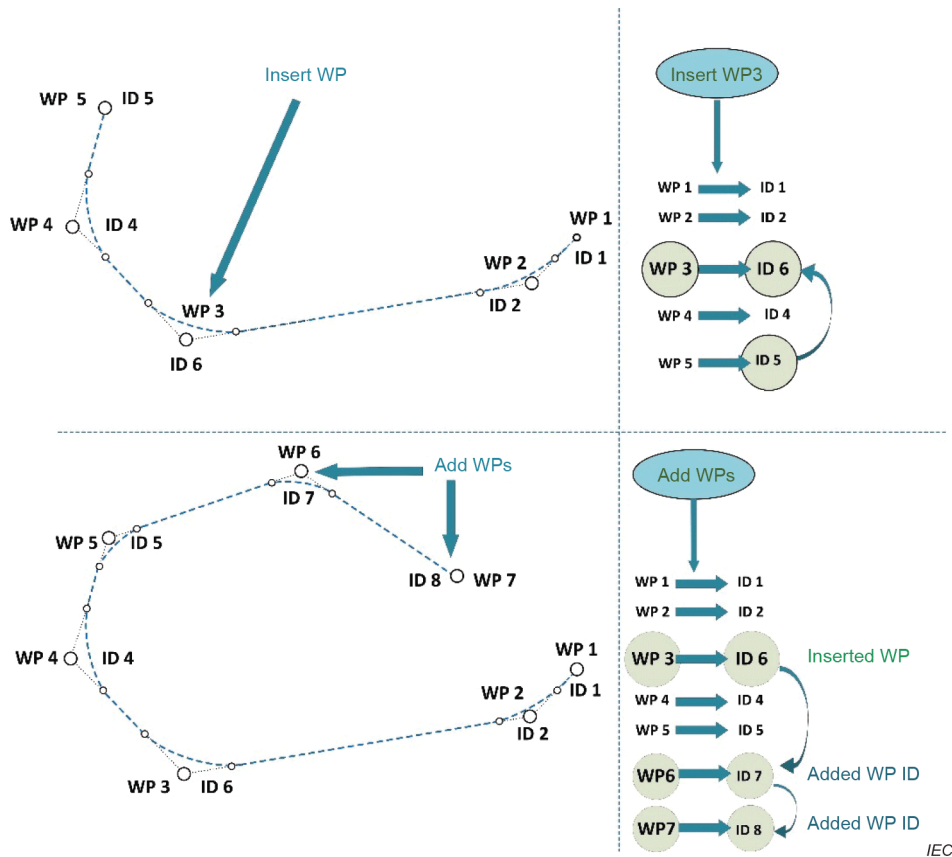


Figure 3 – RouteWaypointID usage examples: Insert

Table 11 – RouteWaypoint object attributes

| Attribute Name                   | Description                                                                                                                                                                                                                                                             | Data Type       | Multiplicity | Implementation | Remarks                                                                                                                                                                                                          |
|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| routeWaypointID                  | Identifier of the waypoint. The identifier shall be unique in the route.                                                                                                                                                                                                | Integer         | 1            | Mandatory      | Positive integer                                                                                                                                                                                                 |
| routeWaypointName                | Name of waypoint                                                                                                                                                                                                                                                        | String          | 0..1         | Mandatory      |                                                                                                                                                                                                                  |
| routeWaypointExternalReferenceID | External reference information related to the waypoint                                                                                                                                                                                                                  | String          | 0..1         | Optional       |                                                                                                                                                                                                                  |
| routeWaypointFixed               | Indicator if the route waypoint is fixed or editable                                                                                                                                                                                                                    | Boolean         | 0..1         | Mandatory      | By default, all waypoints are editable unless set to fixed.<br>FALSE: Editable. Deletion or update of the waypoints including waypoint position.<br>TRUE: Fixed. No deletion or update of the waypoint position. |
| geometry                         | Geographical position of the waypoint in degrees<br>Examples:<br><geometry><br><S100:pointProperty><br><S100:Point gml:id="RTE.WP.1.PT"<br>srsName="EPSG:4326"><br><gml:pos> 59 483136 22 609812<br></gml:pos><br></S100:Point><br></S100:pointProperty><br></geometry> | GM_Point        | 1            | Mandatory      | For value range, see IHO S-100.<br>The minimum resolution is 0,000 1°.                                                                                                                                           |
| routeWaypointTurnRadius          | Turn radius in nautical miles                                                                                                                                                                                                                                           | Real            | 1            | Mandatory      | The value range is 0,0 NM to 5,0 NM<br>The maximum resolution is 0,01 NM                                                                                                                                         |
| routeWaypointExtensions          | Additional proprietary information for the Route waypoints specified by the manufacturer                                                                                                                                                                                | RouteExtensions | 0..*         | Optional       |                                                                                                                                                                                                                  |

## 7.2.8 RouteWaypointLeg

The RouteWaypointLeg object (see Figure 4 and Figure 5) is optional for a waypoint which contains related information from a waypoint. The order of the RouteWaypointLeg elements follows the order of the RouteWaypoint elements as defined in RouteWaypoints.

Each route leg is formed within the framework of the set geometry (great circle or rhumb line) on the terrestrial ellipsoid. The routeWaypointLegGeometryType element is mandatory. Each route waypoint leg is formed as the shortest of all the possible segments within the framework of the set geometry in two waypoints. It shall be in the range  $-180^\circ \leq \text{lon} \leq 180^\circ$  and  $-90^\circ \leq \text{lat} \leq 90^\circ$ . With this restriction, each point on the terrestrial surface (except for the poles, which can be corrected by setting zero longitudes only for them) can be uniquely correlated with a lat/lon pair. Moreover, introduction of this restriction permits, as in the case of the turn radius, easy detection of the "junk" longitude values.

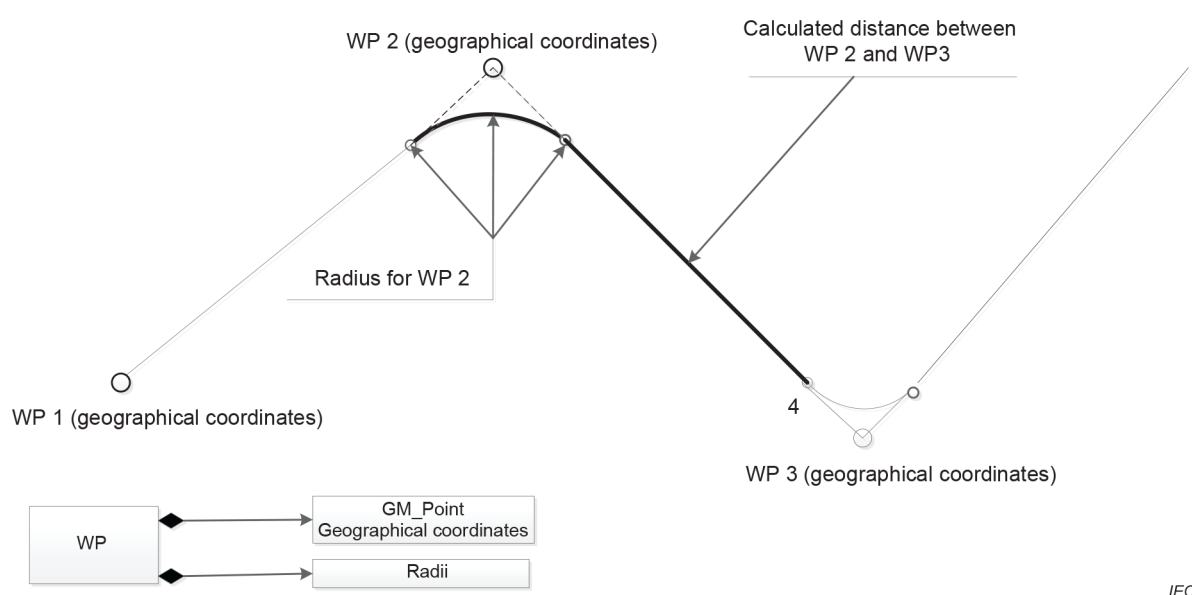


Figure 4 – RouteWaypointLegDistance between WP2 and WP3

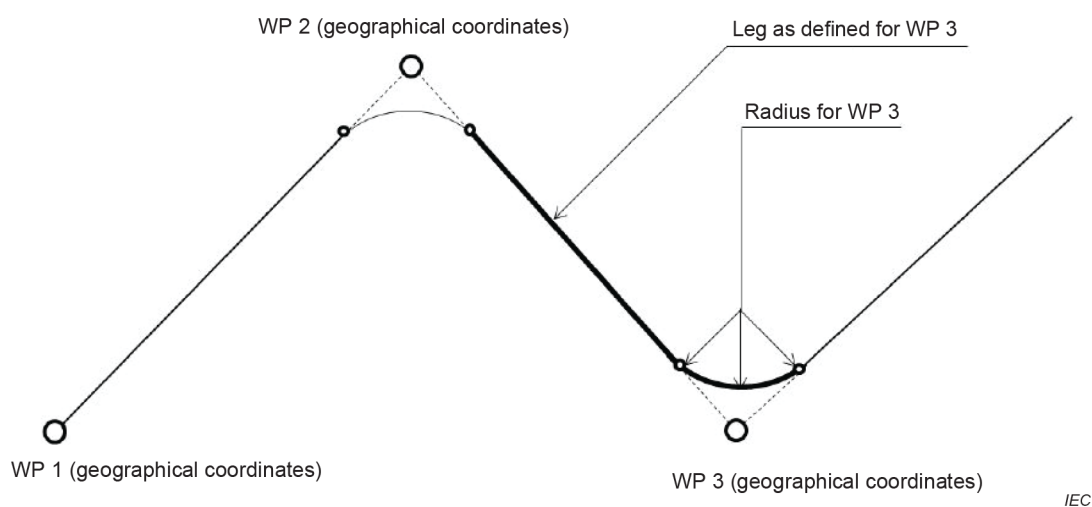
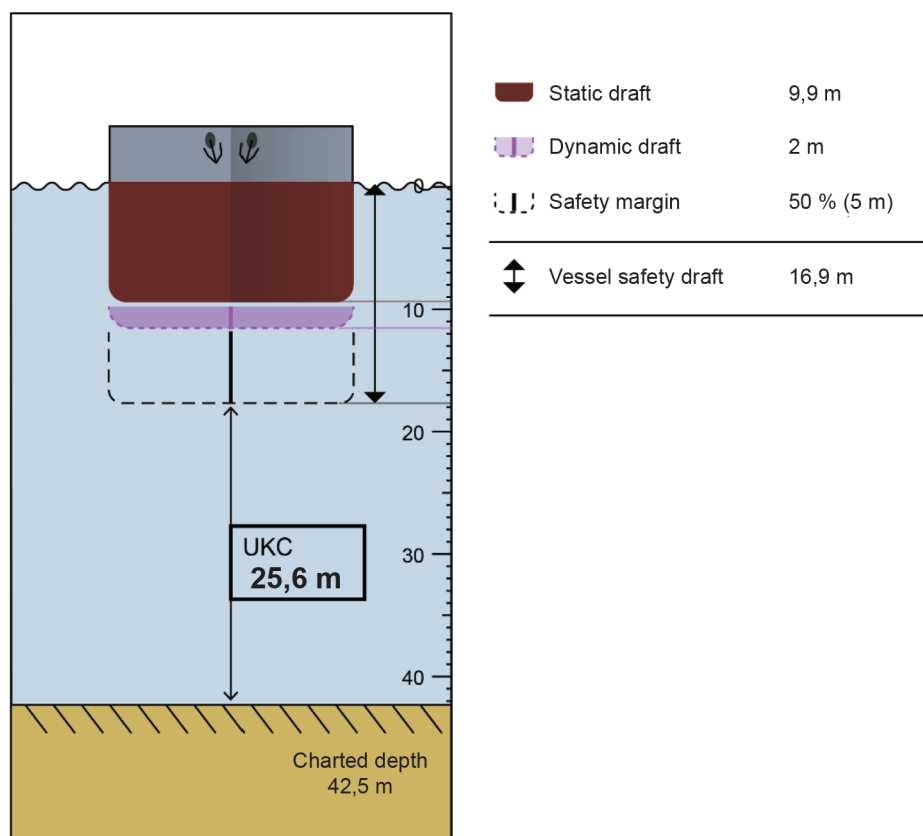


Figure 5 – RouteWaypointLeg parameters belonging to WP3

The routeWaypointLegStarboardXTDL and routeWaypointLegPortXTDL are optional attributes.

The under-keel clearance (see Figure 6) is a vertical distance between the deepest underwater point of the ship's hull accounting for the water level, dynamic draft, safety margin; and charted depth. That clearance shall be sufficient to allow the ship's floatability in the most adverse hydrographical and meteorological conditions.



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**Figure 6 – Under-keel clearance example**

The static draft is the draft of the vessel when not making way or subject to sea and swell influences, i.e. the maximum draft the vessel has loaded to.

The dynamic draft is the draft of the vessel when making way and subject to squat, sea and swell state and increase of draft due to heel when turning.

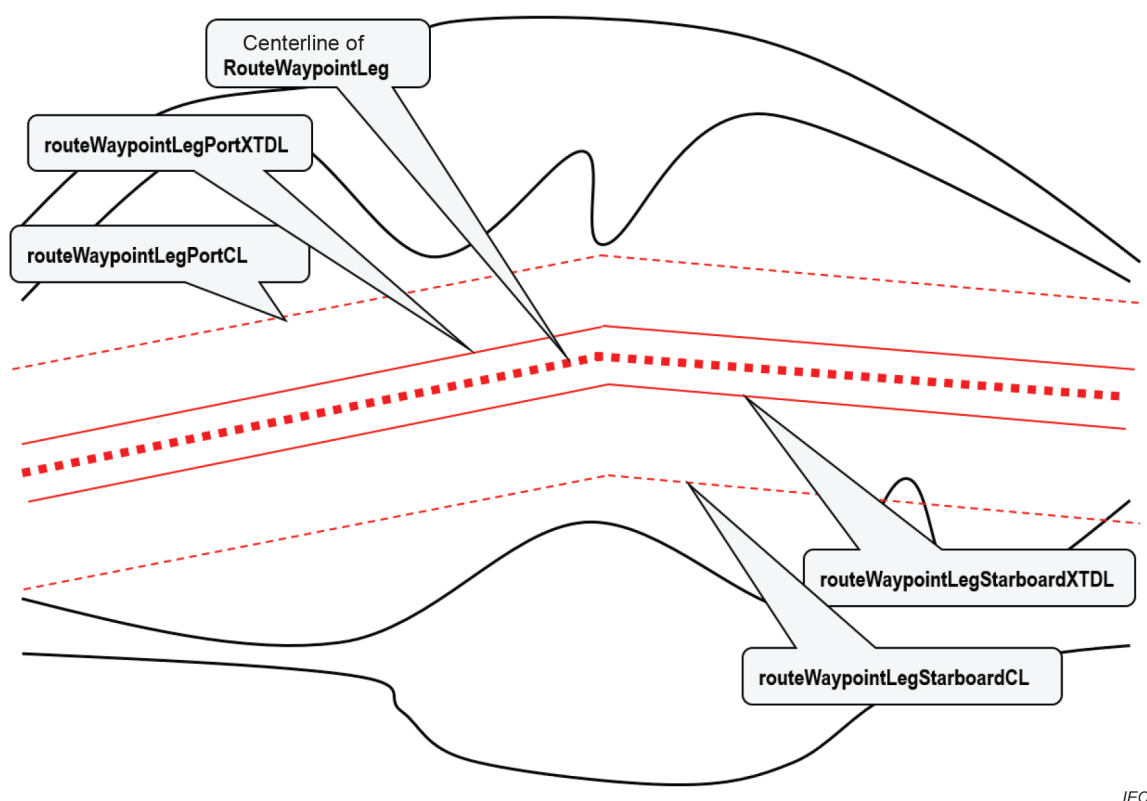
The safety margin is the draft component including uncertainties such as:

- the accuracy of the hydrographic data (references to reliability are often included on charts CATZOC);
- the vessel's size and handling characteristics;
- changes in the predicted tidal height, caused by wind speed and direction and high or low barometric pressure;
- the nature and stability of the seabed, i.e. sand waves, siltation, pipelines, obstructions etc.

Vessel safety draft is the sum of the static draft, dynamic draft and safety margin.

The waypoint leg area (see Table 12) is the area within a perpendicular distance from the center line of the leg as specified by `routeWaypointLegStarboardCL` and `routeWaypointLegPortCL`. In the case of crossing the 180° meridian, there might be multiple instances of the waypoint leg area. This can be derived from the route plan.

The waypoint leg area is related to the requirement of IMO MSC 232/A.11.3.5 for the user defined distance to check prohibited areas, areas with special conditions or navigational hazards. A smaller area within a perpendicular distance of the center line of the leg as specified by `routeWaypointLegStarboardXTDL` and `routeWaypointLegPortXTDL` is related to the requirement of IMO MSC 232/A.11.4.5 for an alarm when the user specified cross track limit for deviation from the planned route is exceeded. See Figure 7. The waypoint leg centerline is the center line of the leg.



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Figure 7 – RouteWaypointLeg limits example

Table 12 – RouteWaypointLeg object attributes

| Attribute name                | Description                                                                                                                                               | Data type | Multiplicity | Implementation | Remarks                                                                                           |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|--------------|----------------|---------------------------------------------------------------------------------------------------|
| routeWaypointLegStarboardXTDL | Starboard cross track distance limit.<br>Used during the route monitoring onboard.                                                                        | Integer   | 0..1         | Optional       | Unit: metre<br>The value range is 1 m to 10 000 m.<br>The resolution is 1 m.                      |
| routeWaypointLegPortXTDL      | Port cross track distance limit.<br>Used during the route monitoring onboard.                                                                             | Integer   | 0..1         | Optional       | Unit: metre<br>The value range is 1 m to 10 000 m.<br>The resolution is 1 m.                      |
| routeWaypointLegStarboardCL   | Starboard cross track distance check limit<br>Used to check route plan against the safety contour, areas with special condition and navigational hazards. | Integer   | 0..1         | Optional       | Unit: metre<br>The value range is 1 m to 10 000 m.<br>The resolution is 1 m.                      |
| routeWaypointLegPortCL        | Port cross track distance check limit.<br>Used to check route plan against the safety contour, areas with special condition and navigational hazards.     | Integer   | 0..1         | Optional       | Unit: metre<br>The value range is 1 m to 10 000 m.<br>The resolution is 1 m.                      |
| routeWaypointLegSafetyContour | Planned safety contour                                                                                                                                    | Real      | 0..1         | Optional       | Unit: metre<br>The resolution is 0,1 m.                                                           |
| routeWaypointLegSafetyDepth   | Planned safety depth                                                                                                                                      | Real      | 0..1         | Optional       | Unit: metre<br>The resolution is 0,1 m.                                                           |
| routeWaypointLegGeometryType  | Geometry type of leg                                                                                                                                      | Enum      | 1            | Mandatory      | Default value is 1 = loxodrome.<br>1: loxodrome (= rhumb line),<br>2: orthodrome (= great circle) |
| routeWaypointLegSOGMin        | Regulatory lowest speed over ground                                                                                                                       | Real      | 0..1         | Optional       | Unit: knots, speed over ground                                                                    |
| routeWaypointLegSOGMax        | Regulatory highest speed over ground                                                                                                                      | Real      | 0..1         | Optional       | Unit: knots, speed over ground                                                                    |
| routeWaypointLegSTWMax        | Maximum safe speed through water                                                                                                                          | Real      | 0..1         | Optional       | Unit: knots, speed through water                                                                  |
| routeWaypointLegSTWMin        | Minimum safe speed through water                                                                                                                          | Real      | 0..1         | Optional       | Unit: knots, speed through water                                                                  |

| Attribute name               | Description                                                                                | Data type       |  | Multiplicity | Implementation | Remarks                                   |
|------------------------------|--------------------------------------------------------------------------------------------|-----------------|--|--------------|----------------|-------------------------------------------|
| routeWaypointLegDraft        | Planned static draft, maximum                                                              | Real            |  | 0..1         | Optional       | Unit: metre<br>The resolution is 0,1 m.   |
| routeWaypointLegDraftForward | Planned static draft forward                                                               | Real            |  | 0..1         | Optional       | Unit: metre<br>The resolution is 0,1 m.   |
| routeWaypointLegDraftAft     | Planned static draft Aft                                                                   | Real            |  | 0..1         | Optional       | Unit: metre<br>The resolution is 0,1 m.   |
| routeWaypointLegDraftMax     | Maximum draft of the route waypoint leg for all vessels                                    | Real            |  | 0..1         | Optional       | Unit : metre<br>The resolution is 0,01 m. |
| routeWaypointLegAirDraftMax  | Maximum air draft of the route waypoint leg for all vessels                                | Real            |  | 0..1         | Optional       | Unit : metre<br>The resolution is 0,01 m. |
| routeWaypointLegBeamMax      | Maximum vessel beam of the route waypoint leg for all vessels                              | Real            |  | 0..1         | Optional       | Unit : metre<br>The resolution is 0,01 m. |
| routeWaypointLegLengthMax    | Maximum vessel length of the route waypoint leg for all vessels                            | Real            |  | 0..1         | Optional       | Unit : metre<br>The resolution is 0,01 m. |
| routeWaypointLegStaticUKC    | Minimum static UKC on the leg                                                              | Real            |  | 0..1         | Optional       | Unit: metre<br>The resolution is 0,1 m.   |
| routeWaypointLegDynamicUKC   | Minimum dynamic UKC on the leg                                                             | Real            |  | 0..1         | Optional       | Unit: metre<br>The resolution is 0,1 m.   |
| routeWaypointLegSafetyMargin | Draft component including uncertainties                                                    | Real            |  | 0..1         | Optional       | Unit: metre<br>The resolution is 0,1 m.   |
| routeWaypointLegNote         | Note for the route waypoint leg                                                            | String          |  | 0..1         | Optional       |                                           |
| routeWaypointLegIssue        | Safety issue for the route waypoint leg                                                    | String          |  | 0..1         | Optional       |                                           |
| routeWaypointLegExtensions   | Additional proprietary information for the RouteWaypointLegs specified by the manufacturer | RouteExtensions |  | 0..*         | Optional       |                                           |

### 7.3 Information types

#### 7.3.1 General

Information types are identifiable pieces of information in a dataset that can be shared between other features. They have attributes but have no relationship to any geometry. Information types may reference other information types.

#### 7.3.2 RouteSchedules

The feature RouteSchedules described in Table 13 shall contain zero or one RouteSchedule object.

The three main elements of a schedule are: ETA, ETD, and speed. These schedule elements can be set manually by the operator or calculated by machine. See Table 13 to Table 16.

Each schedule element is associated with a routeWaypointID. When a RouteScheduleManual is used, the schedule element is set by the operator. When a RouteScheduleCalculated is used, all schedule element values except manual elements are set by machine. The schedule elements of passed waypoints may be omitted.

If the route geometry changes, all the calculated elements for schedules shall be reset, as the calculation results basically depend on the geometry.

#### 7.3.3 RouteSchedule

The schedules contain three distinguishable parts: manual schedule (RouteScheduleManual), calculated schedule (RouteScheduleCalculated), and recommended schedule (RouteScheduleRecommended). The manual schedule is used to indicate manually entered values which are the basis for the schedule calculation/estimation. The main goal for the ship is to navigate safely to meet the manual schedule.

The RouteScheduleManual contains a list of RouteScheduleElement objects that describe time preferences and calculation restrictions for each leg or waypoint of the route. A waypoint shall have only one associated RouteScheduleElement within a RouteScheduleManual.

**NOTE** The manually entered values are normally one or several of 1) manually entered planned time of departure from berth, 2) manually entered planned time of arrival to PBG (pilot boarding ground) and/or berth, 3) manually entered planned speed on certain legs, 4) speed constrained by SOGMin/Max on a leg (the regulatory constraints), and the preferred service speed window depending on cargo and weather.

If an external party has entered manual values, the calculated schedule shall be removed or cleared to indicate that it is invalid. Also, if waypoints have been changed, the calculated schedule may be invalid and shall be removed or cleared as a signal to the ship to re-calculate the schedule. Only one active manual schedule is allowed in a route plan.

RouteScheduleRecommended object is used by, from the ship perspective, external actors to recommend or request a new time, for example a port can use the ETD or ETA in the recommended schedule to request/recommend a new time for departure or arrival.

RouteScheduleCalculated object contains a sequence of RouteScheduleElement objects that store calculations results according to user's preferences available from the RouteScheduleManual or RouteScheduleRecommended object. A waypoint shall have only one associated RouteScheduleElement within a RouteScheduleCalculated object.

The calculated schedule contains manually entered values and calculated estimations on waypoints between the manually set times. Hence, the calculated schedule is more complete with times on each waypoint. It is calculated based on manually entered values and regulatory speeds on legs. The calculated schedule is set by the ship, but can also be calculated onshore by for example a route optimization provider.

If the receiving application uses route information only for display or information purposes, it shall use the RouteScheduleElementCalculated object since this has all the schedule elements.

**Table 13 – RouteSchedules object attributes**

| Attribute name           | Description                                                                              | Data type       | Multiplicity | Implementation | Remarks |
|--------------------------|------------------------------------------------------------------------------------------|-----------------|--------------|----------------|---------|
| routeSchedulesExtensions | Additional proprietary information for the route schedules specified by the manufacturer | RouteExtensions | 0..*         | Optional       |         |

**Table 14 – RouteScheduleManual object attributes**

| Attribute name                | Description                                                                                    | Data type       | Multiplicity | Implementation | Remarks |
|-------------------------------|------------------------------------------------------------------------------------------------|-----------------|--------------|----------------|---------|
| routeScheduleManualExtensions | Additional proprietary information for the route schedule manual specified by the manufacturer | RouteExtensions | 0..*         | Optional       |         |

**Table 15 – RouteScheduleCalculated object attributes**

| Attribute name                    | Description                                                                                            | Data type       | Multiplicity | Implementation | Remarks |
|-----------------------------------|--------------------------------------------------------------------------------------------------------|-----------------|--------------|----------------|---------|
| routeScheduleCalculatedExtensions | Additional proprietary information for the route schedule calculated and specified by the manufacturer | RouteExtensions | 0..*         | Optional       |         |

**Table 16 – RouteScheduleRecommended object attributes**

| Attribute Name                     | Description                                                                                             | Data Type       | Multiplicity | Implementation | Remarks |
|------------------------------------|---------------------------------------------------------------------------------------------------------|-----------------|--------------|----------------|---------|
| routeScheduleRecommendedExtensions | Additional proprietary information for the route schedule recommended and specified by the manufacturer | RouteExtensions | 0..*         | Optional       |         |

Table 17 – RouteSchedule object attributes

| Attribute Name          | Description                                                                             | Data Type       | Multiplicity | Implementation | Remarks             |
|-------------------------|-----------------------------------------------------------------------------------------|-----------------|--------------|----------------|---------------------|
| routeScheduleID         | Identifier of the schedule. This identifier is unique in the route                      | Integer         | 1            | Mandatory      | positive integer    |
| routeScheduleName       | Name of schedule                                                                        | String          | 0..1         | Optional       | Human readable text |
| routeScheduleExtensions | Additional proprietary information for the route schedule specified by the manufacturer | RouteExtensions | 0..*         | Optional       |                     |

### 7.3.4 RouteScheduleManual/RouteScheduleCalculated/RouteScheduleRecommended

The RouteScheduleCalculated shall contain both parameters consistent with the manually set values (presented in RouteScheduleManual or RouteScheduleRecommended), and the calculated values.

Consistency means equal value intervals for the routeScheduleElementETA, routeScheduleElementETD (with some reservations for this parameter which will be referred to below) and equality of the rest of parameters, as it is essentially dependent on the specific routeScheduleElementETA, routeScheduleElementETD values rather than on their intervals.

The schedule is considered complete if:

- 1) its RouteScheduleCalculated element contains ETD parameter values for all the waypoints except the last one, and the ETA and speed parameter values for all the waypoints except the first one;
- 2) the RouteScheduleManual element is not in contradiction with the RouteScheduleCalculated element, and the data for RouteScheduleManual is sufficient for recalculating the schedule.

### 7.3.5 RouteScheduleElement

The routeScheduleID (see Table 17) is intended for machine processing. The routeScheduleName is intended for the human operator. A unique routeScheduleID shall be set for each RouteSchedule object. The routeScheduleName attribute is optional, and there may be several schedules with the same name within the framework of one route.

NOTE 1 The routeScheduleName attribute is intended mainly for making it easier for an operator handling several schedules for one and the same route, to find the necessary schedule and distinguish the schedules from one another.

NOTE 2 It is helpful to use a globally unique identifier (GUID) for a routeScheduleID in the routeSchedule, to avoid problems associated with the merging of two versions of the same route from different sources, since the GUID guarantees that the schedules would not intersect, and that one could be certain about which schedules are common.

When all/any of the following attributes are changed,

- routeScheduleElementETA;
- routeScheduleElementETD (see Table 18);
- routeScheduleElementPlanSOG;

there is a need to set intervals appropriately by filling in the following attributes:

- routeScheduleElementETDWindowBefore;
- routeScheduleElementETDWindowAfter;
- routeScheduleElementETAWindowBefore;
- routeScheduleElementETAWindowAfter.

All the fields describing a certain time interval (routeScheduleElementETAWindowAfter, routeScheduleElementETDWindowAfter, routeScheduleElementETAWindowBefore, routeScheduleElementETDWindowBefore) shall have the integer format with minutes. When the interval length is more than 24 h, and comes to for example 37 h 27 min, this shall be expressed as 2247.

### 7.3.6 RouteInfo

The routeInfoName (see Table 19) attribute is mandatory, intended for human reading purposes, and shall not be empty or consist of space symbols only.

When a route plan is exchanged in any given status, the validity period can be defined with a start and stop, or eventually only one of them. The attributes `routeInfoValidityStart/routeInfoValidityEnd` shall be understood by the receiving party that the route shall be used only within the given period. For a reference route (see Clause A.11), this implies that the use of the route for passage planning shall not be possible outside the given time window. For a recommended route for example, giving a recommended ETA, the validity period implies that the receiver shall not be able to base passage planning on the received route after this time window, and eventually shall request a new recommendation (see Clause A.10). For a service replying with an under keel clearance management (see Clause A.6) condition, the validity period shall be understood as the period during which the affected ship has to reply that the recommended route is to be used, and given the status of "used for monitoring". This understanding shall apply to any use of these two attributes.

The `routeInfoAuthor` attribute may specify not only the name with initials, but also the organizational position in human readable format. This attribute is not mandatory but important to support understanding by the receivers of a route.

The `routeInfoEditionTime` is mandatory and is the time when the given route was created or updated.

The `routeInfoStatus` field is mandatory. The `routeInfoStatus` shall be used to give the status of the route in order to support the various scenarios, for example route optimization and route cross check. The intention of the "Terminated" status is to inform receivers of a route plan that the route has been completed or stopped/cancelled; for example if a route is cancelled, possible previous receivers need to be made aware about this, whether or not they are given access rights to the route that "replaces" the cancelled one. Figure 8 describes typical transitions of `routeInfoStatus` values for a ship. The route planning typically starts with an initial route or when a ship receives reference routes (`routeInfoStatus=1` (Initial)). Some attributes in an initial route may be added or modified. When a route plan is ready to use, it changes state to "Planned" (`routeInfoStatus=2`).

The planned route may be sent to shore for processing; received routes are normally updated in the planned route. At any time, the ship may receive a recommended route (`routeInfoStatus=3`), an acknowledged route (`routeInfoStatus=4`) or a route issues (`routeInfoStatus=9`).

When route is loaded into ECDIS for monitoring, it changes status to "Used for monitoring" (`routeInfoStatus=5`).

If route is not finalised when unloaded, the route changes to status "Planned" (`routeInfoStatus=2`). When route is unloaded from ECDIS and the complete route plan is finalised or cancelled, the route changes status to "Terminated" (`routeInfoStatus=6`).

Figure 9 describes typical transitions of `routeInfoStatus` values for a shore side service.

Shore is waiting for a route from a ship, or a route request from a ship. If a received route is planned or used for monitoring, processing is required. After the processing, the response is sent back to the ship with either a recommended route, an acknowledged route, a route issue, an incomplete route or a route error.

When the shore receives a terminated route, it ends all processing related with the route plan. When the shore receives the route request with an initial route or when it needs to send a reference route, it provides a reference route to the ship.

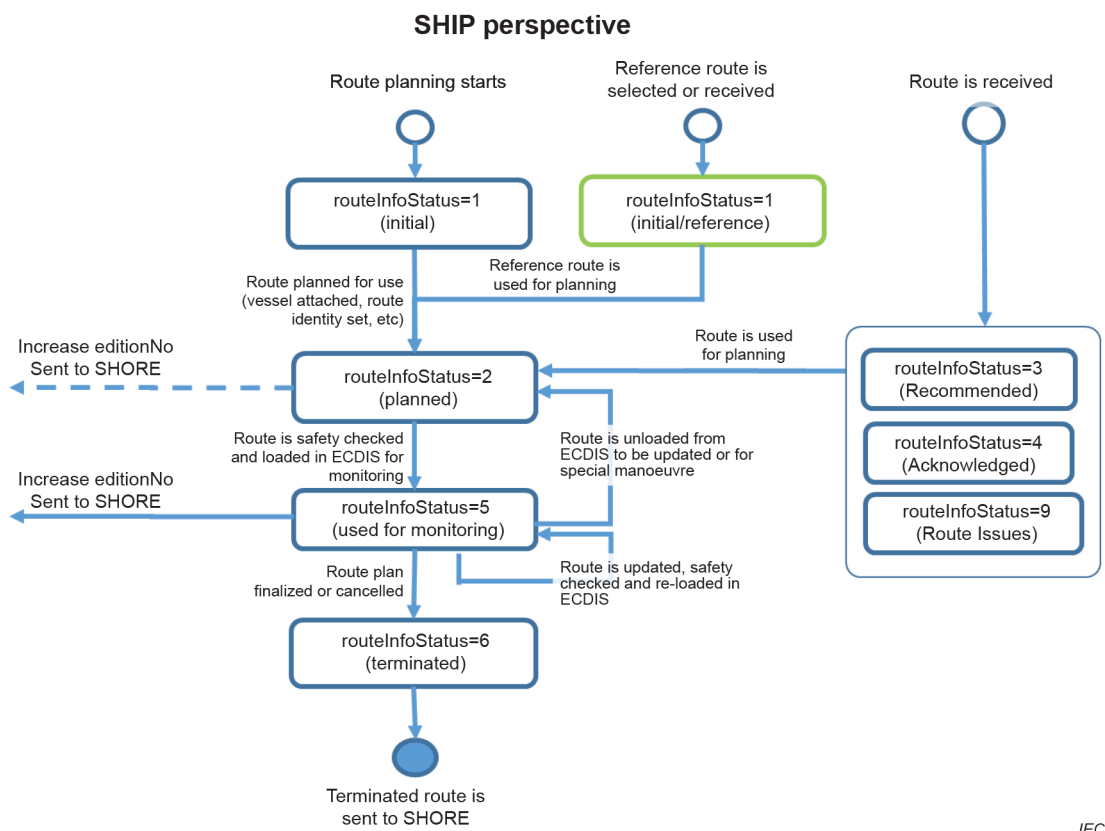


**Figure 8 – State diagram for route status from ship perspective**

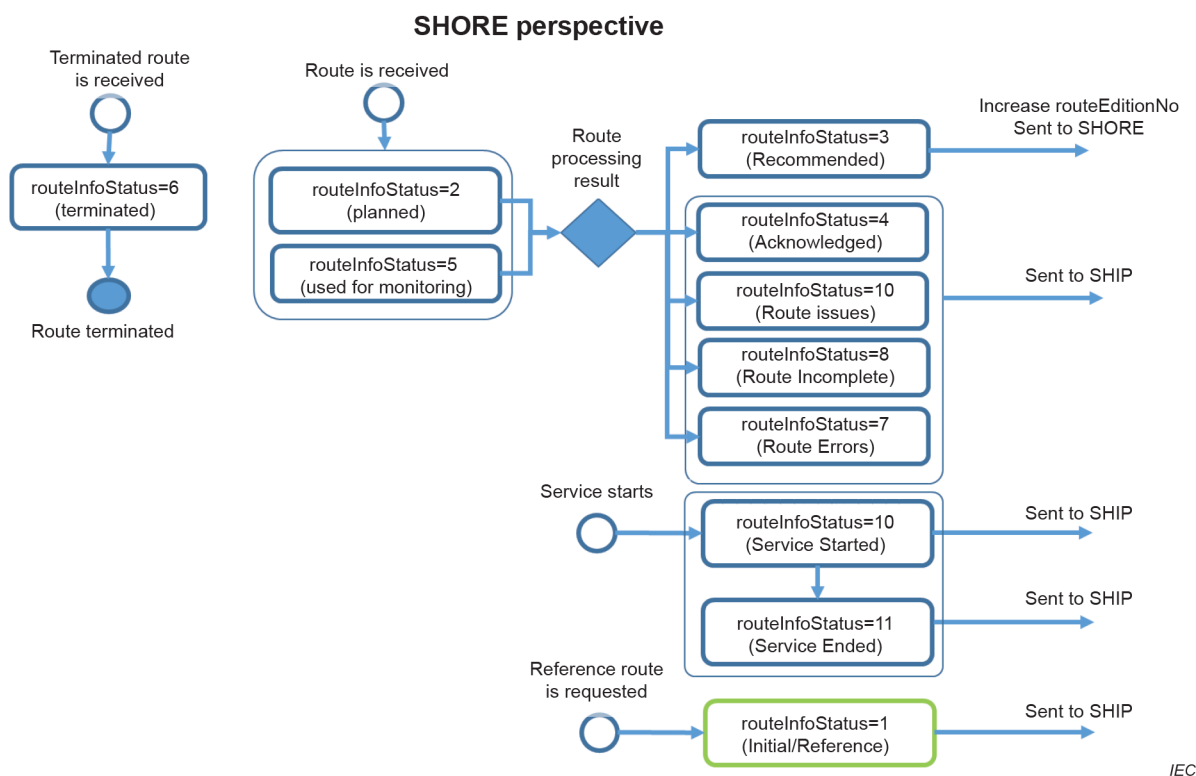


**Figure 9 – State diagram of route status from shore perspective**

**Table 18 – RouteScheduleElement object attributes**

| Attribute name                      | Description                                                                                                     | Data type       | Multiplicity | Implementation | Remarks                                  |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------|-----------------|--------------|----------------|------------------------------------------|
| routeWaypointID                     | Waypoint identifier of the schedule                                                                             | Integer         | 1            | Mandatory      |                                          |
| routeScheduleElementPlanSOG         | Planned speed over ground                                                                                       | Real            | 0..1         | Mandatory      | Unit:<br>knots,<br>speed over<br>ground  |
| routeScheduleElementETD             | Planned or recommended time of departure represented by estimated time of departure (ETD by schedule or by SOG) | DateTime        | 0..1         | Mandatory      |                                          |
| routeScheduleElementETA             | Planned or recommended time of arrival represented by estimated time of arrival (ETA by Schedule or by SOG)     | DateTime        | 0..1         | Mandatory      |                                          |
| routeScheduleElementETDWindowBefore | Describes the period of time before planned or recommended time of departure                                    | integer         | 0..1         | Optional       | UNIT:<br>minutes<br>minutes to<br>ETD    |
| routeScheduleElementETDWindowAfter  | Describes the period of time after planned or recommended time of departure                                     | Integer         | 0..1         | Optional       | UNIT:<br>minutes<br>minutes<br>after ETD |
| routeScheduleElementETAWindowBefore | Describes the period of time before planned or recommended time of arrival                                      | integer         | 0..1         | Optional       | UNIT:<br>minutes<br>minutes to<br>ETA    |
| routeScheduleElementETAWindowAfter  | Describes the period of time after planned or recommended time of arrival                                       | Integer         | 0..1         | Optional       | UNIT:<br>minutes<br>minutes<br>after ETA |
| routeScheduleElementNote            | Notes for the route schedule element                                                                            | String          | 0..1         | Optional       |                                          |
| routeScheduleElementExtensions      | Additional proprietary information for the route schedule element specified by the manufacturer                 | RouteExtensions | 0..1         | Optional       |                                          |

**Table 19 – RouteInfo object attributes**

| Attribute name              | Description                                                                                                                                                                                                                                                                 | Data type | Multiplicity | Implementation | Remarks                                                     |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|--------------|----------------|-------------------------------------------------------------|
| routeInfoName               | Name of the route                                                                                                                                                                                                                                                           | String    | 1            | Mandatory      | Human readable text                                         |
| routeInfoAuthor             | Author of the route                                                                                                                                                                                                                                                         | String    | 0..1         | Mandatory      | Human readable text                                         |
| routeInfoEditionTime        | Time this edition of route plan is edited                                                                                                                                                                                                                                   | DateTime  | 0..1         | Mandatory      | In UTC time, for example 2019-06-26T14:22:02Z               |
| routeInfoDescription        | Additional information for the status of the route, i.e. specific error message and/or cause of the route change and/or any other detail to consider before further use of this route plan and/or the purpose of sending a route plan and/or why this route is recommended. | String    | 0..1         | Mandatory      | Human readable text                                         |
| routeInfoStatus             | Enumerated status value of the route                                                                                                                                                                                                                                        | Enum      | 1            | Mandatory      | See Table 20                                                |
| routeInfoValidityStart      | Start of validity of route plan                                                                                                                                                                                                                                             | DateTime  | 0..1         | Mandatory      |                                                             |
| routeInfoValidityEnd        | End of validity of route plan                                                                                                                                                                                                                                               | DateTime  | 0..1         | Mandatory      |                                                             |
| routeInfoDeparturePortID1   | Primary identifier for departure port given by UN/LOCODE                                                                                                                                                                                                                    | String    | 0..1         | Optional       | UN/LOCODE as found from UNECE's code list                   |
| routeInfoDeparturePortID2   | Secondary identifier for departure port given by free text string                                                                                                                                                                                                           | String    | 0..1         | Optional       | Free text, e.g. location name, berth name, other identifier |
| routeInfoDeparturePortCall  | Reference to port call identifier in departing port                                                                                                                                                                                                                         | String    | 0..1         | Optional       |                                                             |
| routeInfoArrivalPortID1     | Primary identifier for arrival port given by UN/LOCODE                                                                                                                                                                                                                      | String    | 0..1         | Optional       | UN/LOCODE as found from UNECE's code list                   |
| routeInfoArrivalPortID2     | Secondary identifier for arrival port given by free text string                                                                                                                                                                                                             | String    | 0..1         | Optional       | Free text, e.g. location name, berth name, other identifier |
| routeInfoArrivalPortCall    | Reference to port call identifier in arriving port                                                                                                                                                                                                                          | String    | 0..1         | Optional       |                                                             |
| routeInfoReferencePrevRoute | Reference previous route                                                                                                                                                                                                                                                    | String    | 0..1         | Optional       |                                                             |
| routeInfoReferenceNextRoute | Reference next route                                                                                                                                                                                                                                                        | String    | 0..1         | Optional       |                                                             |
| routeInfoVesselType         | Type of ship                                                                                                                                                                                                                                                                | Integer   | 0..1         | Optional       | See Table 21                                                |

| Attribute name          | Description                                                                                                                                                                 | Data type       | Multiplicity | Implementation | Remarks                                                                                       |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------|----------------|-----------------------------------------------------------------------------------------------|
| routeInfoVesselName     | Ship's name                                                                                                                                                                 | String          | 0..1         | Optional       | Any one of these attributes is used for the alternatives for the identification of the vessel |
| routeInfoVesselMMSI     | Ship's MMSI                                                                                                                                                                 | String          | 0..1         | Mandatory      | MMSI is used for vessel identification.                                                       |
| routeInfoVesselCallsign | Ship's call sign                                                                                                                                                            | String          | 0..1         | Optional       | These attributes complement the identification of the vessel.                                 |
| routeInfoVesselIMO      | Ship's IMO number                                                                                                                                                           | String          | 0..1         | Optional       |                                                                                               |
| routeInfoVesselVoyage   | Unique voyage identifier<br>A voyage may have more than one destination and departure locations, but a route plan refers to only one destination and one departure location | String          | 0..1         | Optional       |                                                                                               |
| routeInfoVesselHeight   | Vessel height measured from the keel to the masthead                                                                                                                        | Real            | 0..1         | Optional       | Unit : metres<br>Resolution is 0,01 m                                                         |
| routeInfoVesselLength   | Vessel length overall (LOA)                                                                                                                                                 | Real            | 0..1         | Optional       | Unit : metres<br>Resolution is 0,01 m                                                         |
| routeInfoVesselBeam     | Vessel beam                                                                                                                                                                 | Real            | 0..1         | Optional       | Unit : metres<br>Resolution is 0,01 m                                                         |
| routeInfoDraftMax       | Maximum vessel draft                                                                                                                                                        | Real            | 0..1         | Optional       | Unit : metres<br>Resolution is 0,01 m                                                         |
| routeInfoAirDraftMax    | Maximum vessel air draft                                                                                                                                                    | Real            | 0..1         | Optional       | Unit : metres<br>Resolution is 0,01 m                                                         |
| routeInfoBeamMax        | Maximum vessel beam                                                                                                                                                         | Real            | 0..1         | Optional       | Unit : metres<br>Resolution is 0,01 m                                                         |
| routeInfoLengthMax      | Maximum vessel length                                                                                                                                                       | Real            | 0..1         | Optional       | Unit : metres<br>Resolution is 0,01 m                                                         |
| routeInfoExtensions     | Additional proprietary information for the route info specified by the manufacturer                                                                                         | RouteExtensions | 0..1         | Optional       | Unit : metres<br>Resolution is 0,01 m                                                         |

**Table 20 – Definition of RouteInfoStatus**

| routeInfoStatus | Human readable text | Description of use case                                                                                     | Actors                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----------------|---------------------|-------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1               | Initial             | Initial route or a reference route if meant for more than one specific route plan                           | <p>Ship or shore</p> <ul style="list-style-type: none"> <li>Ship: Initial route which is created in the route database on the ship (route plan is not loaded into monitoring) or external system onboard.</li> </ul> <p>If route is to be stored and used for more than one route plan, the route shall be addressed as a reference route.</p> <ul style="list-style-type: none"> <li>Service provider (shore): reference routes given from a national authority or from a company. This includes a company making common reference routes for their own vessels, or from a service providing routes such as a VTS-service, pilot routes for given areas, routes for winter ice navigation and other appropriate services.</li> </ul> |
| 2               | Planned             | Route and schedule prepared by crew                                                                         | <p>Ship only</p> <p>Route with one or several schedules, calculated and stored in the route database on the ship (route plan is not loaded into monitoring)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 3               | Recommended         | Route and schedule recommended by 3 <sup>rd</sup> party service provider                                    | <p>Shore only</p> <p>Recommended route with one or several schedules, calculated by any 3<sup>rd</sup> party service provider (weather optimization, auto-routing, route checked, traffic management, etc.) and delivered to the ship or fleet operator.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 4               | Acknowledged        | Checked and acknowledged route from any 3 <sup>rd</sup> party service provider or from a ship               | <p>Ship or shore</p> <ul style="list-style-type: none"> <li>Service provider: Acknowledged route verified by 3<sup>rd</sup> party service provider. Route has been checked and approved for a given voyage for example by a VTS. The responsibility to choose a safe route for monitoring is nevertheless the captain's responsibility.</li> <li>Ship: Acknowledged route from ship to shore, for instance a ship acknowledge to perform a specific search and rescue.</li> </ul>                                                                                                                                                                                                                                                     |
| 5               | Used for monitoring | Loaded for monitoring                                                                                       | <p>Ship only</p> <p>Route with or without schedule is loaded for monitoring in the system on board. This is used only for the active route.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 6               | Terminated          | Route completed or cancelled                                                                                | <p>Ship only</p> <p>Route plan has been completed or stopped/cancelled, or end of route monitoring</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 7               | Errors              | The received route information is invalid according to schema validation or application level context check | <p>Ship, shore</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

| routeInfoStatus | Human readable text | Description of use case                                                                                                               | Actors                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8               | Incomplete          | Some fields of received route information are missing for this specific use case                                                      | Ship, shore                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 9               | Route issues        | Route checked by 3 <sup>rd</sup> party and the comments are available in routeWaypointLegIssue and/or routeInfoDescription attributes | <ul style="list-style-type: none"> <li>Shore: Service provider has added routeWaypointLegIssue and/or routeInfoDescription attributes. Route has been checked and disapproved for a given voyage for example by a VTS. The route will then often hold issues on one or more legs (RouteWaypointLegIssue) that should be addressed before resending to the given service, VTS or other.</li> <li>Ship: After import of the route, inform the user about route check issues and provide textual contents of the routeWaypointLegIssue and/or routeInfoDescription attributes for reading.</li> </ul> |
| 10              | Service started     | This status is used for routes sent to a ship confirming a shore based service has started for the given route                        | Shore only                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 11              | Service ended       | This status is used for routes sent to a ship confirming a shore based service has been ended for the given route.                    | Shore only                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

Table 21 – Type of ship

| Identifier no. | Special craft                                                                           |
|----------------|-----------------------------------------------------------------------------------------|
| 50             | Pilot vessel                                                                            |
| 51             | Search and rescue vessel                                                                |
| 52             | Tugs                                                                                    |
| 53             | Port tenders                                                                            |
| 54             | Vessel with anti-pollution facilities and equipment                                     |
| 55             | Law enforcement vessels                                                                 |
| 56             | Spare – for assignments to local vessels                                                |
| 57             | Spare – for assignments to local vessels                                                |
| 58             | Medical transports (as defined in the 1949 Geneva Conventions and Additional Protocols) |
| 59             | Ships and aircraft of States not parties to an armed conflict                           |

| Other ships                 |                                                                    |             |                                                                        |
|-----------------------------|--------------------------------------------------------------------|-------------|------------------------------------------------------------------------|
| First digit                 | Second digit                                                       | First digit | Second digit                                                           |
| 1 – Reserved for future use | 0 – All ships of this type                                         | -           | 0 – Fishing                                                            |
| 2 – WIG                     | 1 – Carrying DG, HS, or MP, IMO hazard or pollutant category X(2)  |             | 1 – Towing                                                             |
| 3 – See right column        | 2 – Carrying DG, HS, or MP, IMO hazard or pollutant category Y(2)  | 3 – Vessel  | 2 – Towing and length of the tow exceeds 200 m or breadth exceeds 25 m |
| 4 – HSC                     | 3 – Carrying DG, HS, or MP, IMO hazard or pollutant category Z(2)  |             | 3 – Engaged in dredging or underwater operations                       |
| 5 – See above               | 4 – Carrying DG, HS, or MP, IMO hazard or pollutant category OS(2) |             | 4 – Engaged in diving operations                                       |
|                             | 5 – Reserved for future use                                        |             | 5 – Engaged in military operations                                     |
| 6 – Passenger ships         | 6 – Reserved for future use                                        | -           | 6 – Sailing                                                            |
| 7 – Cargo ships             | 7 – Reserved for future use                                        | -           | 7 – Pleasure craft                                                     |
| 8 – Tanker(s)               | 8 – Reserved for future use                                        | -           | 8 – Reserved for future use                                            |
| 9 – Other types of ship     | 9 – No additional information                                      | -           | 9 – Reserved for future use                                            |

## 7.4 Association roles of feature catalogue

An association role describes the nature of the relationships. First is the relationship from one feature type to another feature type in a feature association. Second is the relationship from one object (feature or information type) to one information type in an information association. Each association has exactly two roles. Either or both may be a default. This document defines all roles which is used for feature associations and information associations. If there is any conflict in the association roles in Table 22 and Figure 1, Figure 1 has precedence.

**Table 22 – Roles of the route plan**

| Role name                         | Definition                                                 | Code                              | Mult | Remarks |
|-----------------------------------|------------------------------------------------------------|-----------------------------------|------|---------|
| RouteInfoSet                      | A pointer to the aggregate in a whole-part relationship    | routeInfoSet                      | 1    |         |
| RouteInfo                         | A pointer to the class                                     | routeInfo                         | 1    |         |
| RouteWaypointsSet                 | A pointer to the aggregate in a whole-part relationship    | routeWaypointsSet                 | 1    |         |
| RouteWaypoints                    | A pointer to the class                                     | routeWaypoints                    | 0..1 |         |
| RouteWaypointSet                  | A pointer to the aggregate in a whole-part relationship.   | routeWaypointSet                  | 1    |         |
| RouteWaypoint                     | A pointer to the class                                     | routeWaypoint                     | 2..* |         |
| RouteWaypointLegSet               | A pointer to the aggregate in a whole-part relationship    | routeWaypointLegSet               | 1    |         |
| RouteWaypointLeg                  | A pointer to the class                                     | routeWaypointLeg                  | 0..1 |         |
| Route Schedules Set               | A pointer to the aggregate in a whole-part relationship    | routeSchedulesSet                 | 1    |         |
| Route Schedules                   | A pointer to the class                                     | routeSchedules                    | 0..1 |         |
| Route Schedule Set                | A pointer to the aggregate in a whole-part relationship    | routeScheduleSet                  | 1    |         |
| Route Schedule                    | A pointer to the class                                     | routeSchedule                     | 0..* |         |
| RouteScheduleManual Set           | A pointer to the member class in a whole-part relationship | routeScheduleManualSet            | 1    |         |
| RouteScheduleManual               | A pointer to the class                                     | routeScheduleManual               | 0..1 |         |
| RouteScheduleCalculatedSet        | A pointer to the member class in a whole-part relationship | routeScheduleCalculatedSet        | 1    |         |
| RouteScheduleCalculated           | A pointer to the class                                     | routeScheduleCalculated           | 0..1 |         |
| RouteScheduleRecommendSet         | A pointer to the member class in a whole-part relationship | routeScheduleRecommendSet         | 1    |         |
| RouteScheduleRecommend            | A pointer to the class                                     | routeScheduleRecommend            | 0..1 |         |
| RouteScheduleElementManualSet     | A pointer to the member class in a whole-part relationship | routeScheduleElementManualSet     | 0..1 |         |
| RouteScheduleElementCalculatedSet | A pointer to the member class in a whole-part relationship | routeScheduleElementCalculatedSet | 0..1 |         |
| RouteScheduleElementRecommendSet  | A pointer to the member class in a whole-part relationship | routeScheduleElementRecommendSet  | 0..1 |         |
| RouteScheduleElement              | A pointer to the class                                     | routeScheduleElement              | 1..* |         |
| RouteActionPointsSet              | A pointer to the aggregate in a whole-part relationship    | routeActionPointsSet              | 1    |         |
| RouteActionPoints                 | A pointer to the class                                     | routeActionPoints                 | 0..1 |         |
| RouteActionPointSet               | A pointer to the aggregate in a whole-part relationship    | routeActionPointSet               | 1    |         |
| RouteActionPoint                  | A pointer to the class                                     | routeActionPoint                  | 0..* |         |