

# Human error? No, bad design!

## How bad design can cause accidents

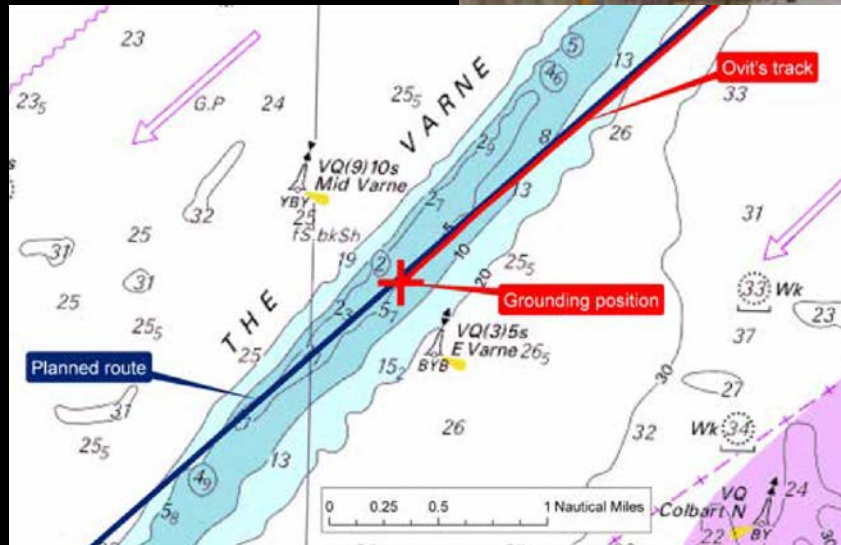
Design commissions and  
design omissions



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Professor of interaction design  
Norwegian University of Science and Technology, Trondheim

# Design commissions

ECDIS usability



The Ovit accident September 2013



“On the basis of the fullest possible appraisal, a detailed voyage or **passage plan** should be prepared which should cover the entire voyage or passage from berth to berth.”

(IMO, 1999)

IMO, International Maritime Organization, ‘Guidelines for Voyage Planning’, Resolution A.893(21), adopted on 25 November 1999.

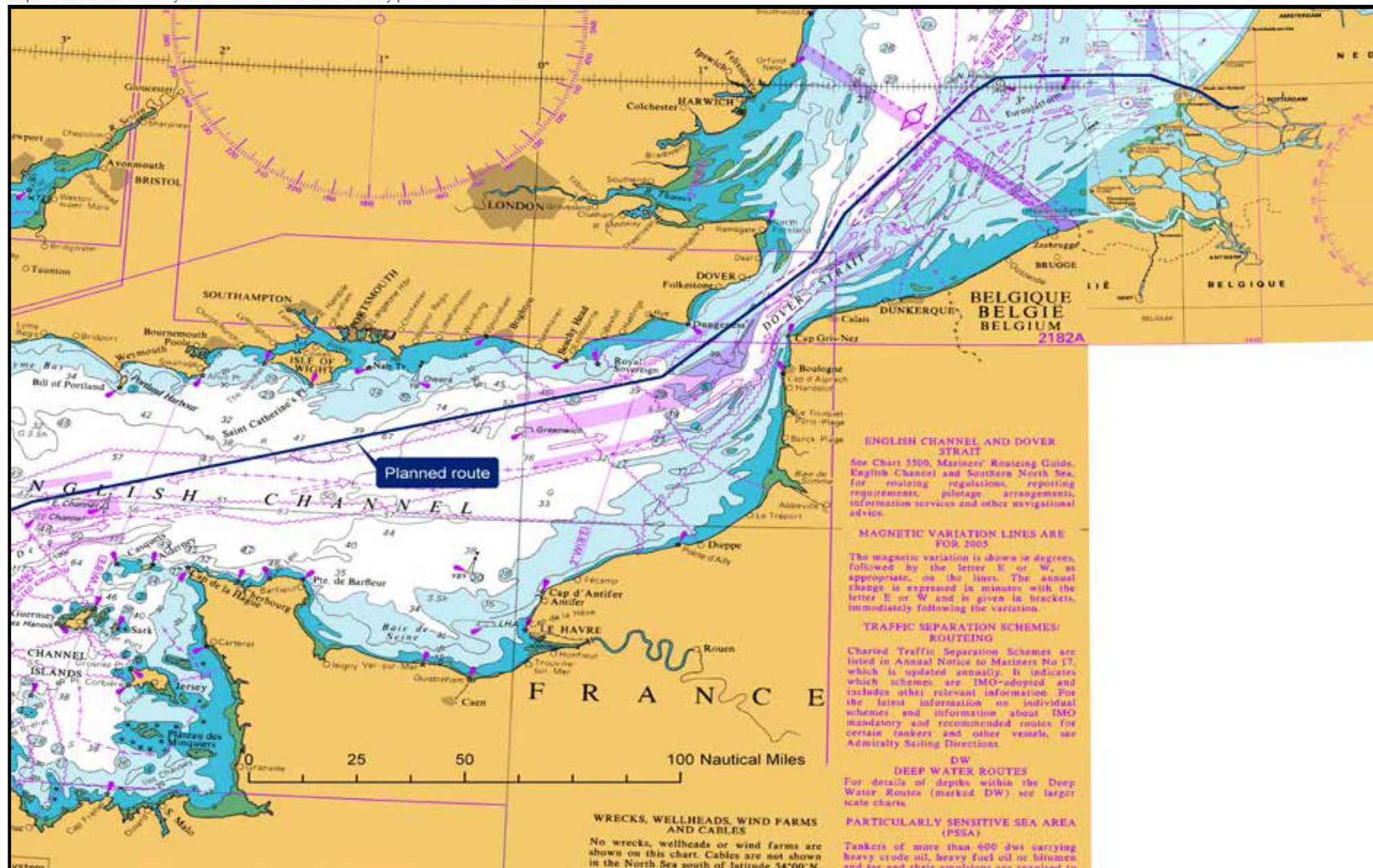


Figure 1: Ovi's passage plan through the Dover Strait

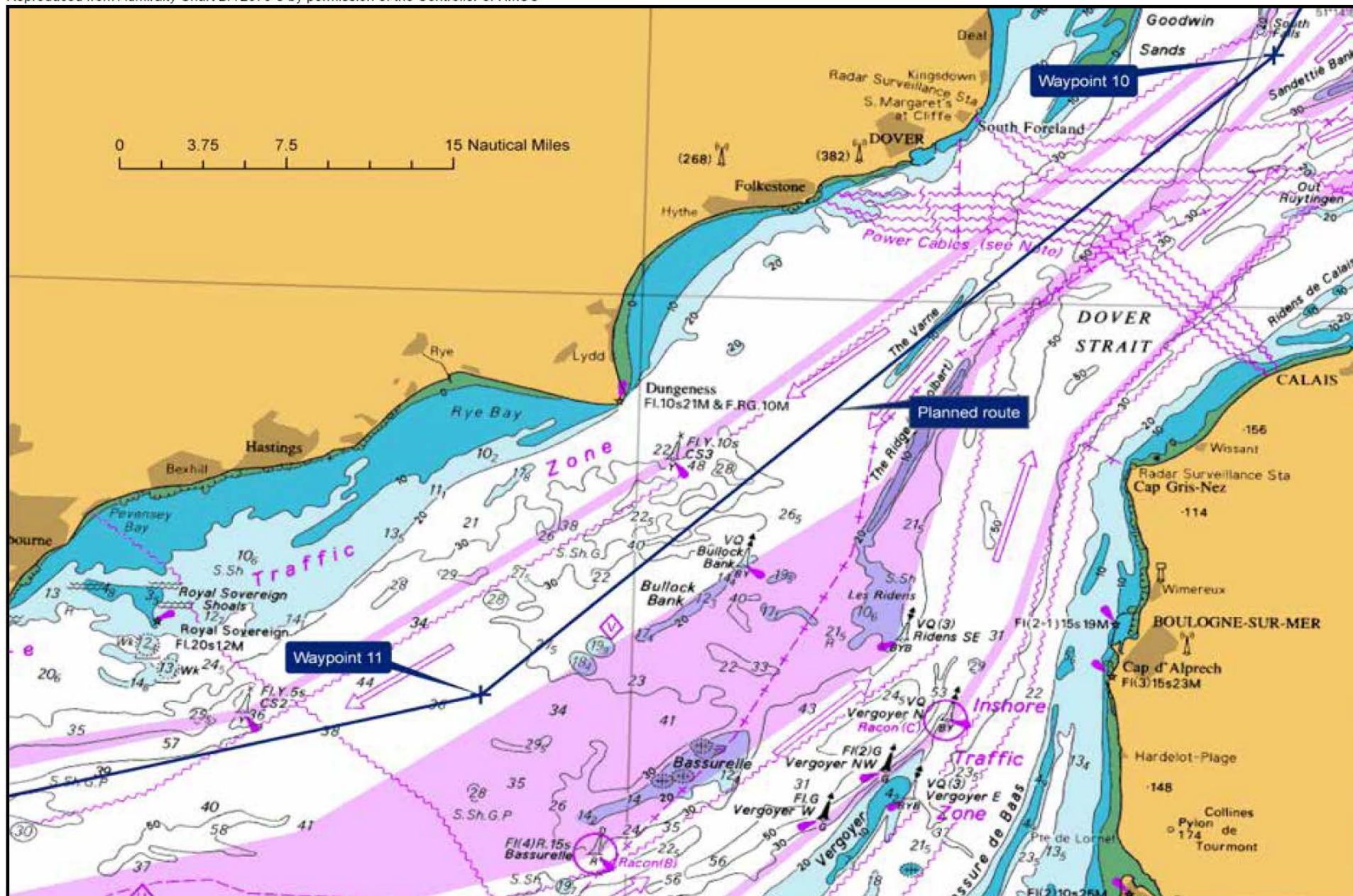


Figure 2: Detail of Dover Strait passage plan

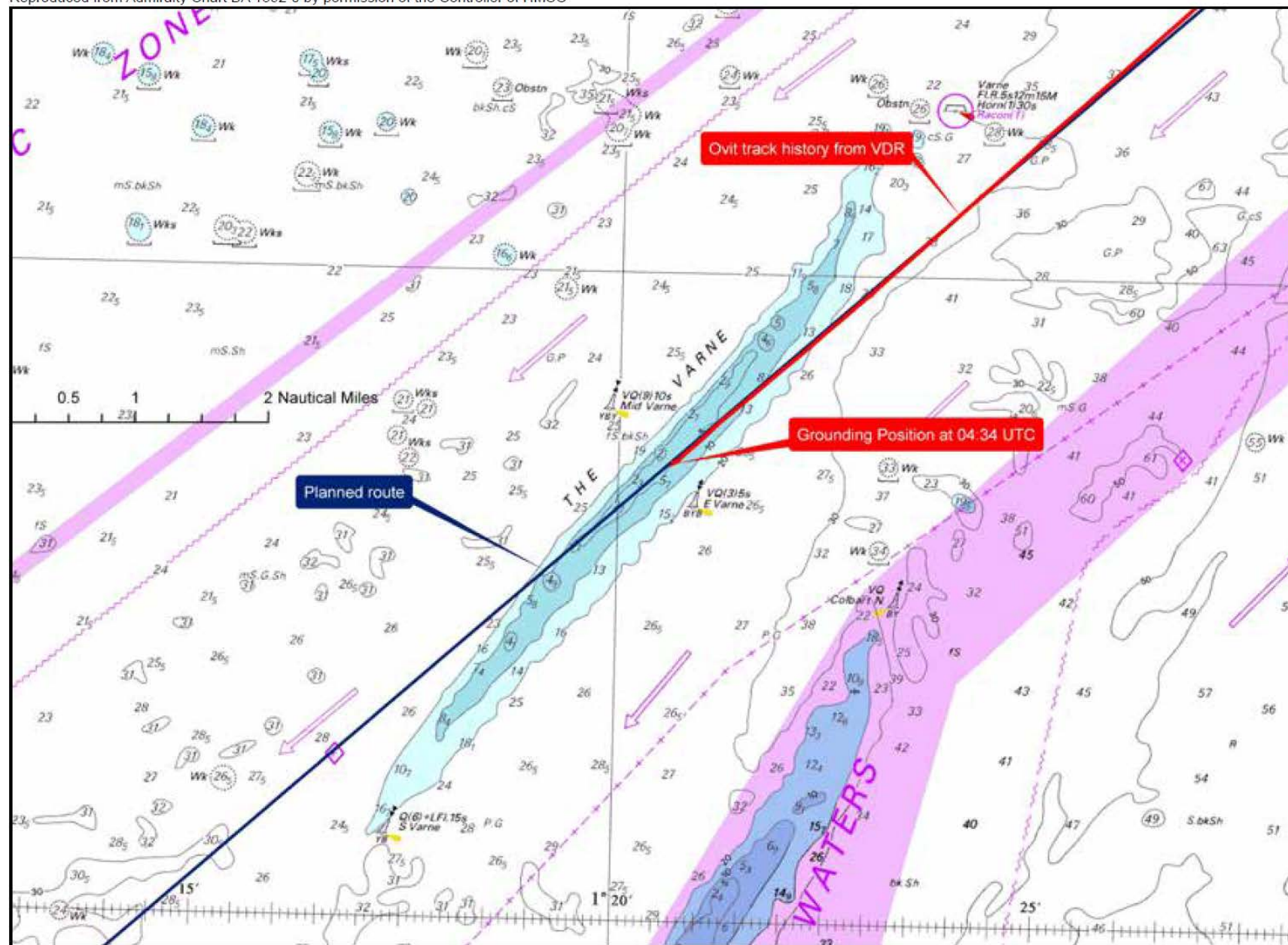


Figure 4: Ovi's grounding position

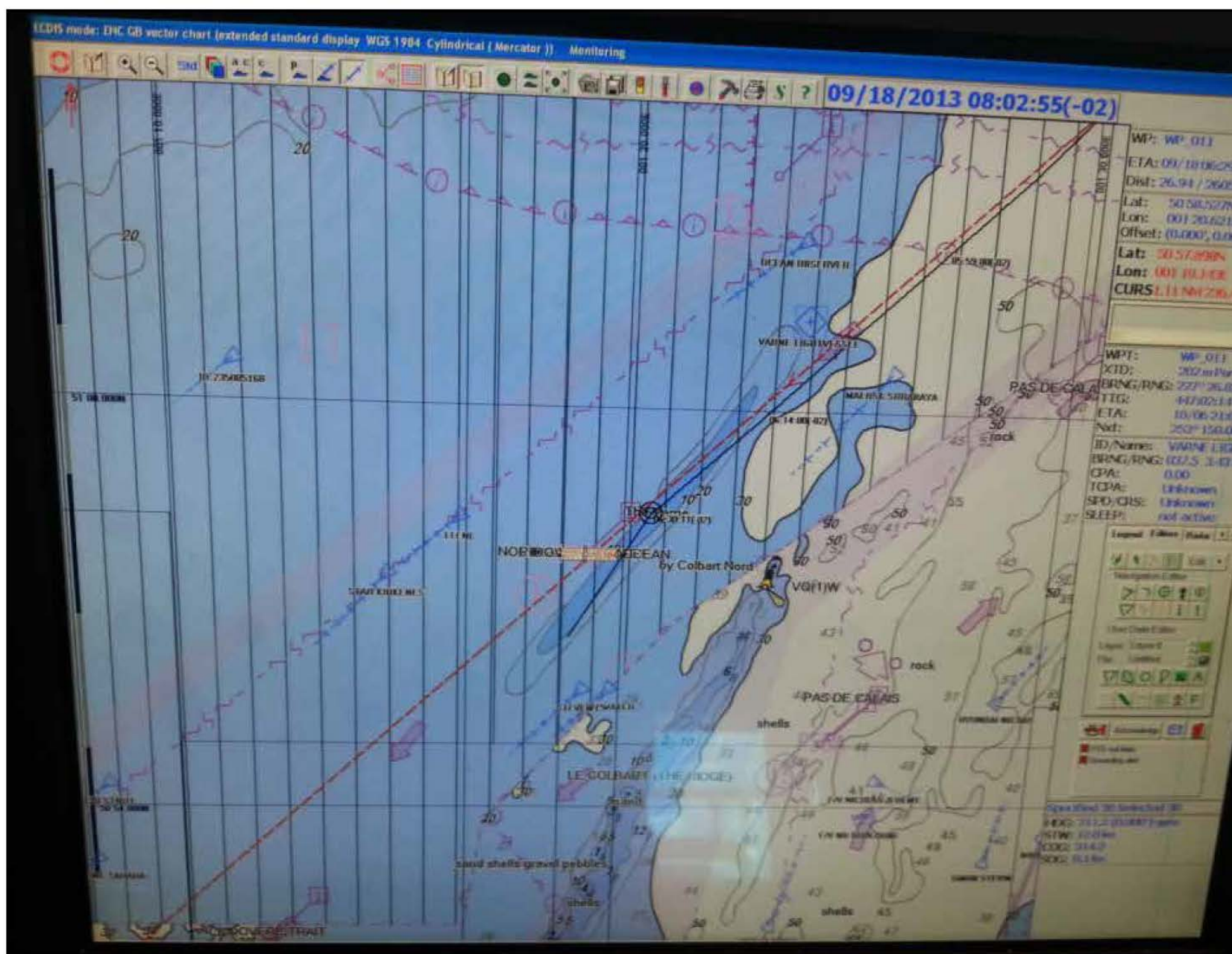


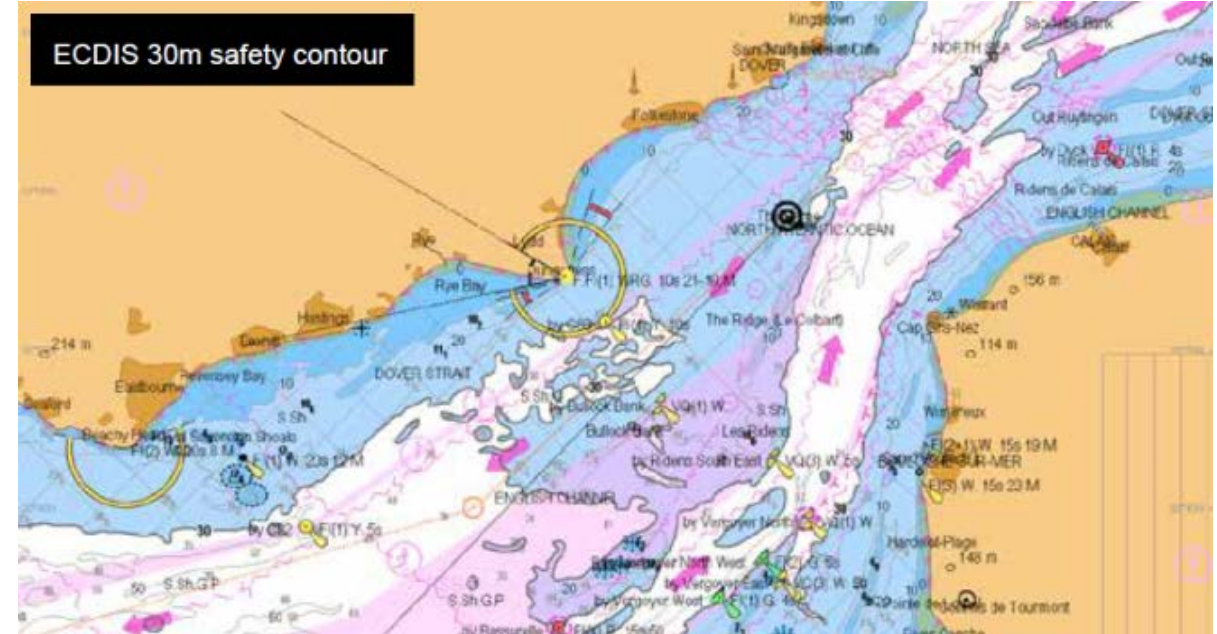
Figure 6: Ovi's ECDIS display when the ship was aground



ECDIS 20m safety contour



ECDIS 30m safety contour



The Maris 900 incorporates two depth alarms:

- The safety contour alarm activates if the guard zone crosses the selected safety contour. This is a mandatory alarm required by the IMO performance standards. The Maris 900 factory default setting value for the safety contour was 30m.
- The grounding alarm activates when the depth at the ship's position is less than the selected safety depth.

**Both features were turned off.**

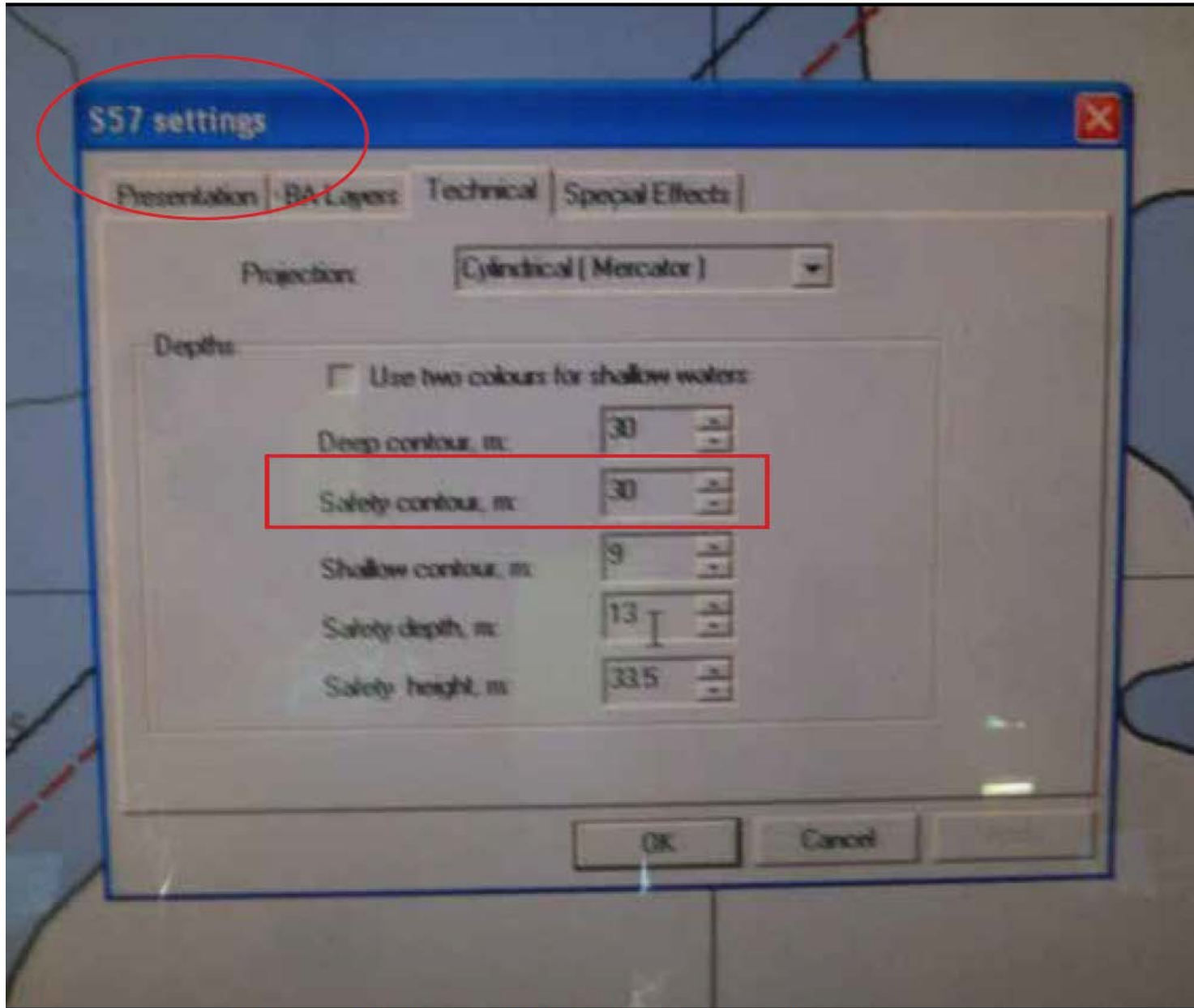
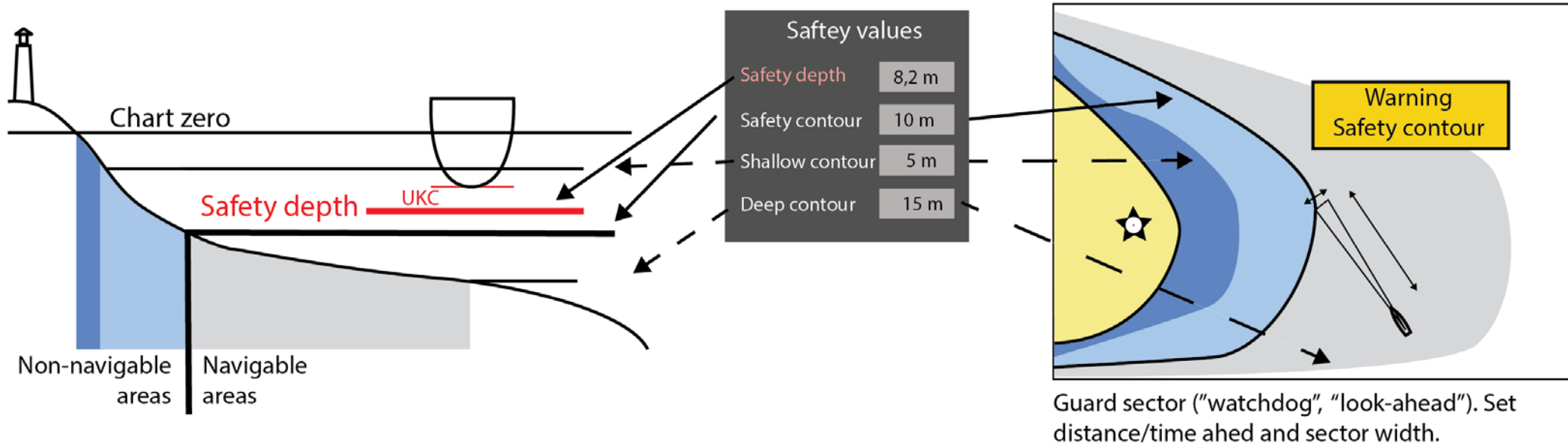


Figure 9: Maris 900 ECDIS 'S57' input page



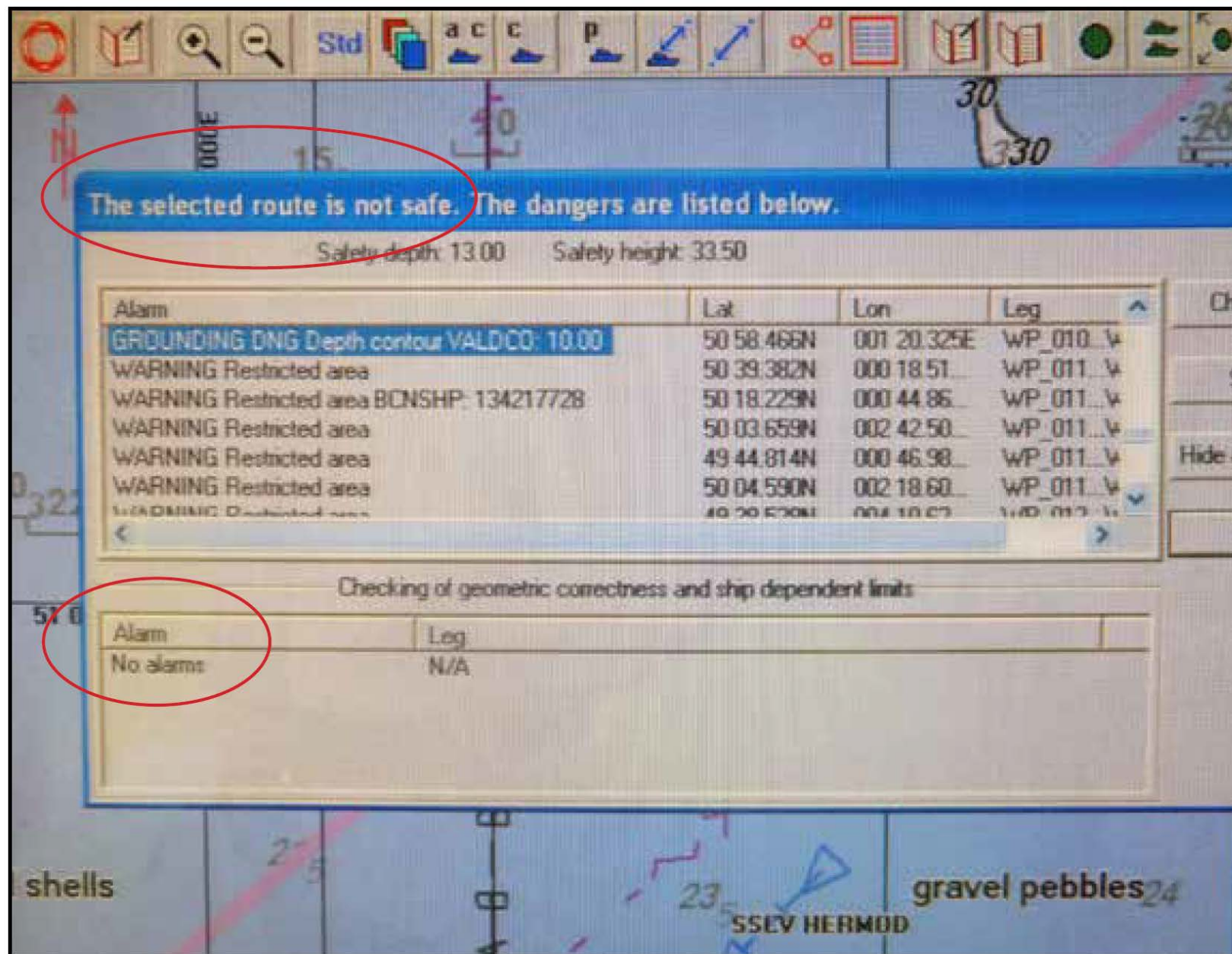
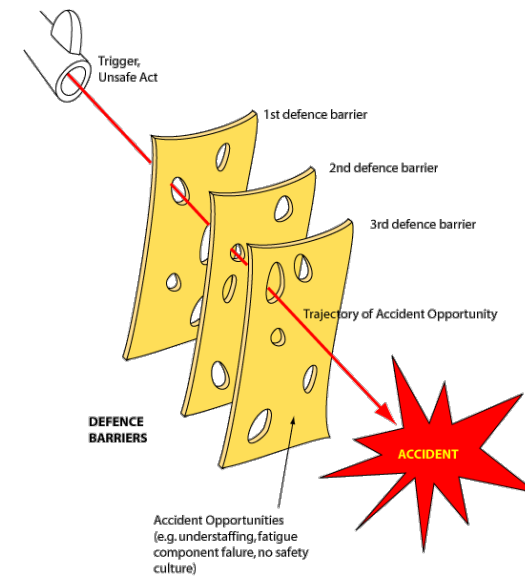


Figure 11: Maris 900 ECDIS check-route page

# Holes in the Swiss cheese

Breaches of safety barriers



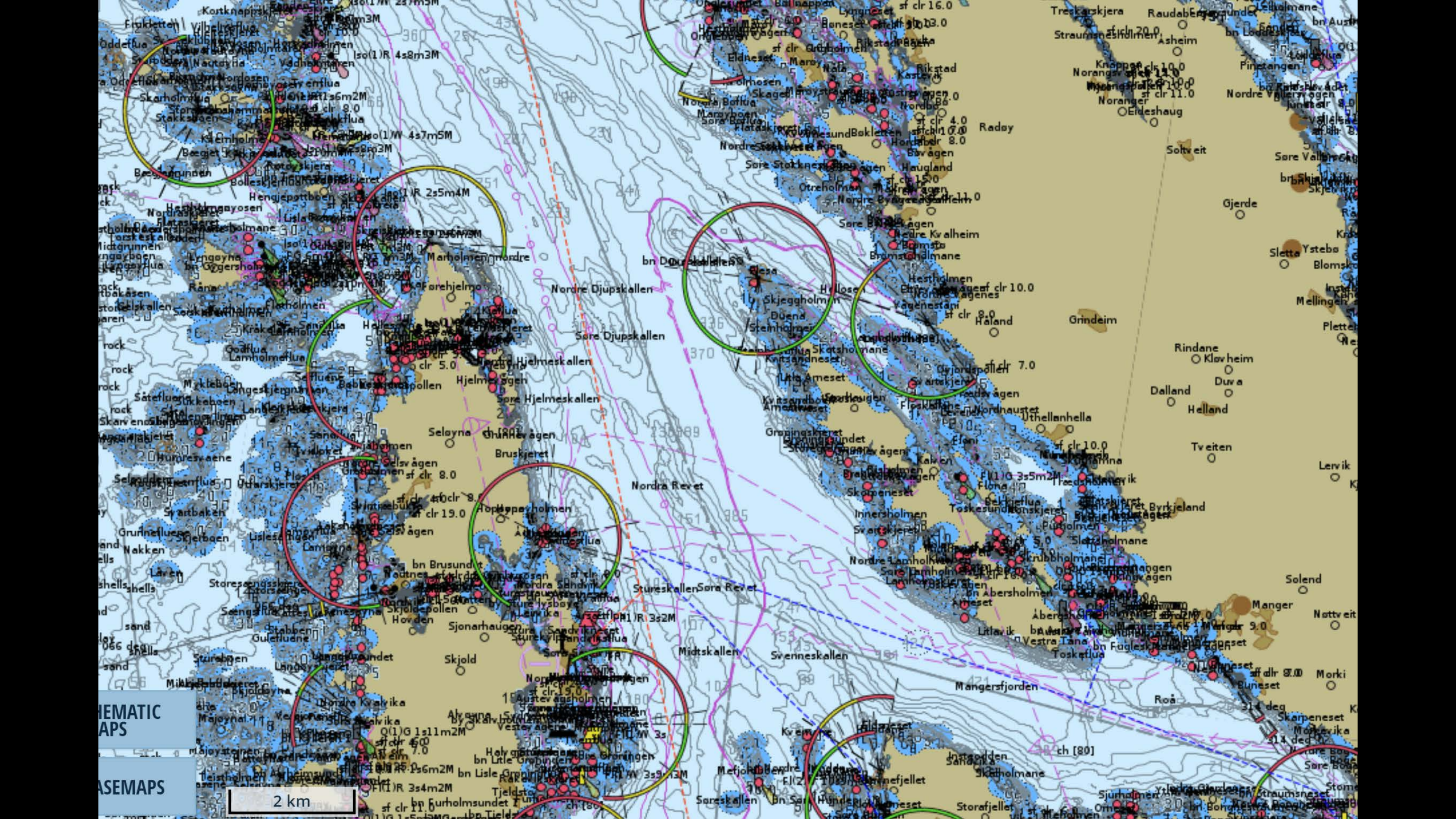
Voyage plan	Incorrect
Safety contour setting	Incorrect
Route check	Done but not understood
Grounding alarm	Off
Look-ahead sector	Off
Off-track alarm	Off
VTS; CoastGuard, Navy	Not intervening

# Design omissions

Ship Traffic Management/Traffic Organization Service



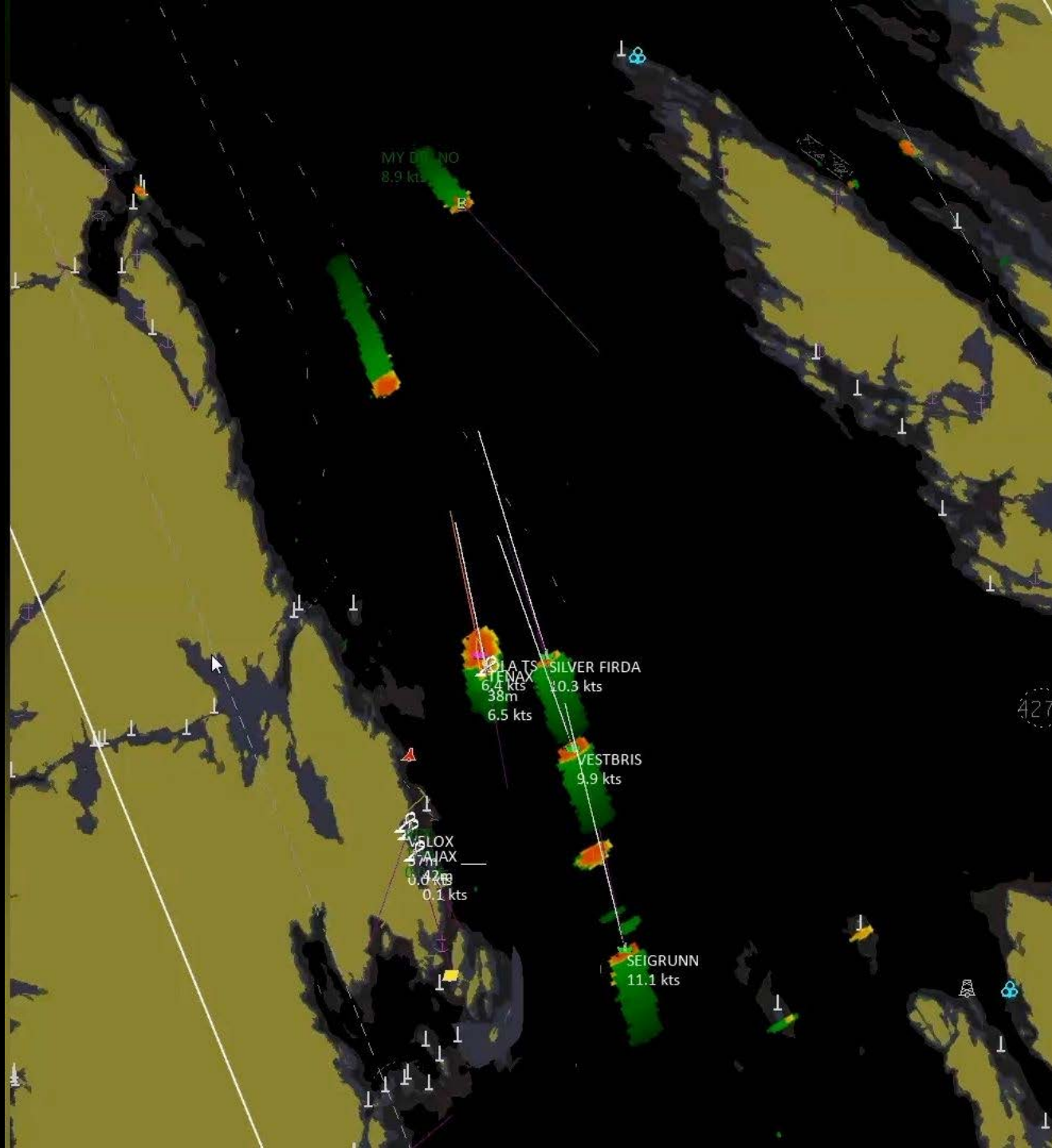
The Helge Ingstad accident November 2018



THEMATIC  
MAPS

BASEMAPS









# e-Navigation

Human Factors

Human-Machine Interface

Information Design

Route Exchange

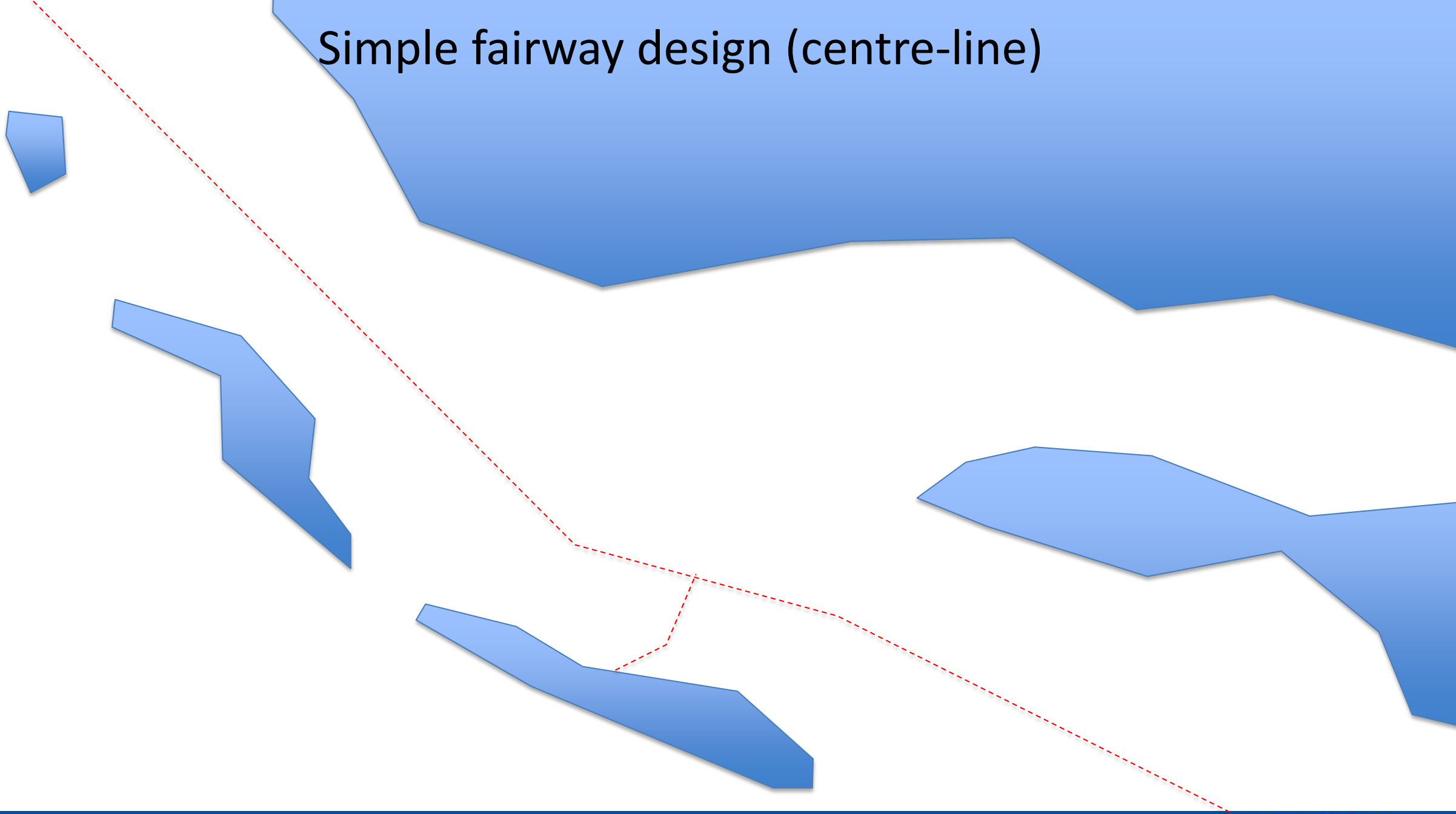
STM

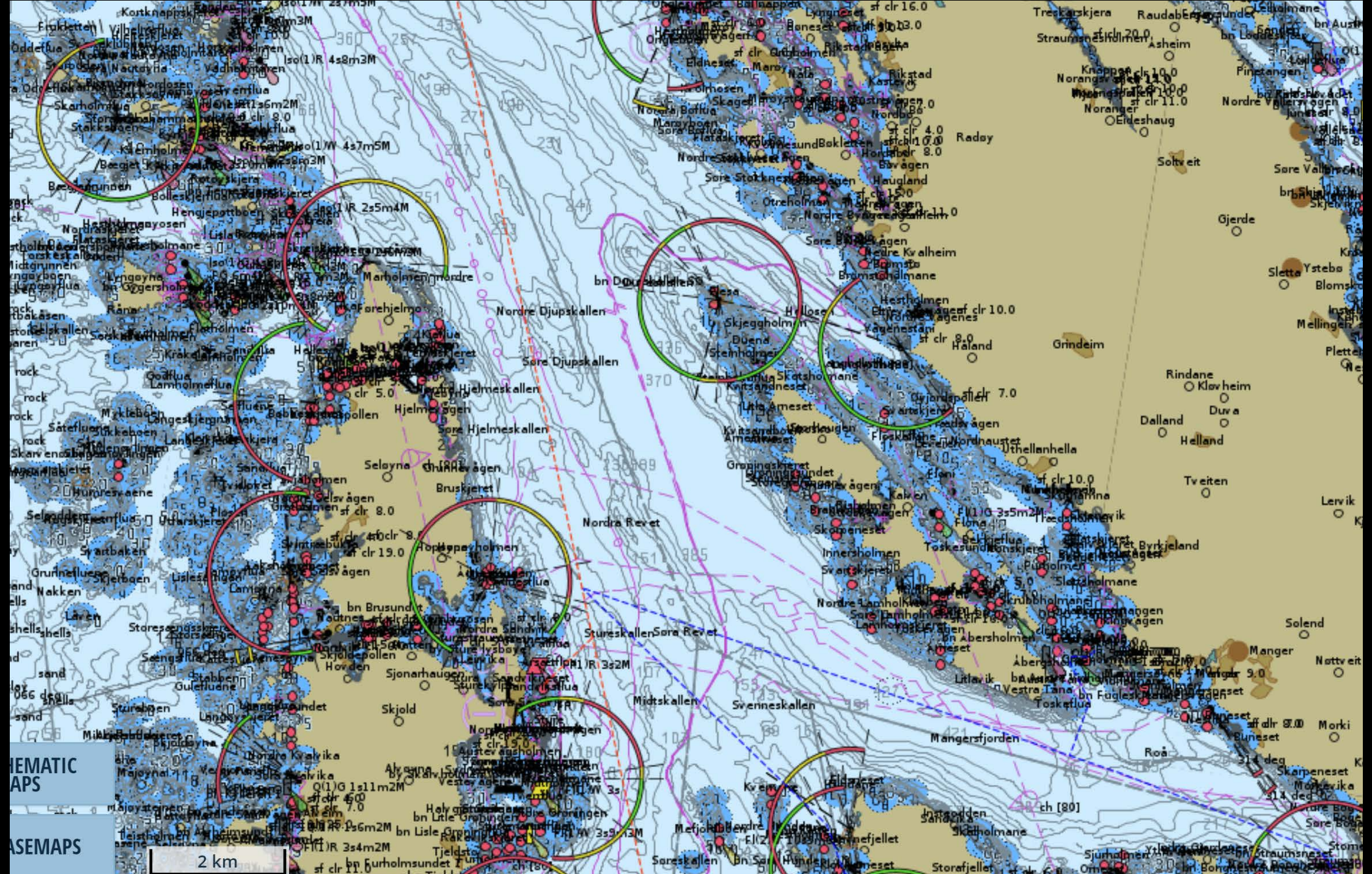
“Intended and suggested routes”

“Moving Havens” (submarine operation)



# Simple fairway design (centre-line)



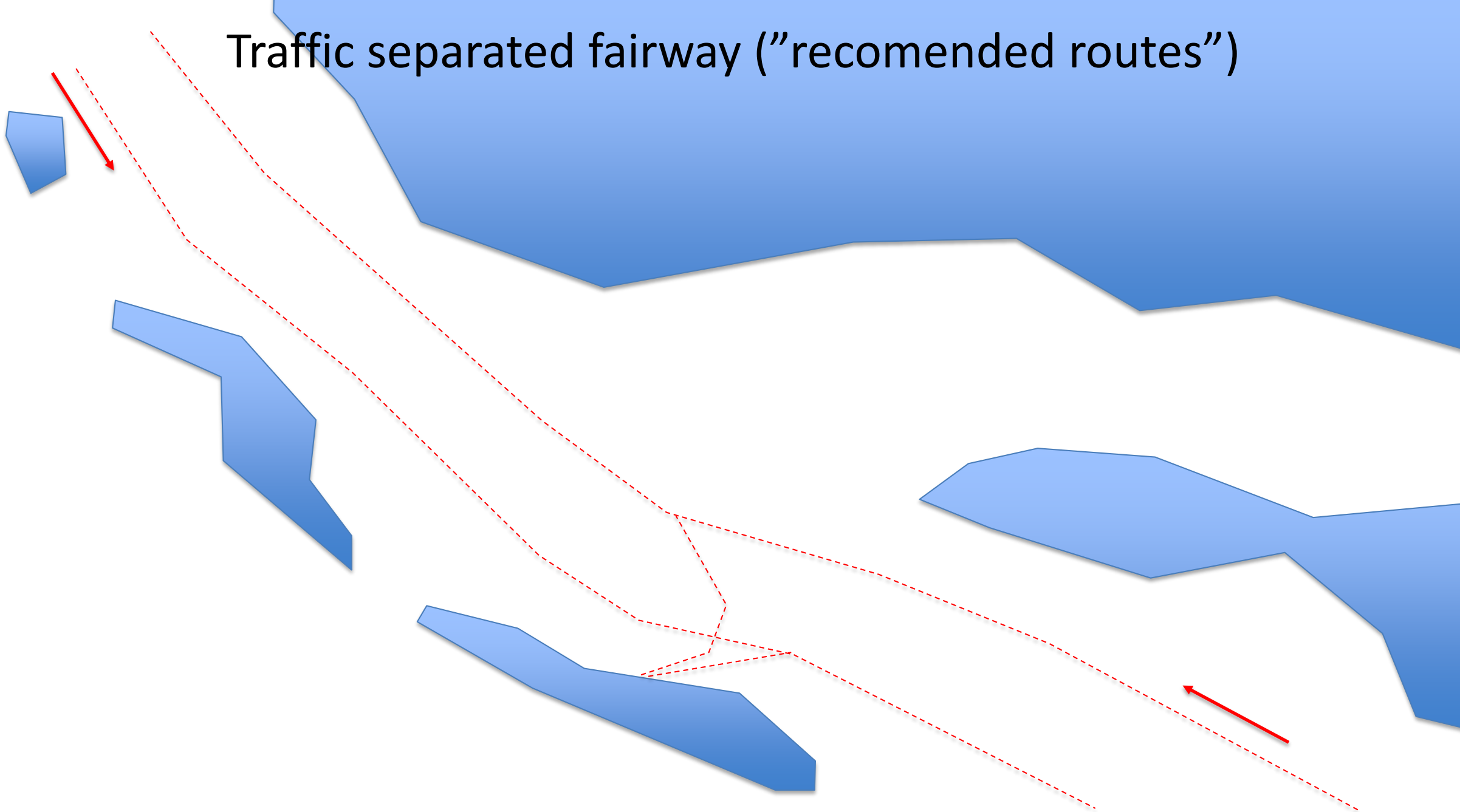


HEMATIC  
APS

ASEMAPS

2 km

# Traffic separated fairway ("recomended routes")



# Digital rutetjeneste - routeinfo.no



KYSTVERKET

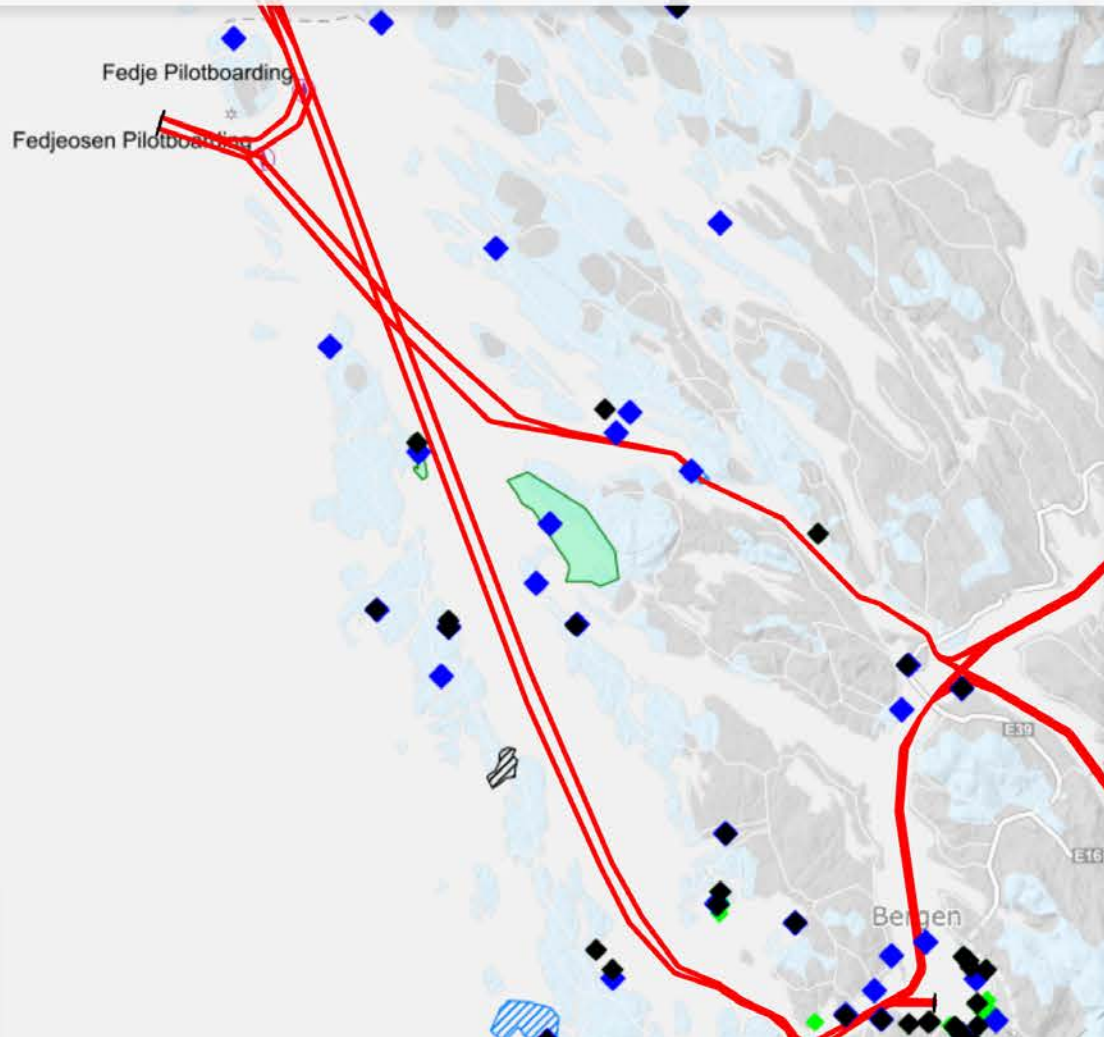
Den digitale rutetjenesten er tilgjengelig for fartøy som anløper havner i farvannet mellom svenskegrensen i øst og Haugesund i sørvest. Tjenesten blir trinnvis gjort tilgjengelig fra sør til nord og vil dekke hele kysten i løpet av 2020.

ROUTEINFO.NO





West Pilotboarding



- Reference routes
- Ports
- Port facilities
- Quays

Search routes and locations

## Routes and Route information from the Norwegian Coastal Administration (NCA)

Disclaimer!

Videoguide 1: [How to use Reference routes](#) (8 MB)

Videoguide 2: [Route information](#) (11MB)

Videoguide 3: [How to set routes together](#) (12MB)

Find NCA's reference routes and route information by searching for port/port facility/quay or route name in the search field above, or navigate and select directly in the map.

The reference routes for navigation can be downloaded free of charge. Easy access to just the reference routes:

- [Oslofjorden](#), last change 23.11.2019
- [Skagerrak](#), last change 23.11.2019
- [Rogaland](#), last change 16.01.2020
- [Vestlandet](#), last change 15.01.2020

When a route is selected, important route information is displayed below the route. Download routes in RTZ-format to bring the route into any navigation platform for route planning. On board the vessel assure the routines given for route-import are followed. For routes with no comments on vessel size, **150 meter length** and **9 meter draught** has been used to quality assure the routes. Limitations in size of vessel may vary along the route caused by regulation or depths (see more under FAQ).

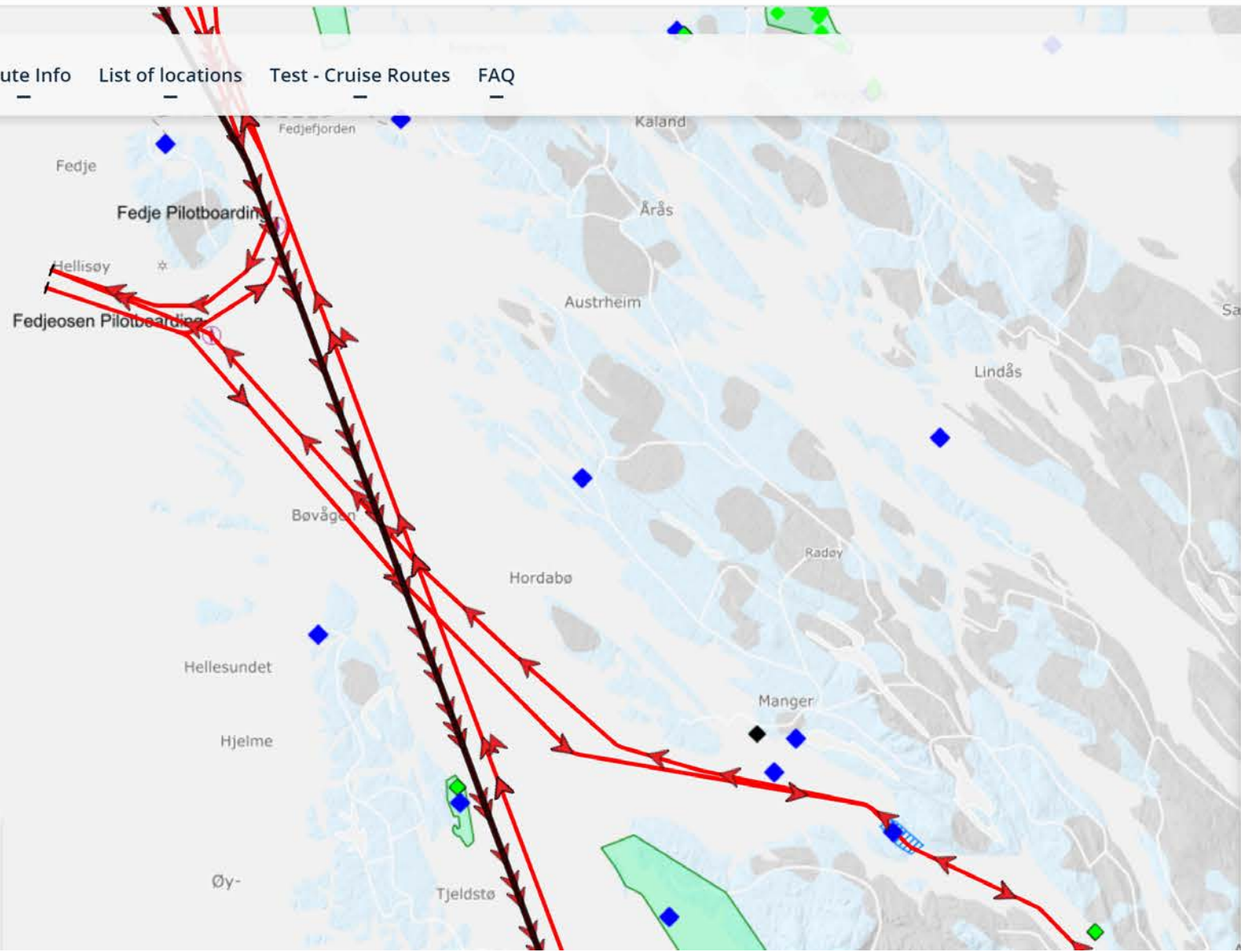
A turn radius of **0,3 nautical miles** is used as default in the reference routes, with a few exceptions in hard turns. Waypoints and turn radius must of course be adapted to vessel and situation as part of the route planning.

Last change 15-16.01.2019: 112 routes from Haugesund to Stad have been

<https://www.routeinfo.no/>



Route Info List of locations Test - Cruise Routes FAQ



- Reference routes
- Ports
- Port facilities
- Quays

Search routes and locations

### Route: 7\_5m\_Stad\_Krakhelle\_Holmengra\_Skudefj

Routename: NCA\_7\_5m\_Stad\_Krakhelle\_Holmengra\_Skudefj\_20200115.rtz

Download RTZ 1.0

### Route Info

Sailing Distance: 223.7 nautical miles

#### Local Regulations for Use of PEC

- Vatlestraumen (1506) Vestlandet
- Skatestraumen (1521) Vestlandet
- Måløysundet (1523) Vestlandet
- Florø (1518) Vestlandet
- Karmsundet nord for Høgevarde (1501) Rogaland

#### Local Regulations (VTS)

- Section 116 - 119
- Section 125 - 128

#### VTS information

```
<?xml version="1.0"?>
<route xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" version="1.0" xmlns="http://www.cirm.org/RTZ/1/0">
  <routeInfo routeName="NCA_Ardal_Skundefjorden_Out_20190704" validityPeriodStart="2019-07-04T02:00:00+02:00"
validityPeriodStop="2020-08-14T02:00:00+02:00" vesselName="Norwegian Coastal Administration"
vesselVoyage="NO-320010" />
  <waypoints>
    <defaultWaypoint radius="0.10">
      <leg starboardXTD="0.04" portsideXTD="0.04" safetyContour="30.00" safetyDepth="30.00"
geometryType="Loxodrome" staticUKC="0.00" dynamicUKC="0.00" />
    </defaultWaypoint>
    <waypoint id="1" name="Ardal">
      <position lat="59.14432287" lon="6.1542135" />
    </waypoint>
    <waypoint id="2" name="Kvannholmen">
      <position lat="59.14189573" lon="6.08508445" />
    </waypoint>
    <waypoint id="3" name="Smaskjaerene">
      <position lat="59.13572616" lon="6.08322484" />
      <leg starboardXTD="0.07" portsideXTD="0.07" />
    </waypoint>
  </waypoints>
</route>
```

**Rout: Ardal\_Skundefjorden\_Out**

**Rout name**

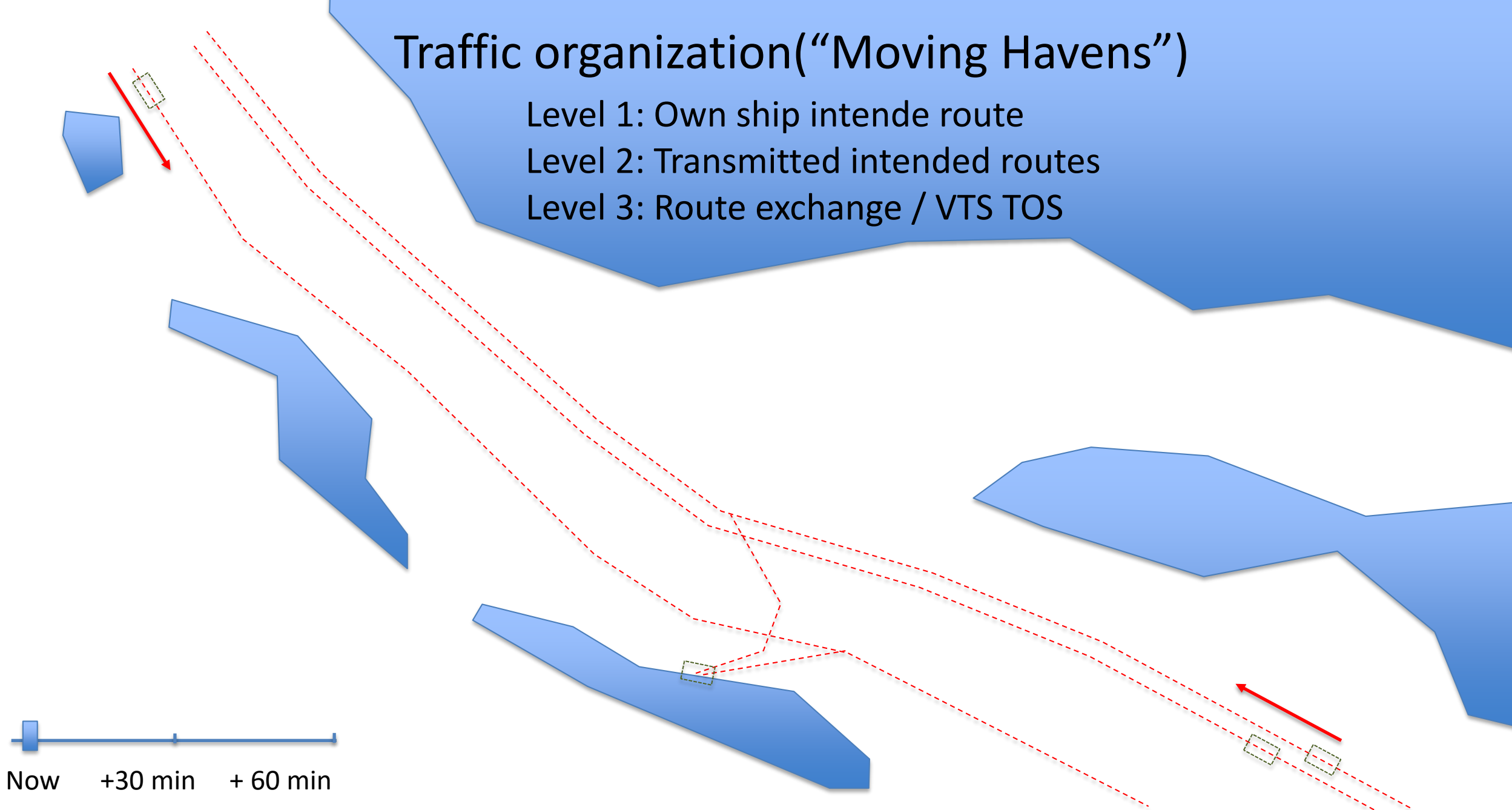
NCA\_Ardal\_Skundefjorden\_Out\_20190704.rtz

# Traffic organization("Moving Havens")

Level 1: Own ship intended route

Level 2: Transmitted intended routes

Level 3: Route exchange / VTS TOS



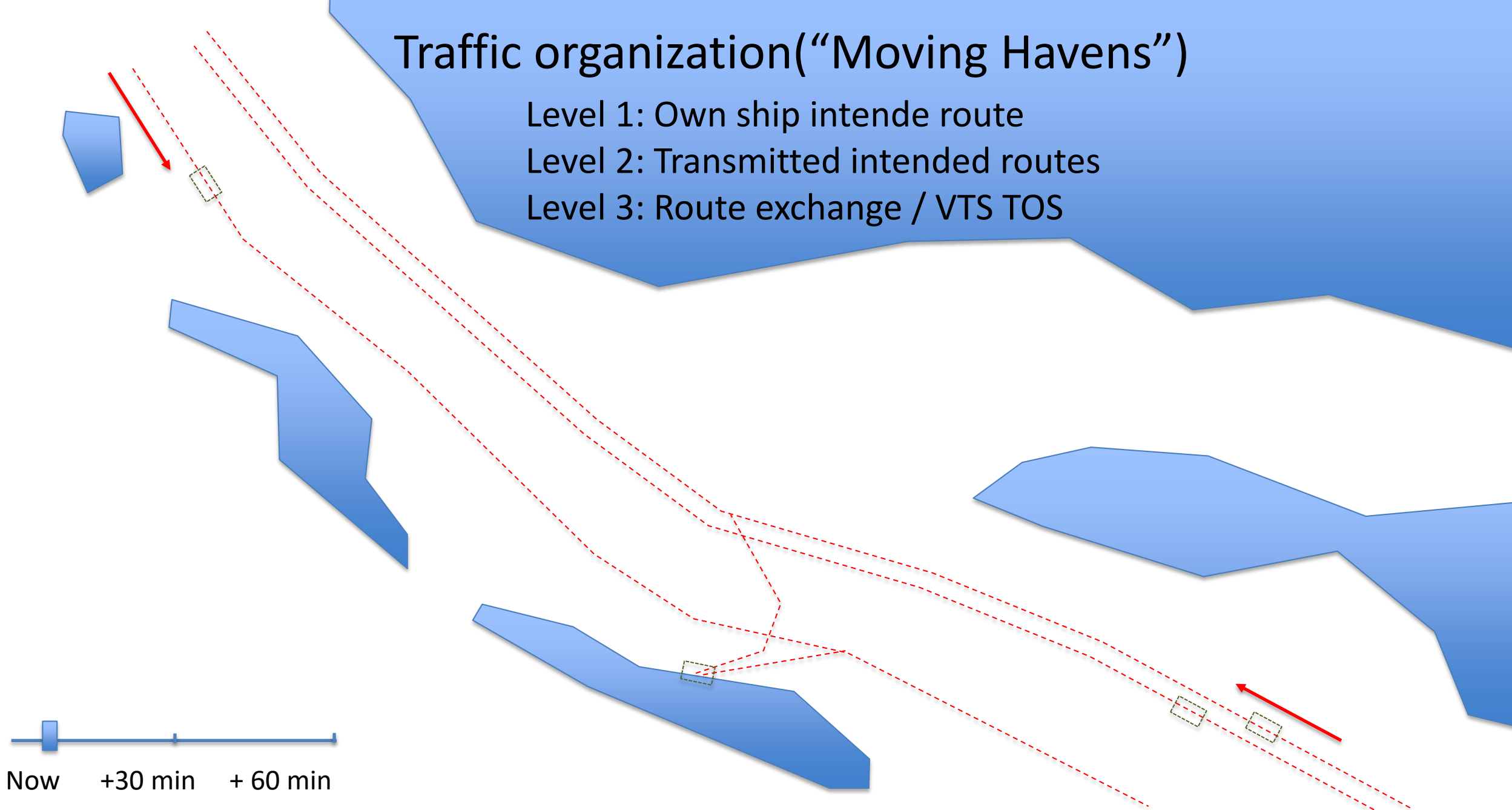
Now +30 min +60 min

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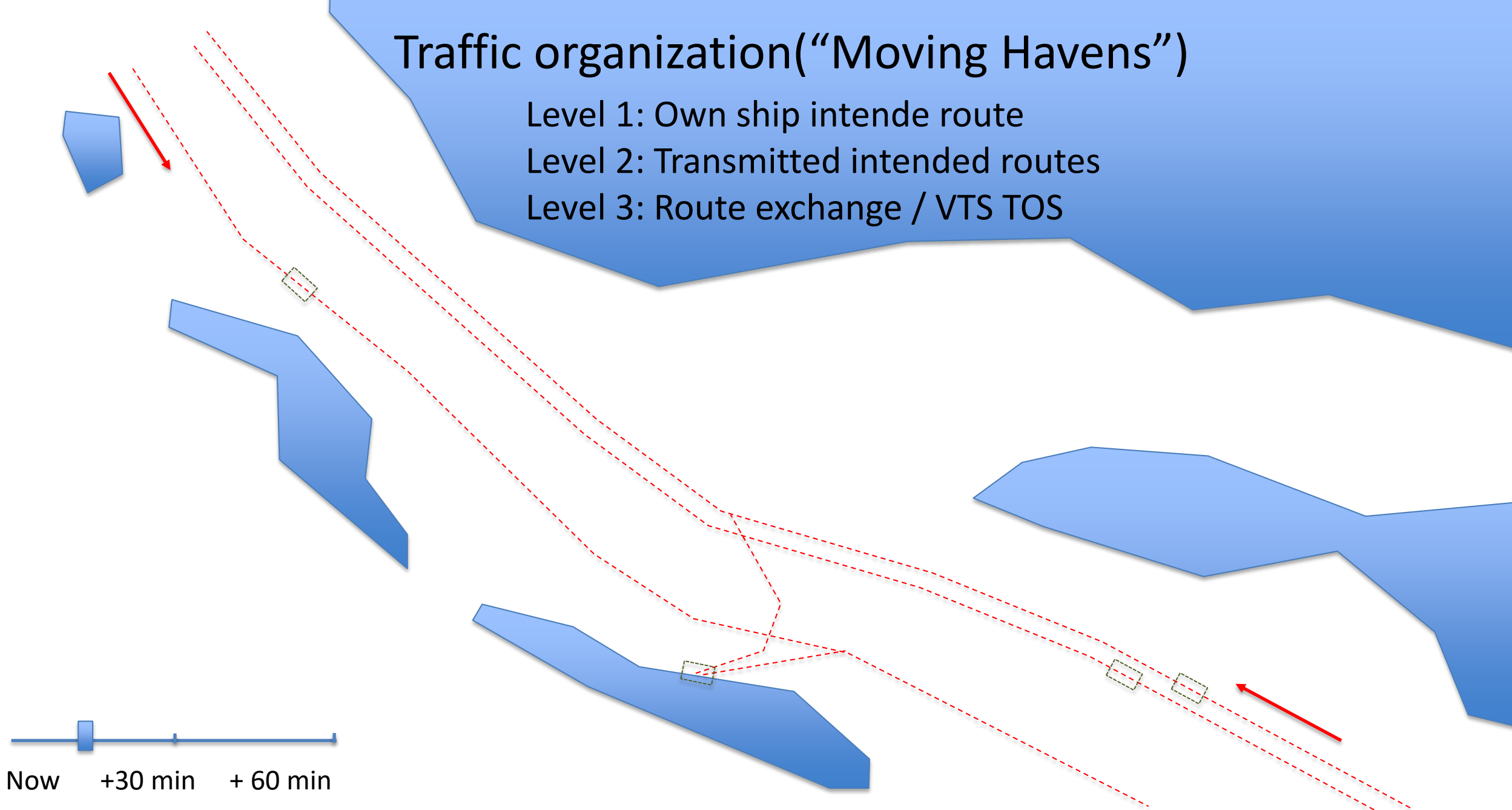
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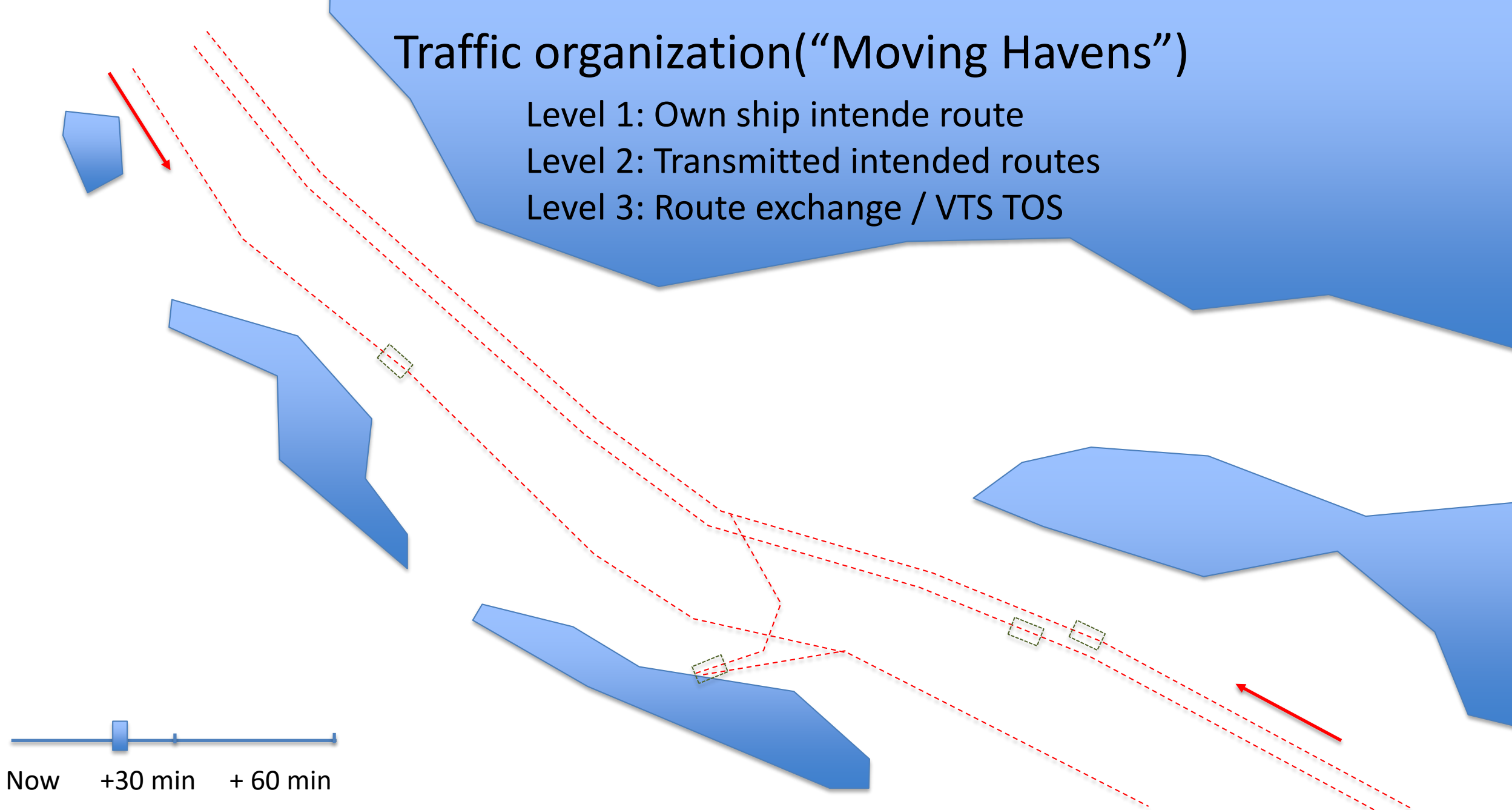
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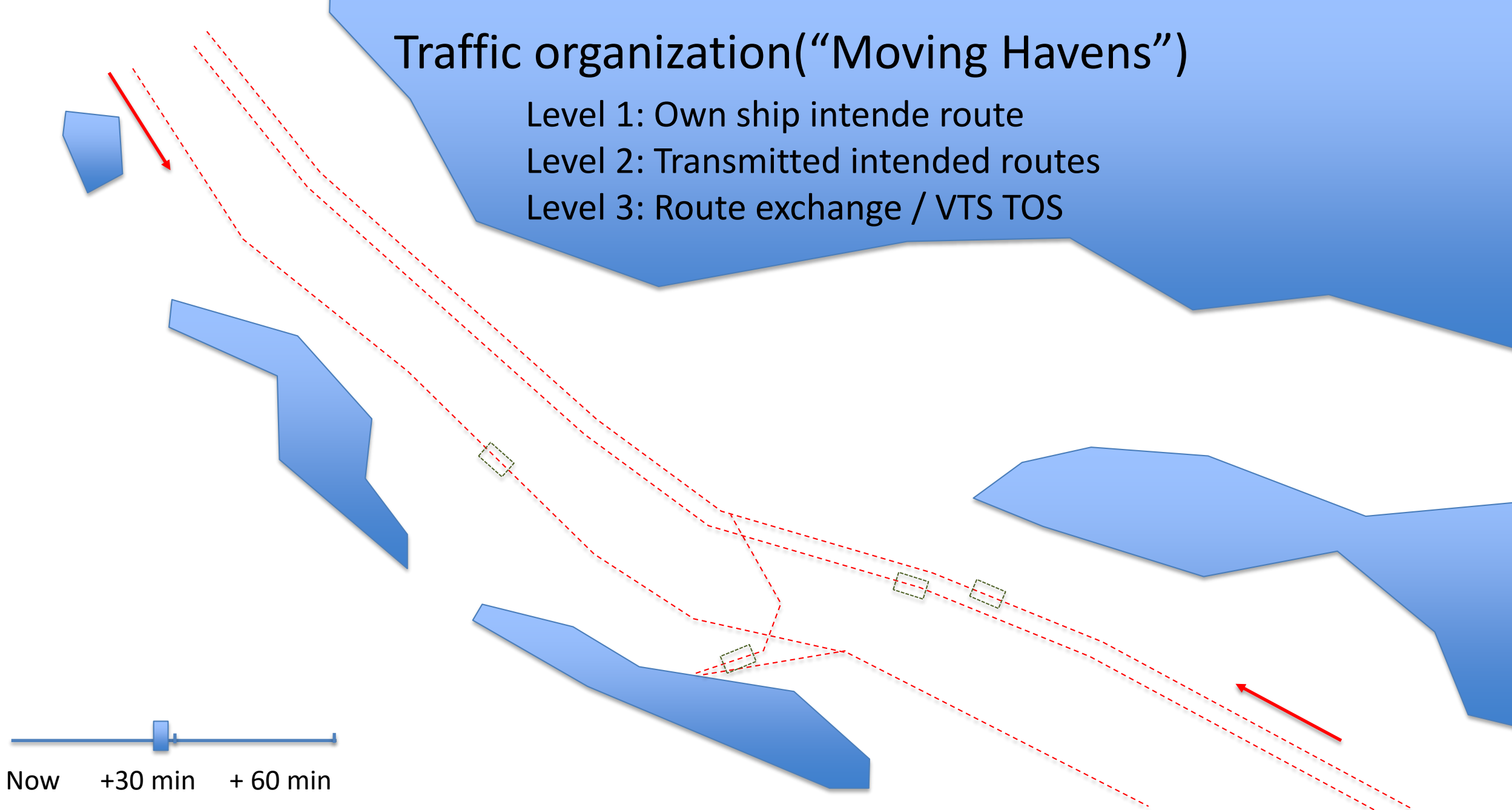
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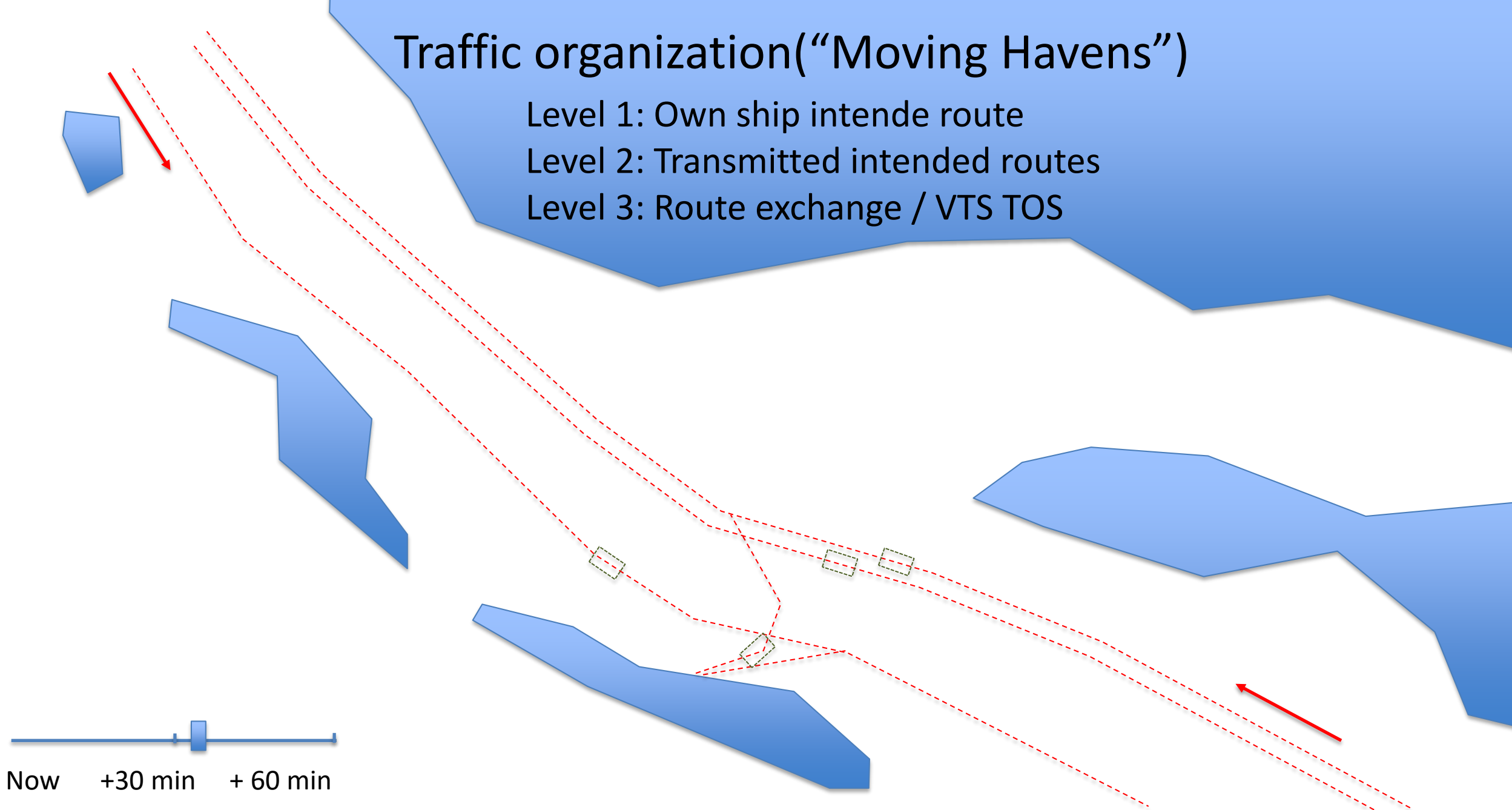


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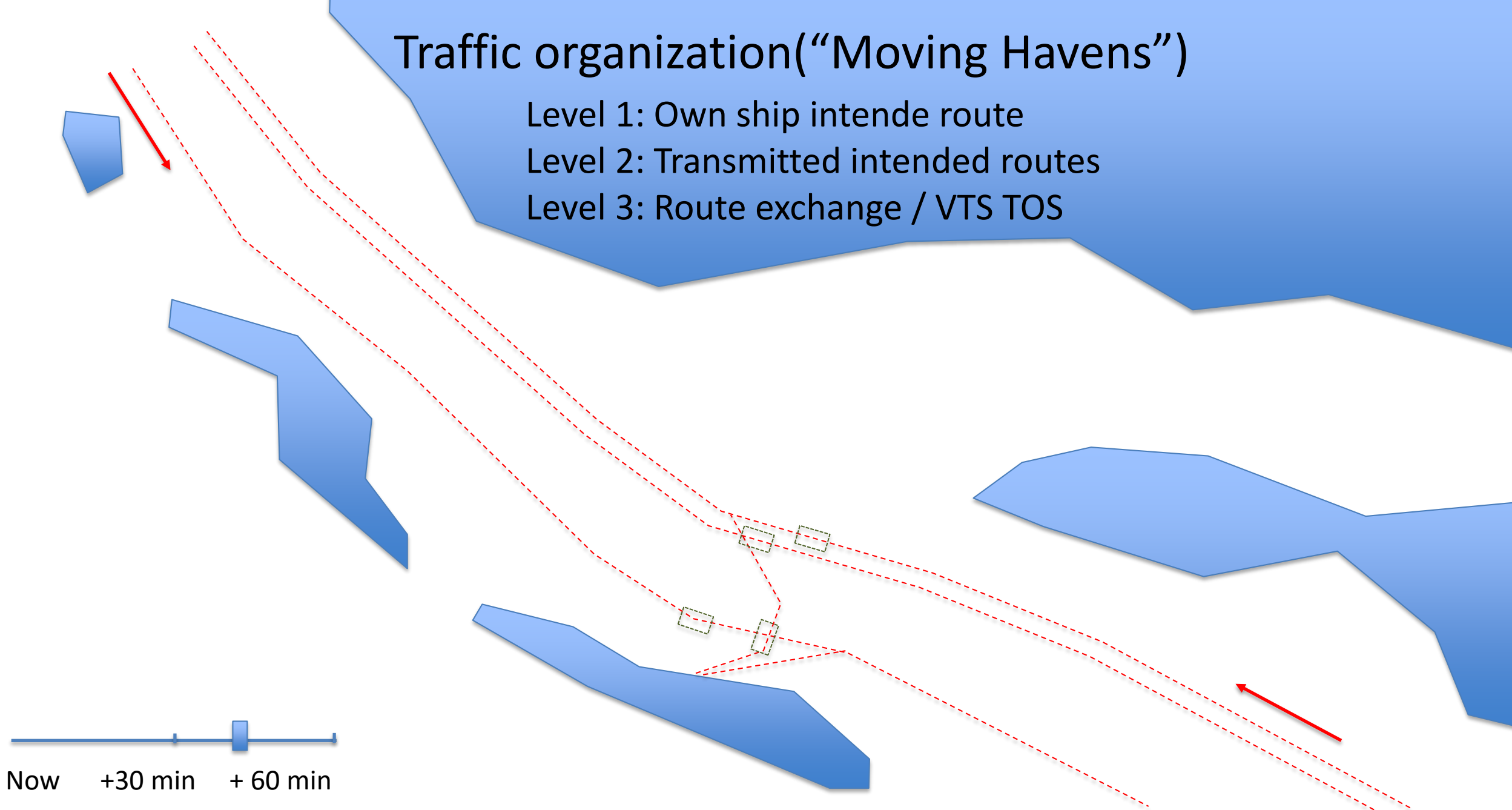
Now +30 min +60 min

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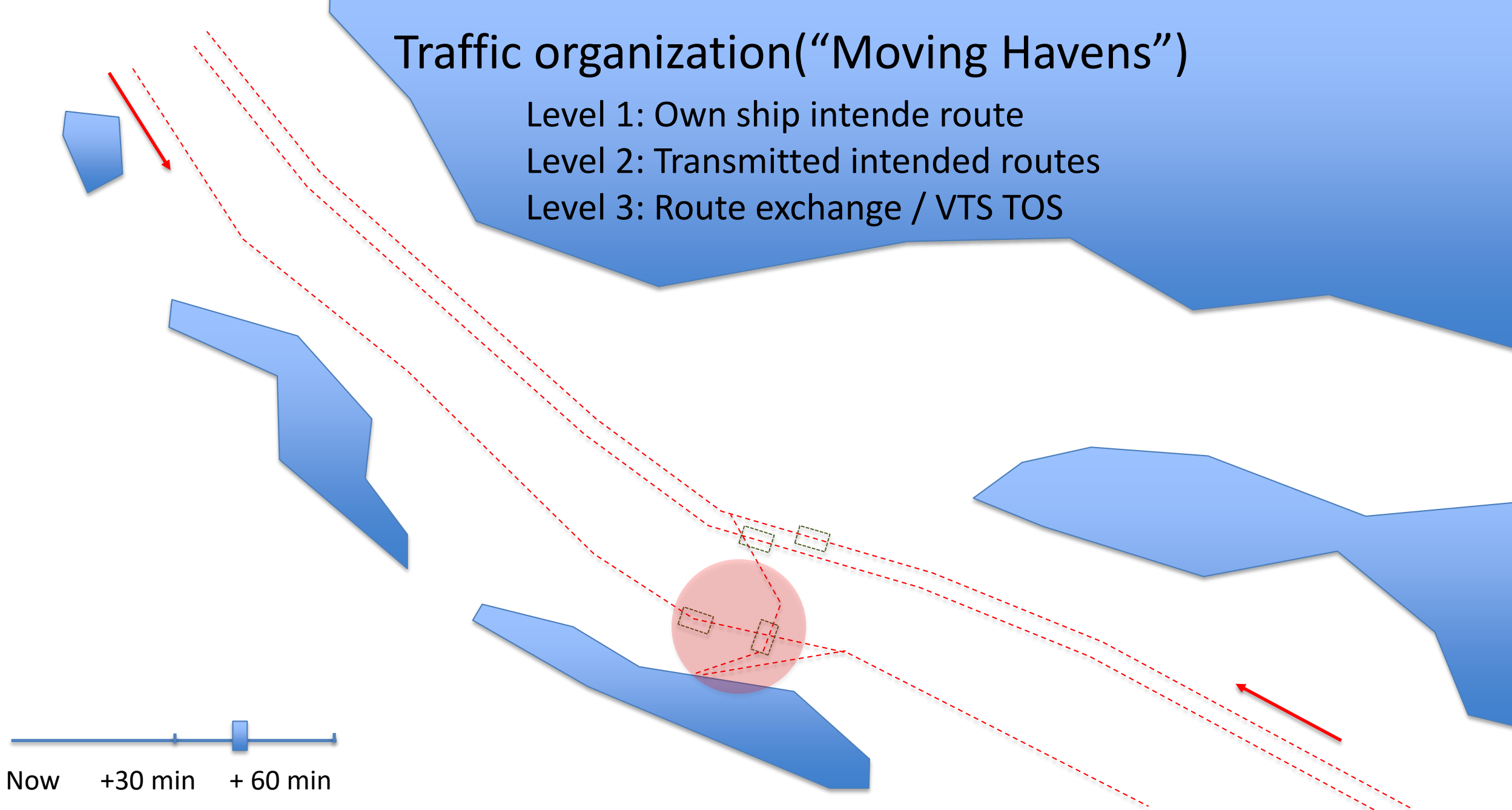
Now +30 min + 60 min

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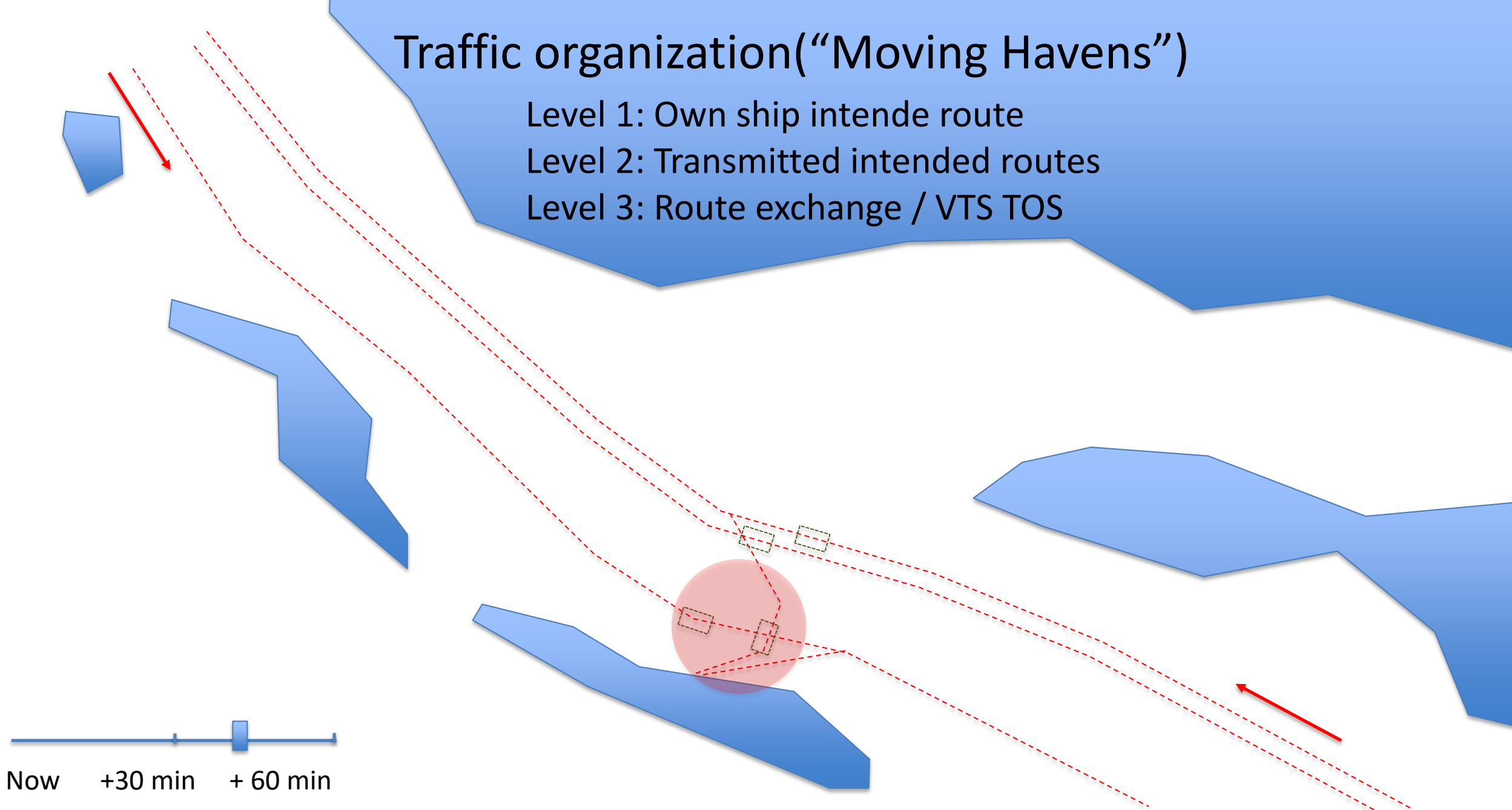


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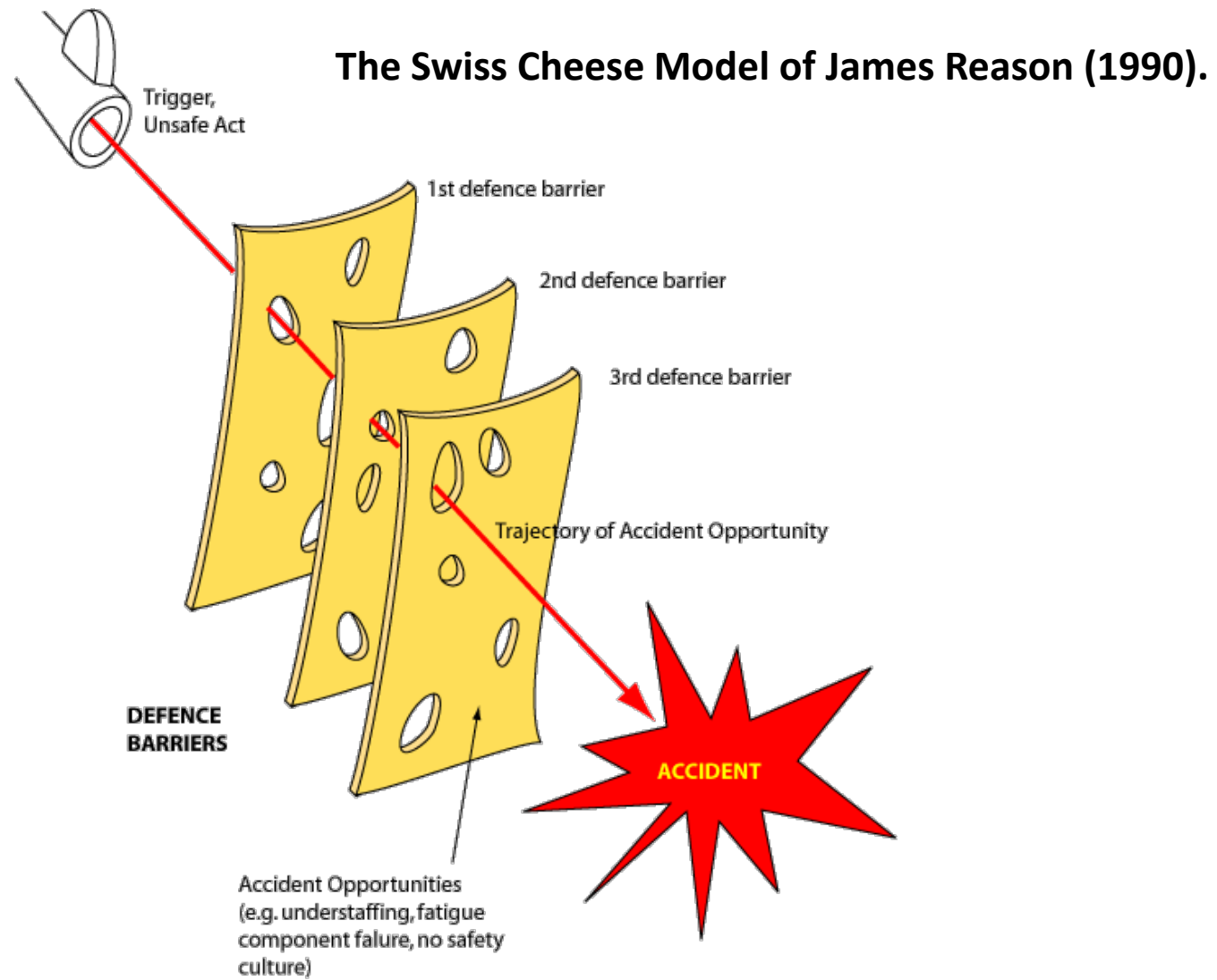
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Now +30 min +60 min



Reason, J. (1990). *Human error*. Cambridge: Cambridge University Press. ISBN 0-521-31419-4.