S-421 is an international enabler established by IEC

(Digitalizing Nautical Communication Between Ship and Shore with S-100)

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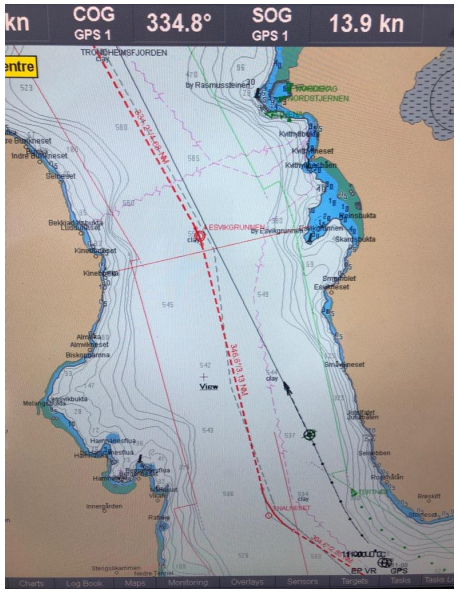

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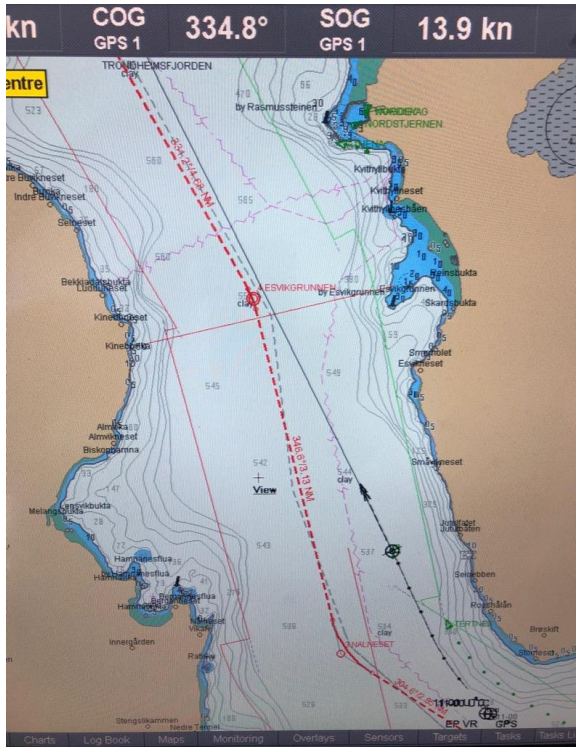
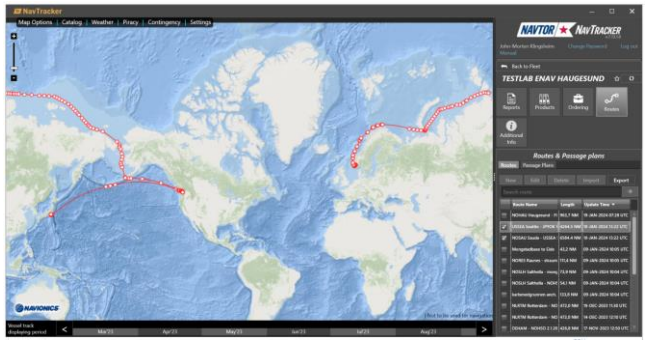
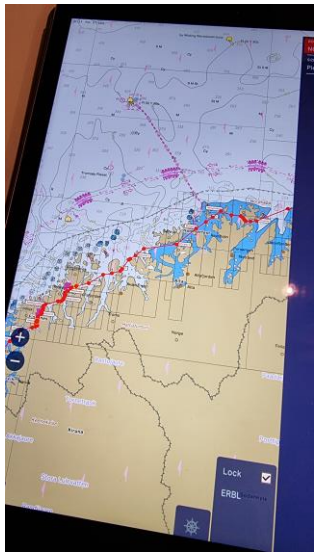


On board (ECDIS)



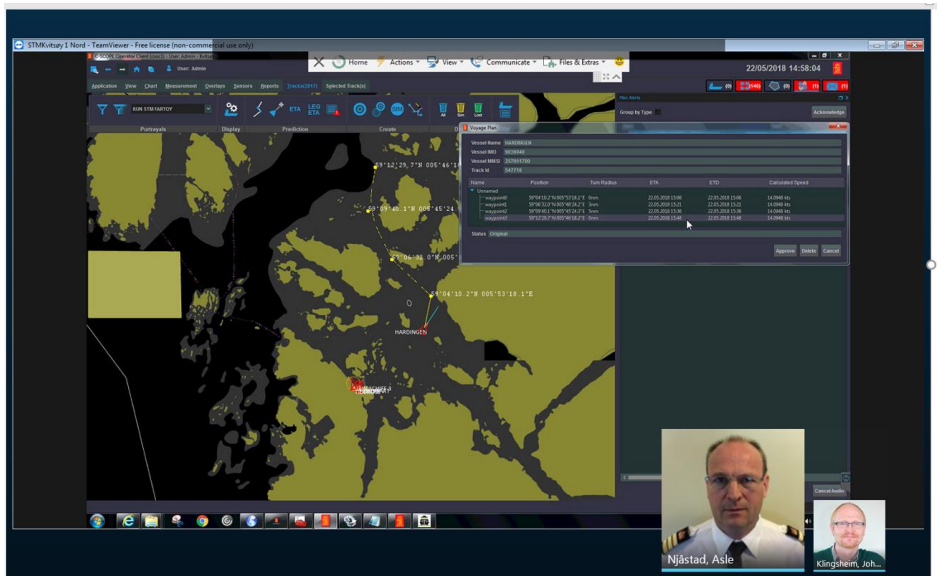
Planning station (NAVTOR)



Portable

Pilot Unit

(Njord Pilot)



VTS operator

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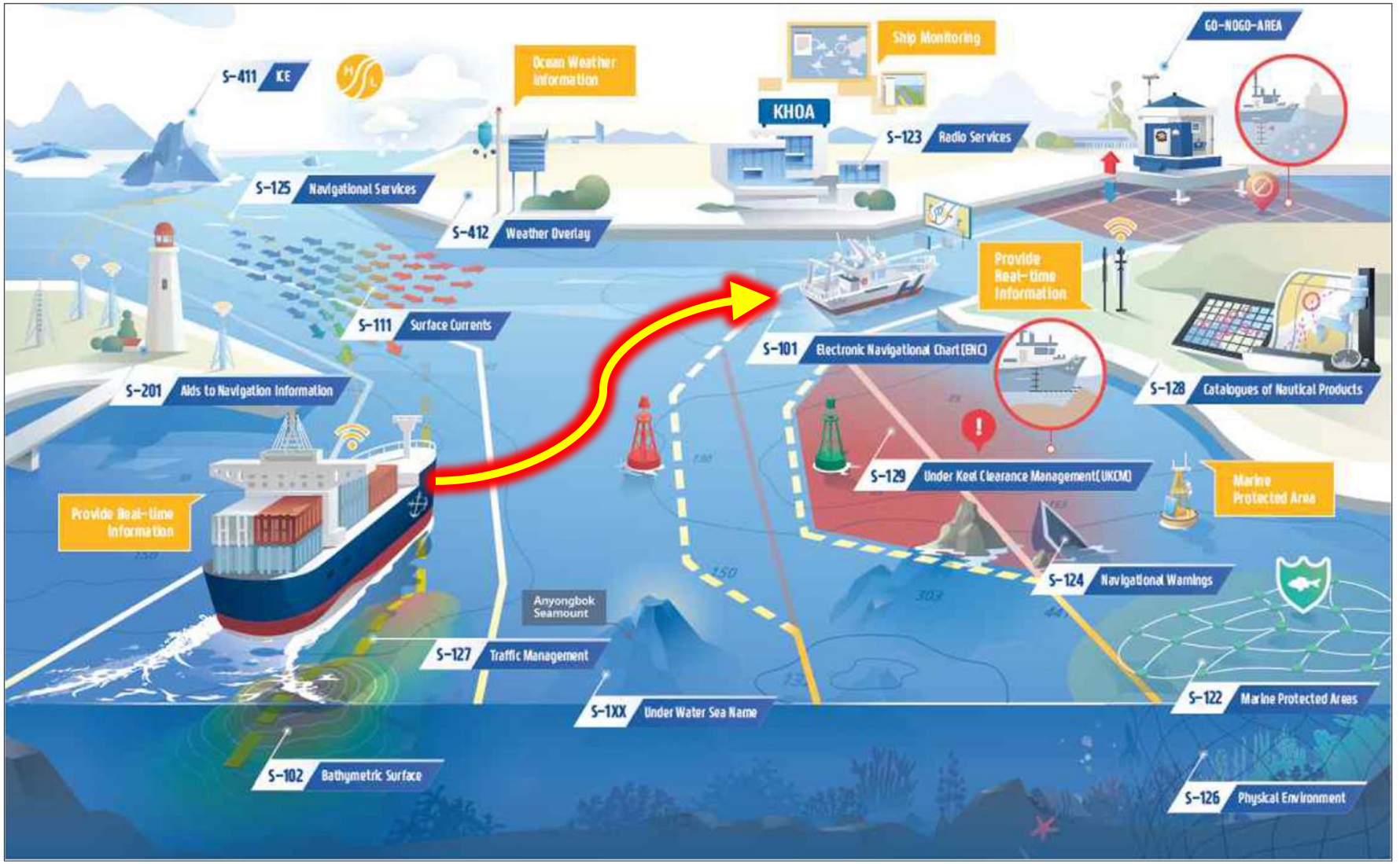
The missing link!



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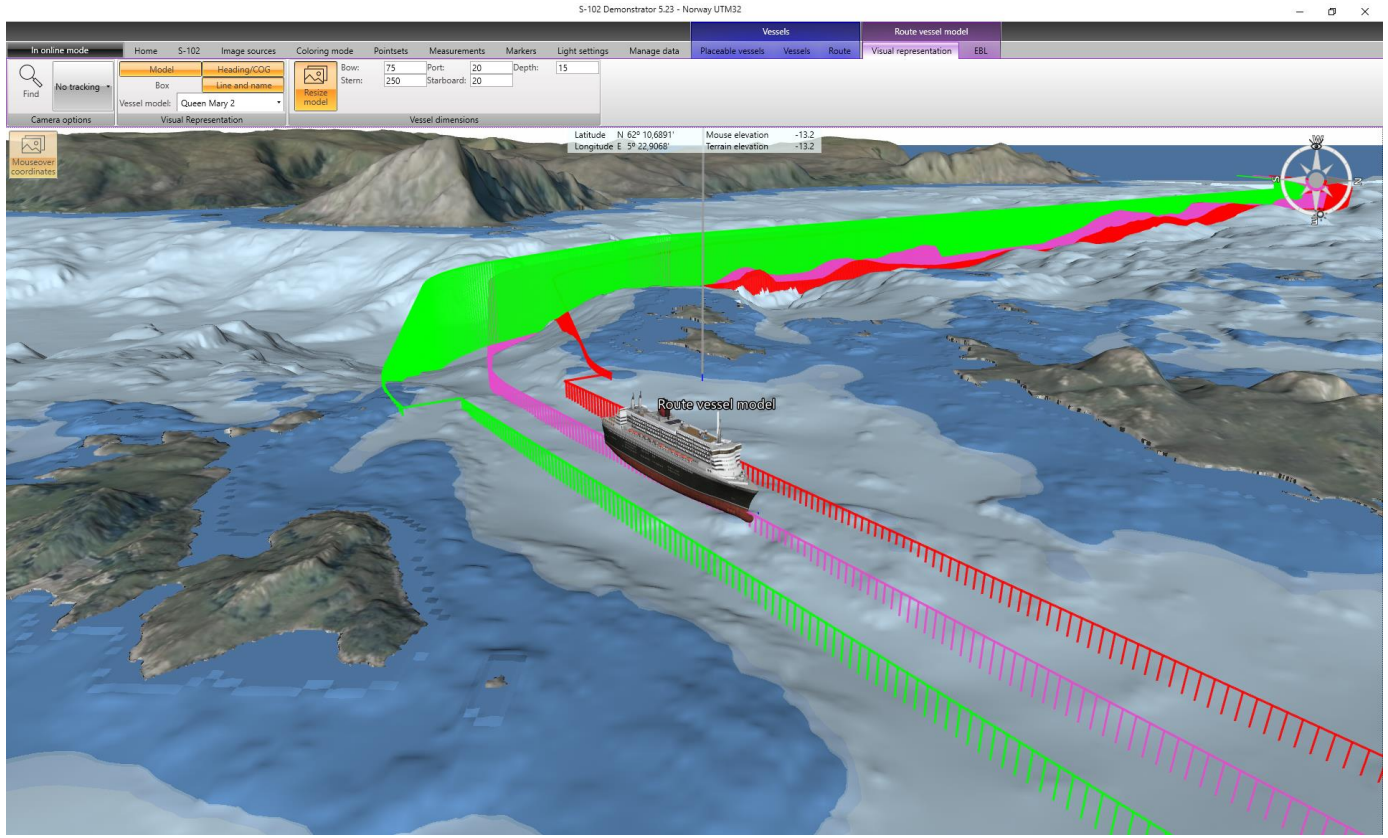
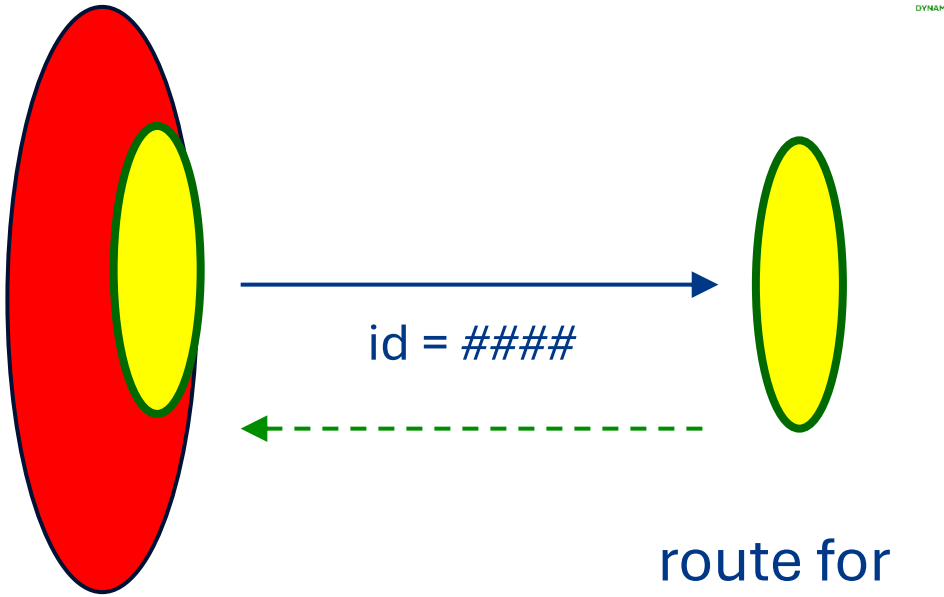


The RTZ route imported to S-100 demonstrator (ECC AS /Kongsberg Digital)

IMO/IEC:

- by update of ECDIS performance standard IEC61174:2015, RTZ made mandatory as exchange format for **route plans**, with implementation 2016
- NCSR 10 (2023): Agreed to draft amendments to the performance standards for electronic chart display and information systems (ECDIS) were agreed to facilitate the digital exchange of ships' route plans – ship to shore. (S-421 chosen as mandatory, RTZ as voluntary)
- (Amendments to Resolution MSC.530(106)) will be submitted to MSC 108 in May 2024 for approval.
- Technical specifications IEC 63173-1 (S-421), IEC 63173-2 (SECOM) pluss details in new IEC-61174 (ECDIS performance standard). Finalized 2025/26
- January 2026 may be the first time data can be shown in an ECDIS, and all new systems required compatible by 2029 (not confirmed dates).

Route exchange

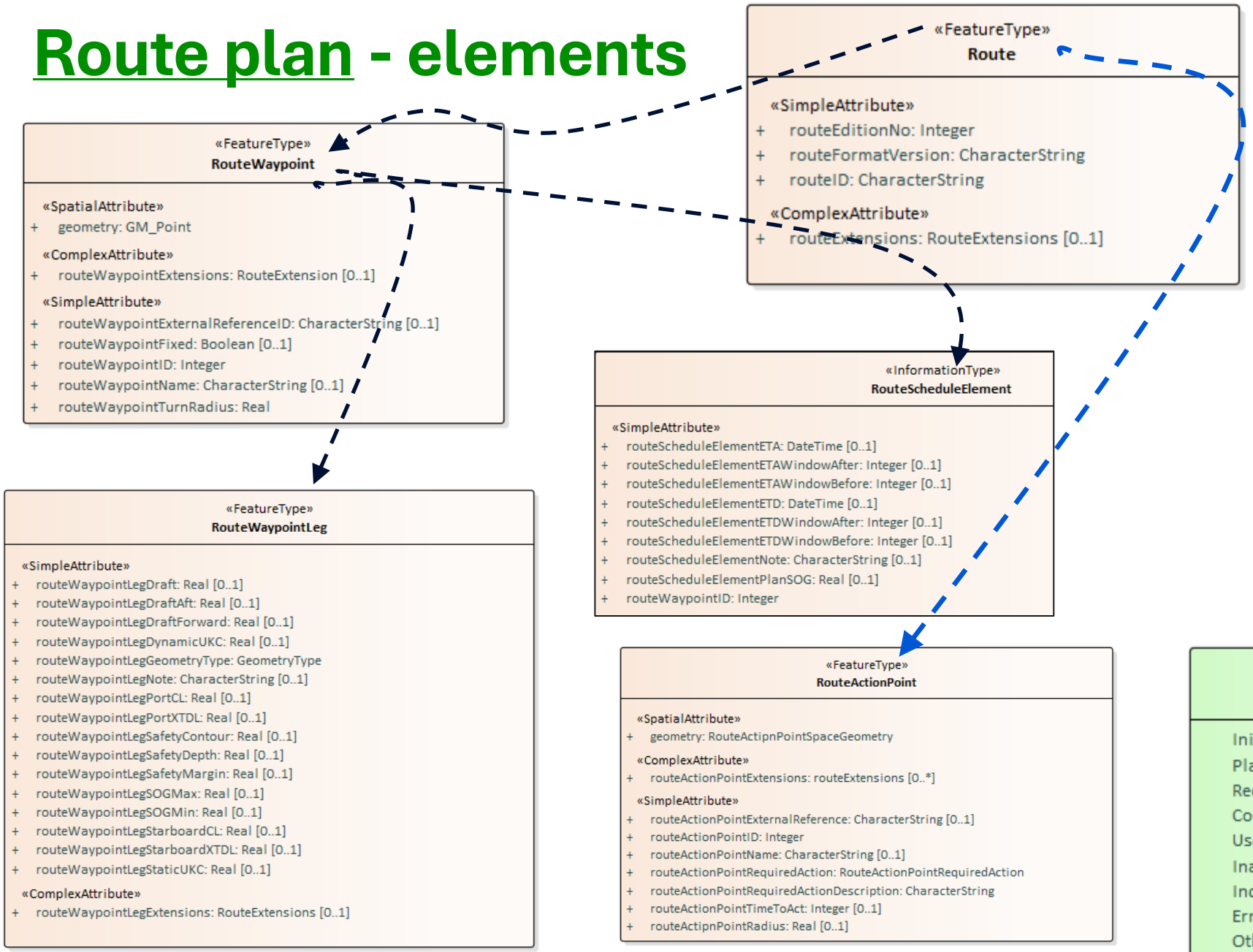


The route in ECDIS /route planner

route for exchange

A route received in the vessel will be kept a bit on distance and not accepted to replace the route in the ECDIS / planner without manual check by navigator “Route plans received should be indicated by ECDIS as for voyage planning purposes only”

Route plan - elements



S-421 – Example of use cases

- The S-100 ECDIS will include the generic solution + a minimum of one from the list should be supported.
  Service specifications the tool to assure services are evolving.
  Use cases from IEC 63173-1 (S421 v 1.0)
  - General
  - Route cross check
  - Flow management
  - Enhanced monitoring
  - Ice navigation
  - Under keel clearance management
  - Fleet route planning
  - Chart management
  - Route optimization
  - Port call synchronization
  - Reference route
  - Search and rescue

S-421 ver 1.1

- Possible changes S-421 to come 2024:
  - Only minor changes will be looked into
  - Look into changes needed to suport S-100 ed. 5.2
  - Modernized GML application schema
  - *routeActionPointRequiredAction*: New categories (5 warning, …)
  - support colon (:) as part of *routeActionPointExternalReference. Reference to S-98 on interoperability by using MRN*
  - *Suggested to include routeWaypointLegID to support FAL Noon report*
  - *Today hosted in CIRM (http://cirm.org/s-421). Ver 1.1 might be hosted by IHO*

- Next IEC meeting in October 2024 to finish ver 1.1, then voting
- Also include work on a public supporting document to address harmonisation of services.

S-421 ver 1.1

- Supporting document:
  - supporting document to assure harmonized services.
  - Route plan exchange as part of:
    - Nautical publications (Maritime service 12)
    - Search and Rescue
    - Shore reporting?

IEC

Technical Committee 80
Maritime navigation and radiocommunication equipment
systems Working Group 17 Common Maritime Data Structure

Under development

Exchange of Route Plan for Mariners

Supporting document for mariners

1 Introduction

This is a preliminary version intended for testing of ma[illegible]ervices in the context of e-Navigation. Target audience of this document are onboard m[illegible]

This document supports the S-100 compliant ECDIS. Purpose of th[illegible]document is to guide mariners how to handle the exchange of 'route plans' specified in IEC 6[illegible]-1:2021.

Using an S-100 compliant ECDIS gives access to a number of new fu[illegible]alities and services, according to IMO resolution MSC.530(106). The main purpose of the S-100 compliant ECDIS is to support voyage planning and voyage monitoring, however new use cases are also supported.

2 The mariner can receive a route plan from any service provider to be utilized in the S-100 compliant ECDIS. OInaddition to that, the mariner can choose to send a route plan from the vessel, often as part of a message also holding other information.Maritime services using route plans

Routeinfo, A Quality-Assured Service

- 687 reference routes for navigation
- Quality-assured by NCA services:
  - Pilot Service
  - Vessel Traffic Service
  - Aids to Navigation Service
  - Pilot Exemption Certificate Unit
- Depth data reviewed by the Norwegian Hydrographic Service.
- Routes are quality assured for vessels up to 150 meters length and 9 meters draught, with some exceptions.
- Four voyage categories: Inbound, outbound, between ports and coastal.

Regulations

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On land

- For sea navigators access to relevant regulations is a nightmare,
  - “ban on passing”

- Update of regulations as part of Nautical Publications will set ground for connections to the regulation in a route plan via *Action Points*. This can be done by the mariner himself, by the ECDIS/planner software or by a reference route from a route provider – government or private.

Maritime Traffic Regulation, Section 117 - 120

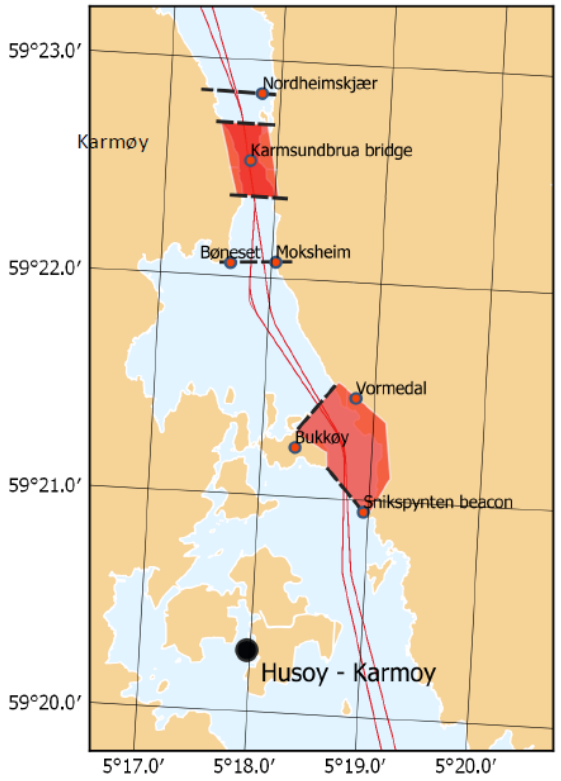
Statutory authority: Laid down by the Ministry of Transport and Communications on 10 February 2021 (no. 523) pursuant to sections 2, 7, 11 and 13, of Act no. 70 of 21 June 2019 relating to harbours and fairways, etc. (the Harbour Act)

Section 118. (Ban on passing on the stretch Skudenesfjorden–Karmsundet–Sletta)
Vessels must not pass other vessels under Karmsundbrua bridge, in the waters 300 metres north and south of the bridge or in the strait at Bukkøy on the stretch between a line in a 050° direction from the northern brink of Bukkøy to shore north of Vormedal and a straight line from the south-east brink of Bukkøy to the Snikspynten beacon if:

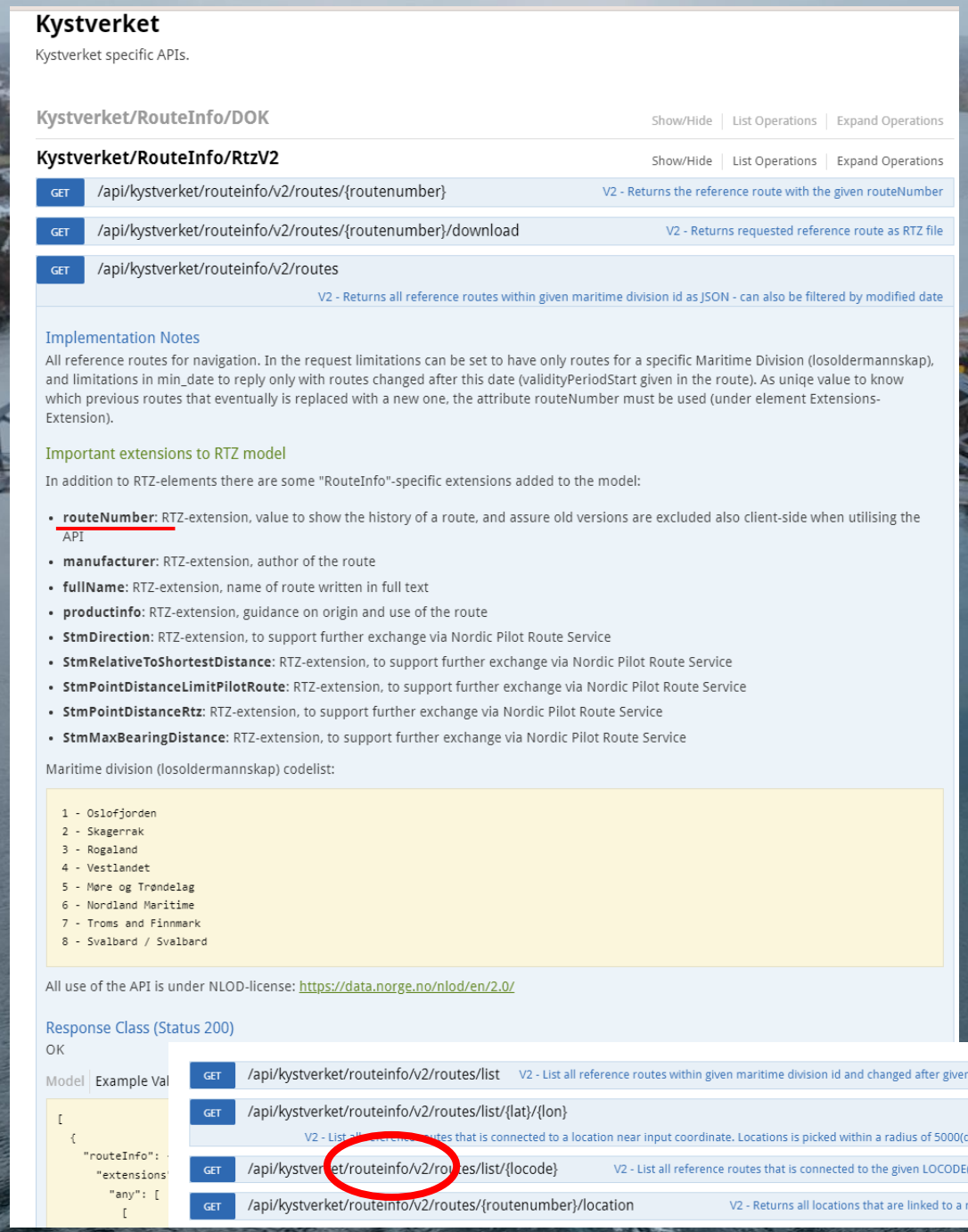
a) the vessel is carrying hazardous or noxious cargo and has a length greater than 100 metres
b) the vessel has a length greater than 120 metres
c) visibility is less than 0.5 nautical mile.

In the instances mentioned in the first paragraph, vessels must maintain a distance of at least 0.5 nautical mile from other vessels sailing in the same direction.

continues on page 2



Red areas in the chart indicate parts where vessels must not pass, given in section 118



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API for reference routes

(Open API, RTZ-format)

- RTZ is much more limited.
- S421 will assure better machine to machine operability
  - The limitations in ship dimensions can be machine read.
  - The unique id will be in a standard format. Further exchange shall guarantee handling of id's. (IEC 63173 + IEC 61174 + IMO decissions).
  - Important information elements in route plan will be available for user, not only name of route and waypoints.
  - **Status** of the route defined
  - Any locations to be included as part of the **route plan**, including UN/LOCODE

Info on API, https://routeinfo.no/faq, last section

Navigation lab

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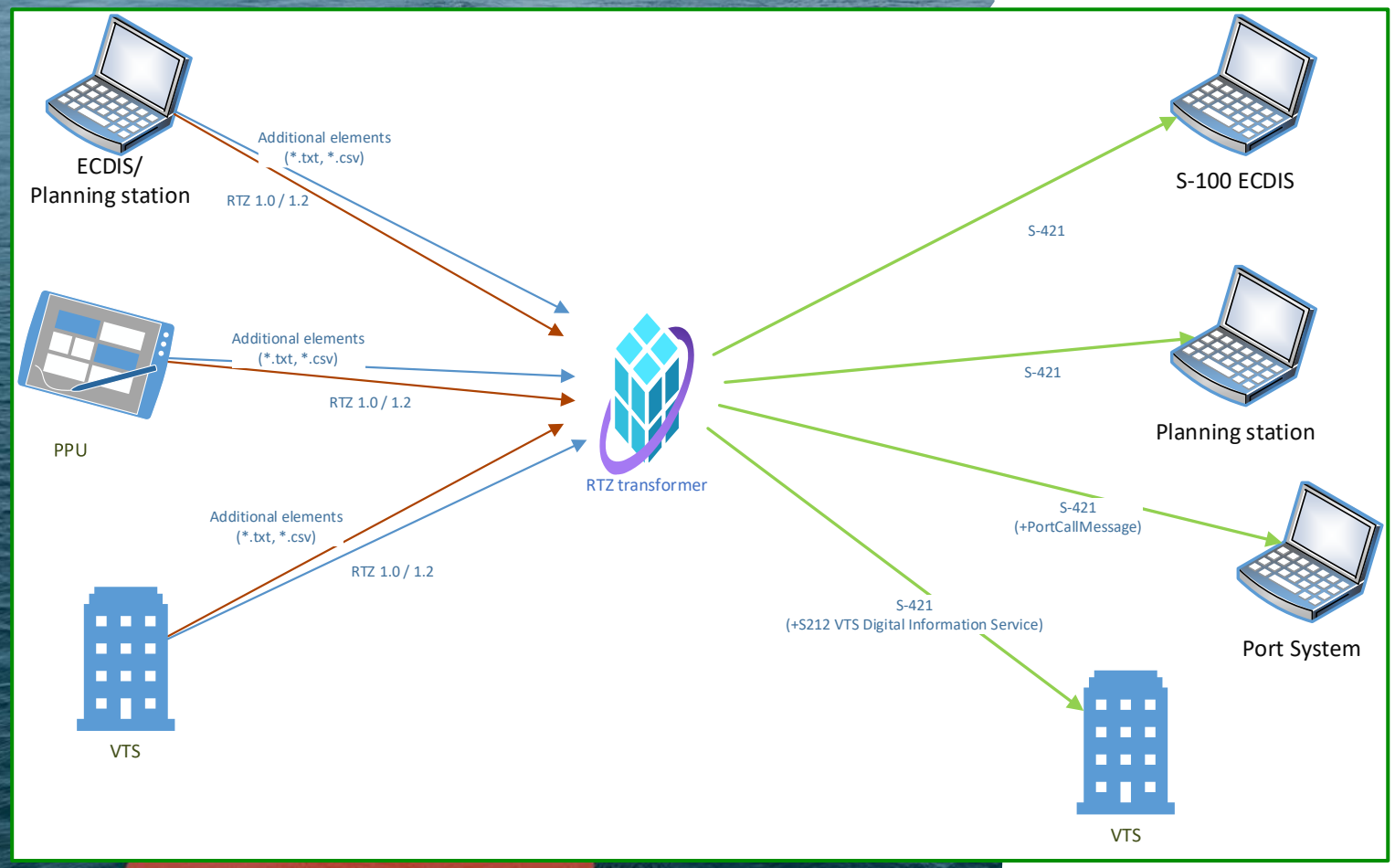


ISTS – Project 2022-2024

Information exchange for better Just in time Arrival

RTZ-files can be brought in from any environment (RTZ 1.0, RTZ 1.2, maybe RTZ 1.1 / RTZ 1.7..):
https://s421creator.ecc.no/

The main information elements brought in from the RTZ-file. Additional elements by manually input in the service, including Action points.

Primitive version for proof of concept. Schedule is not included in the test.

MARITIME ITS

1) RTZ -> S421

transformer 1/2

Waypoints,
and
Action points

https://s421creator.ecc.no/index.html

NCA_OsloWest_In_20230607.rtz Upload RTZ

Route Details

Route Format Version *
1

Route ID *
urn:mrn:iho:no01:test:referenceroute:no-110003

Route Edition No *
1

Route Info

Route Info Name *
NCA_OsloWest_In_20230607

Mandatory elements

Route Info

Route Info Author
Norwegian Coastal Administration

Route Info Status
1

Route Info Length Max
150

Route Info Draft Max
9

Route Info Air Draft Max

Route Info Description
See information on www.routeinfo.no before use of this Reference Route for Navigation. The Ref

ADD ACTION ROUTE POINT

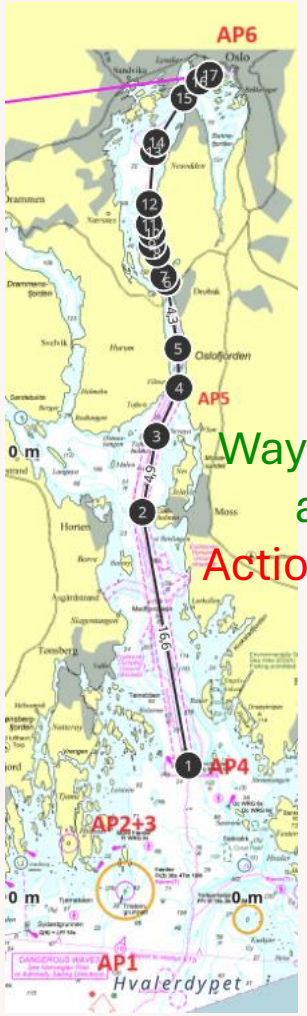
Route Action Point ID: 1, External Reference: urn:mrn:iho:no01:test:com:pilot_boarding:Faerder, Radius: , Latitude: 59.0, Longitude: 10.4166666666, Time to act: 30, Action: 1, Description: Contact pilot service on VHF ch ...

Route Action Point ID: 2, External Reference: urn:mrn:iho:no01:test:com:vhf:horten_vts_sector_n, Radius: , Latitude: 59.0, Longitude: 10.4166666666, Time to act: 5, Action: 1, Description: Change to VHF channel 18 (Horten VTS sector north)

Route Action Point ID: 3, External Reference: urn:mrn:iho:no01:test:isps_terminal_NOOSL-0027, Radius: , Latitude: 59.0, Longitude: 10.4166666666, Time to act: 30, Action: 1, Description: Contact lines men (phone +47 ## ## ## ##) for details on mooring

1) RTZ -> S421

transformer 2/2



https://s421creator.ecc.no/index.html

NCA_OsloWest_In_20230607.rtz Upload RTZ

Route Details

Route Info

ADD ACTION ROUTE POINT

Route Action Point ID: 1, External Reference: urn:mrn:iho:no01:test:com:vhf:horten_vts_sector_s, Radius: , Latitude: 58.960, Longitude: 10.6223, Time to act: 15, Action: 2, Description: Request clearence to access VTS area from Horten VTS via VHF channel 18 or via the Maritime Single Window SafeSeaNet Norway

Route Action Point ID: 2, External Reference: urn:mrn:iho:no01:test:pilot_boarding:Faerder, Radius: , Latitude: 59.0, Longitude: 10.41666667, Time to act: 150, Action: 1, Description: Final confirmation no later than 2 hours prior to pilotage in Safe Sea Net Norway

Route Action Point ID: 3, External Reference: urn:mrn:iho:no01:test:norwegian_nautical_information:element000999:Master-Pilot_Exchange_Information_Card, Radius: , Latitude: 59.0, Longitude: 10.41666667, Time to act: 60, Action: 1, Description: Master-Pilot Exchange Information Card including Required Boarding Arrangements for Pilot

Route Action Point ID: 4, External Reference: urn:mrn:iho:no01:test:com:vhf:horten_vts_sector_n, Radius: , Latitude: 59.16086, Longitude: 10.65817, Time to act: 60, Action: 1, Description: Change to VHF channel 18 (Horten VTS sector north)

Route Action Point ID: 5, External Reference: urn:mrn:iho:no01:test:S127:maritime_traffic_regulation:section_67_68, Radius: , Latitude: 59.65983, Longitude: 10.61955, Time to act: 10, Action: 1, Description: Ban on passing on the stretch Drøbaksundet - Oslo, between Småskjærene beacon in the south and Aspond beacon in the north

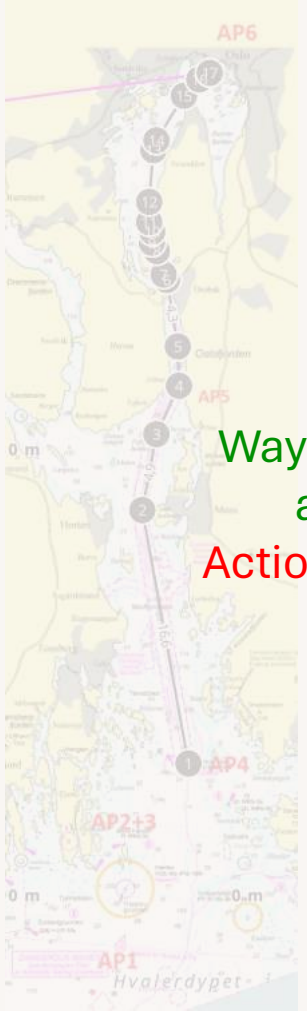
Route Action Point ID: 6, External Reference: urn:mrn:iho:no01:test:S131:port_facility:NOOSL-0027, Radius: , Latitude: 59.88683, Longitude: 10.75567, Time to act: 30, Action: 1, Description: Contact lines men to confirm details on mooring (phone +47 ## ## ## ##)

SUBMIT

+47 ## ## ## ##) for details on mooring

1) RTZ -> S421

transformer 2/2



Waypo
an
Action

External references to products already available in the ship equipment, like Nautical Publications, opens for giving the navigator the relevant information with sending a very limited amount of data

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MARITIME ITS

Posible use-cases...

«FeatureType»
Route

«SimpleAttribute»
+ routeEditionNo: Integer
+ routeFormatVersion: CharacterString
+ routeID: CharacterString

«ComplexAttribute»
+ routeExtensions: RouteExtensions [0..1]

«FeatureType»
RouteWaypoint

«SpatialAttribute»
+ geometry: GM_Point

«ComplexAttribute»
+ routeWaypointExtensions: RouteExtension [0..1]

«SimpleAttribute»
+ routeWaypointExternalReferenceID: CharacterString [0..1]
+ routeWaypointFixed: Boolean [0..1]
+ routeWaypointID: Integer
+ routeWaypointName: CharacterString [0..1]
+ routeWaypointTurnRadius: Real

«InformationType»
RouteScheduleElement

«SimpleAttribute»
+ routeScheduleElementETA: DateTime [0..1]
+ routeScheduleElementETAWindowAfter: Integer [0..1]
+ routeScheduleElementETAWindowBefore: Integer [0..1]
+ routeScheduleElementETD: DateTime [0..1]
+ routeScheduleElementETDWindowAfter: Integer [0..1]
+ routeScheduleElementETDWindowBefore: Integer [0..1]
+ routeScheduleElementNote: CharacterString [0..1]
+ routeScheduleElementPlanSOG: Real [0..1]
+ routeWaypointID: Integer

«FeatureType»
RouteWaypointLeg

«SimpleAttribute»
+ routeWaypointLegDraft: Real [0..1]
+ routeWaypointLegDraftAft: Real [0..1]
+ routeWaypointLegDraftForward: Real [0..1]
+ routeWaypointLegDynamicUKC: Real [0..1]
+ routeWaypointLegGeometryType: GeometryType
+ routeWaypointLegNote: CharacterString [0..1]
+ routeWaypointLegPortCL: Real [0..1]
+ routeWaypointLegPortXTDL: Real [0..1]
+ routeWaypointLegSafetyContour: Real [0..1]
+ routeWaypointLegSafetyDepth: Real [0..1]
+ routeWaypointLegSafetyMargin: Real [0..1]
+ routeWaypointLegSOGMax: Real [0..1]
+ routeWaypointLegSOGMin: Real [0..1]
+ routeWaypointLegStarboardCL: Real [0..1]
+ routeWaypointLegStarboardXTDL: Real [0..1]
+ routeWaypointLegStaticUKC: Real [0..1]

«ComplexAttribute»
+ routeWaypointLegExtensions: RouteExtensions [0..1]

«FeatureType»
RouteActionPoint

«SpatialAttribute»
+ geometry: RouteActipnPointSpaceGeometry

«ComplexAttribute»
+ routeActionPointExtensions: routeExtensions [0..*]

«SimpleAttribute»
+ routeActionPointExternalReference: CharacterString [0..1]
+ routeActionPointID: Integer
+ routeActionPointName: CharacterString [0..1]
+ routeActionPointRequiredAction: RouteActionPointRequiredAction
+ routeActionPointRequiredActionDescription: CharacterString
+ routeActionPointTimeToAct: Integer [0..1]
+ routeActipnPointRadius: Real [0..1]

«InformationType»
RouteInfo

«SimpleAttribute»
+ routeInfoName: CharacterString
+ routeInfoAuthor: CharacterString [0..1]
+ rouetInfoEditionTime: DateTime [0..1]
+ routeInfoDescription: CharacterString [0..1]
+ routeInfoStatus: RouteInfoStatus
+ routeInfoValidityStart: DateTime [0..1]
+ routeInfoValidityEnd: DateTime [0..1]
+ routeInfoDeparturePortID1: CharacterString [0..1]
+ routeInfoDeparturePortID2: CharacterString [0..1]
+ routeInfoDeparturePortCall: CharacterString [0..1]
+ routeInfoArrivalPortID1: CharacterString [0..1]
+ routeInfoArrivalPortID2: CharacterString [0..1]
+ routeInfoArrivalPortCall: CharacterString [0..1]
+ routeInfoReferencePrevRoute: CharacterString [0..1]
+ routeInfoReferenceNextRoute: CharacterString [0..1]
+ routeInfoVesselType: RouteInfoVesselType [0..1]
+ routeInfoVesselName: CharacterString [0..1]
+ routeInfoVesselMMSI: CharacterString [0..1]
+ routeInfoVesselCallsign: CharacterString [0..1]
+ routeInfoVesselIMO: CharacterString [0..1]
+ routeInfoVesselVoyage: CharacterString [0..1]
+ routeInfoVesselHeight: Real [0..1]
+ routeInfoVesselLength: Real [0..1]
+ routeInfoVesselBeam: Real [0..1]
+ routeInfoDraftMax: Real [0..1]
+ routeInfoAirDraftMax: Real [0..1]
+ routeInfoBeamMax: Real [0..1]
+ routeInfoLengthMax: Real [0..1]

Route plan in VR-simulator / Digital twin

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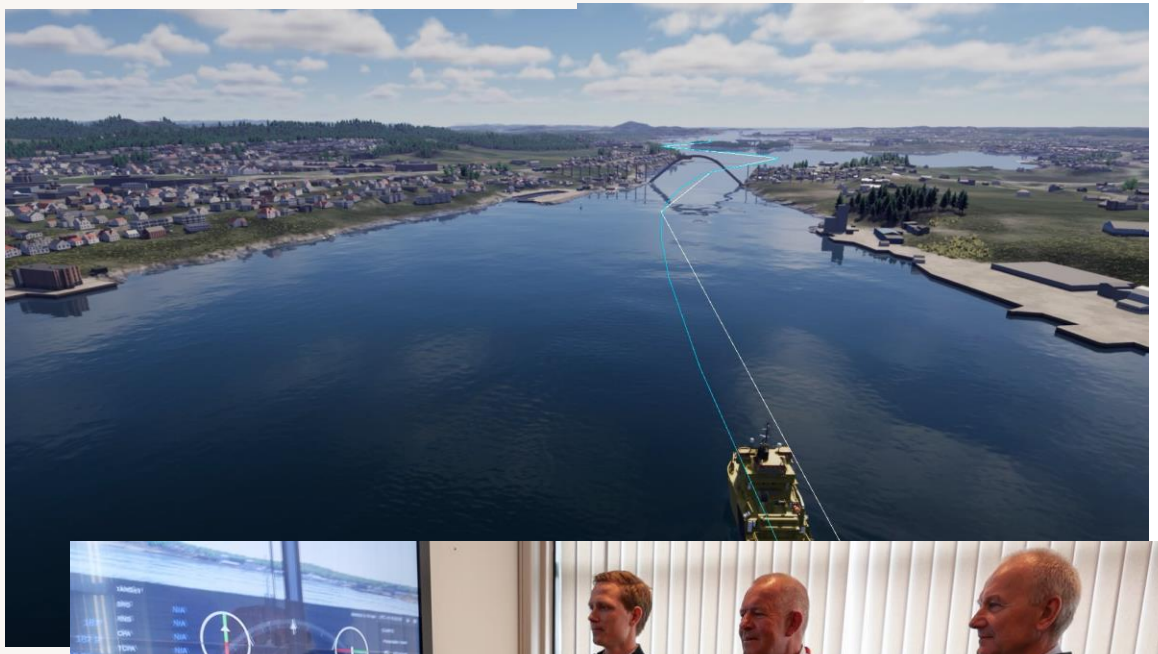

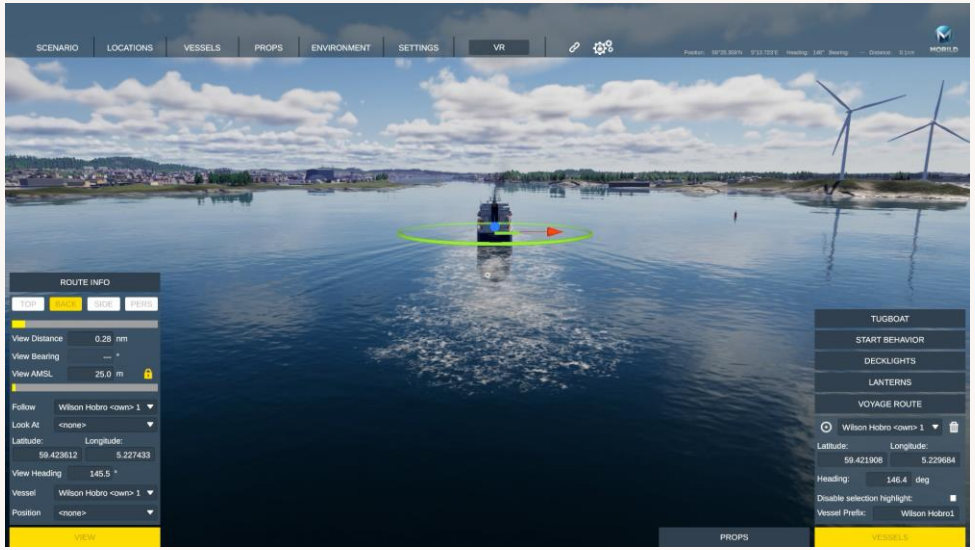

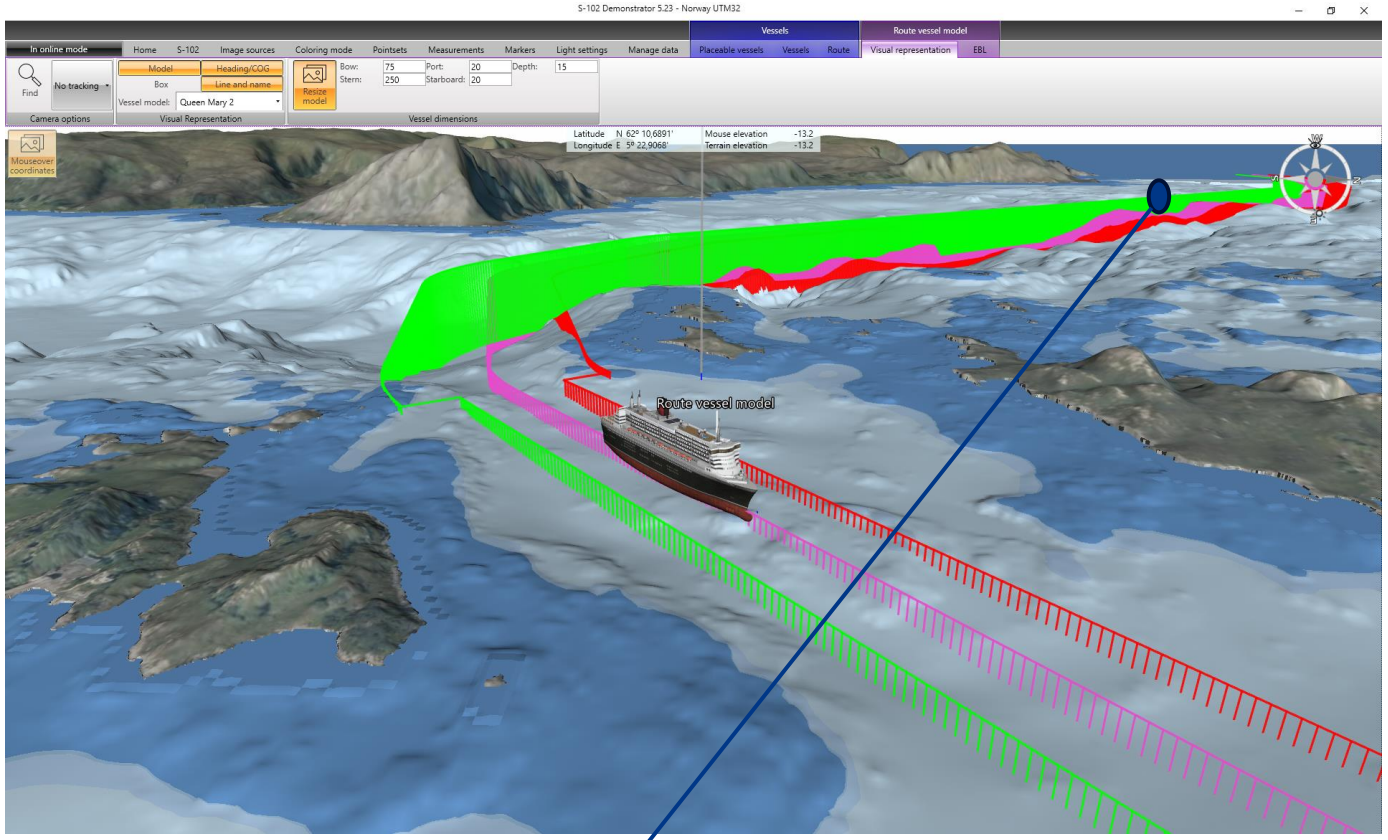

Action point: Confirm pilot order 2 hours before

- Thank you –

John Morten Klingsheim

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Department for Navigation Technology and Pilotage Management
The Norwegian Coastal Administration
jmk@kystverket.no