INFRASTRUCTURE IN TEST AREAS

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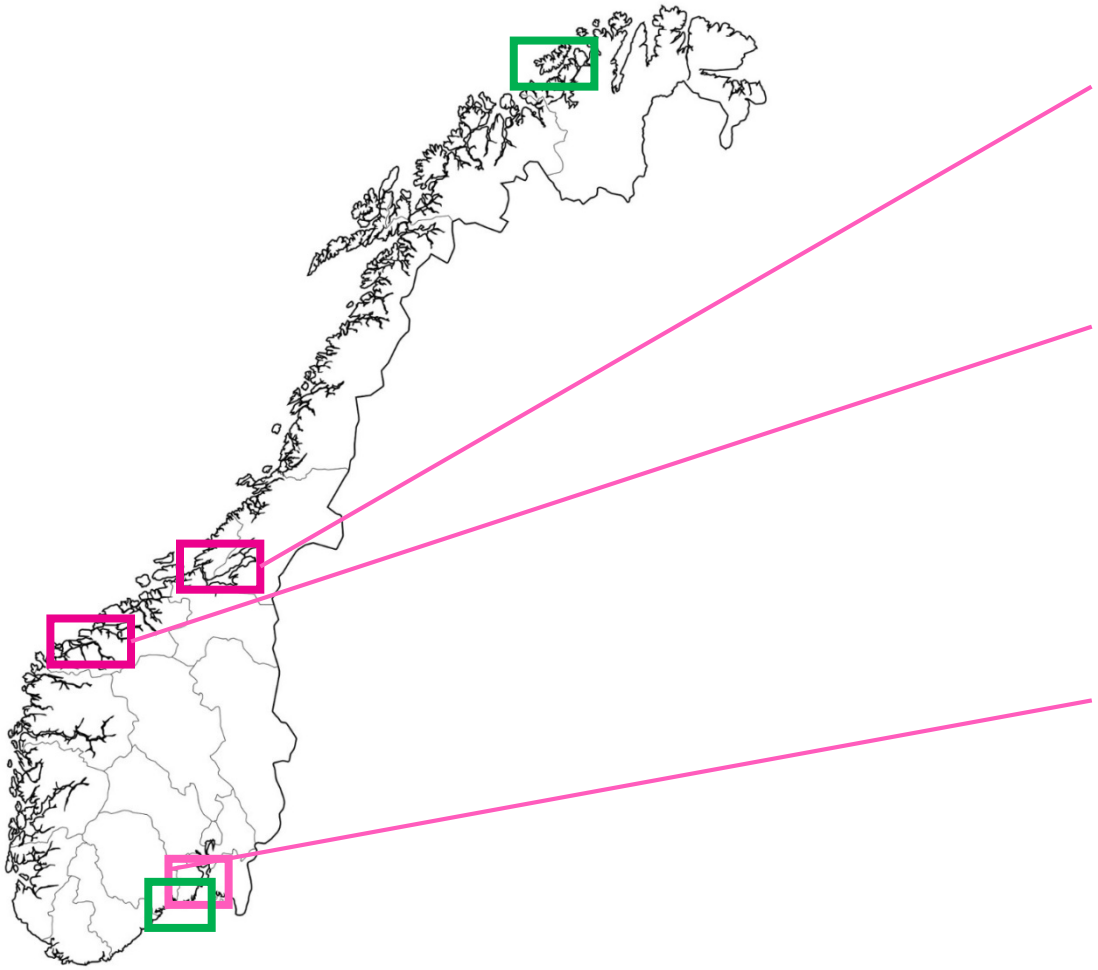
Test areas in Norway



- **Trondheim, September 2016**
  - NTNU, SINTEF + Industry (MR, Kongsberg++)
- **Storfjorden, May 2017**
  - NTNU Ålesund
  - Industry (RR++)
- **Horten, October 2018**
  - Ports
  - Kongsberg, Yara

SINTEF

Coordinated through NFAS (published at INAS)

NFAS Norsk Forum for Autonome Skip

http://nfas.autonomous-ship.org

INAS International Network for Autonomous Ships

http://www.autonomous-ship.org/

SINTEF

Interaction Between Manned and Autonomous Ships:

Automation Transparency

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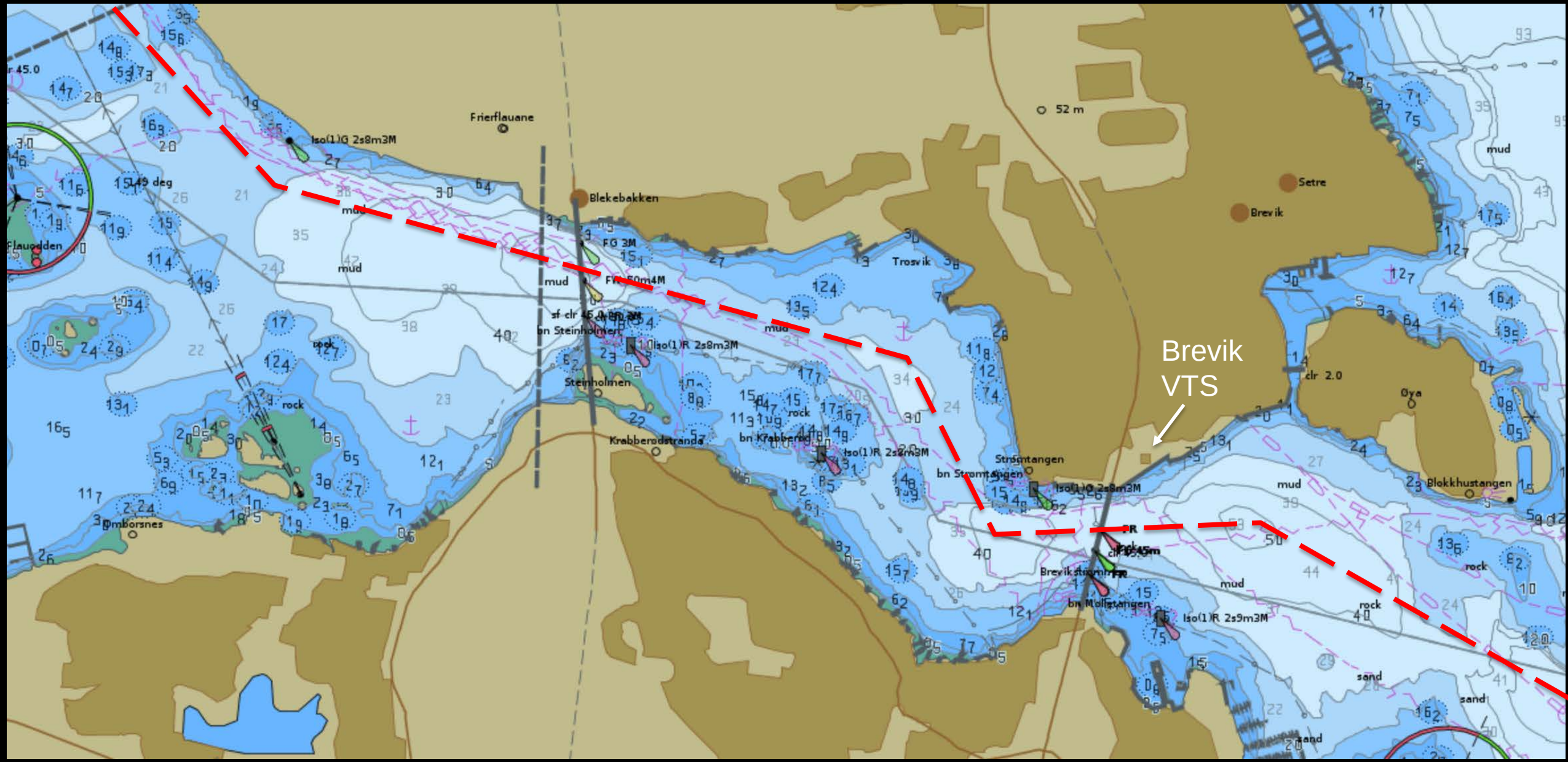
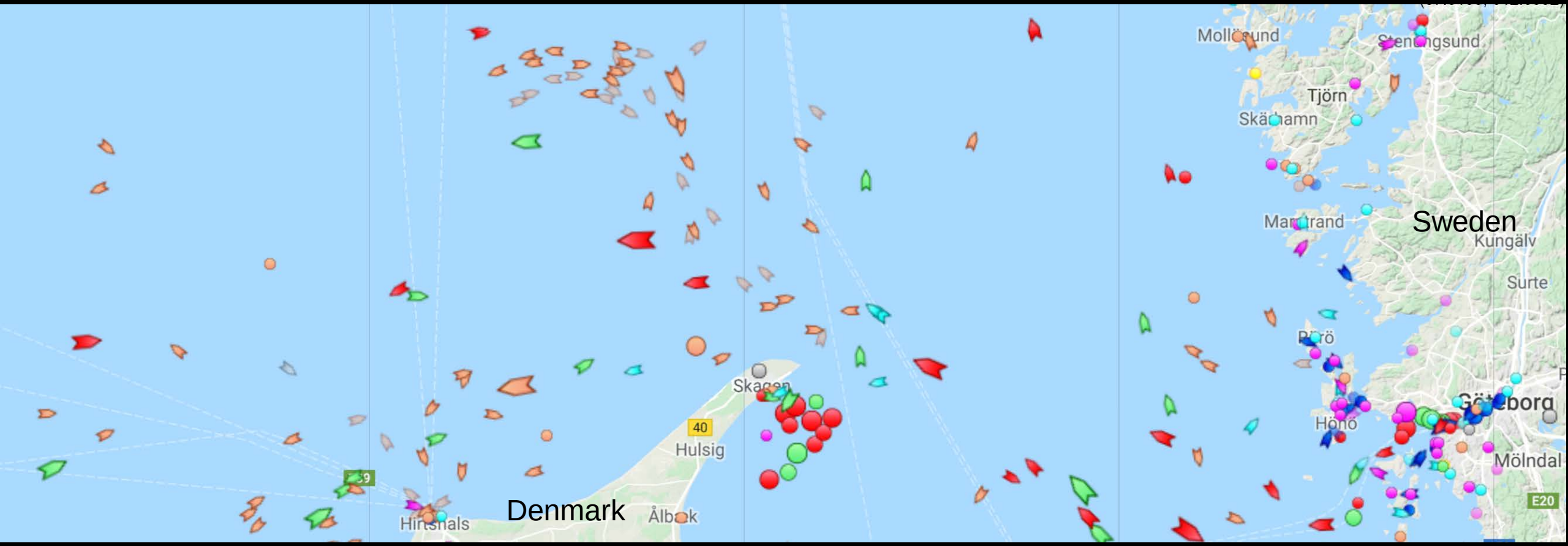
Estimated facts & figures	Capacity	Proximity sensors
Main particulars **Length o.a.**: 79,5 m **Length p.p.**: 72,4 m **Width mld.**: 14,8 m **Depth shelter deck**: 10,8 m **Draught (full)**: 6 m **Draught (ballast)**: 3 m **Service speed**: 6 knots **Max speed**: 13 knots	**Cargo capacity**: 120 TEU **Deadweight**: 3 200 mt **Propulsion system**: Electric **Propellers**: 2 Azimuth pods **Thrusters**: 2 Tunnel thruster **Battery pack**: 7 – 9 MWh	Radar Lidar AIS Camera IR camera **Connectivity & Communication** Maritime Broadband Radio Satellite Communications GSM

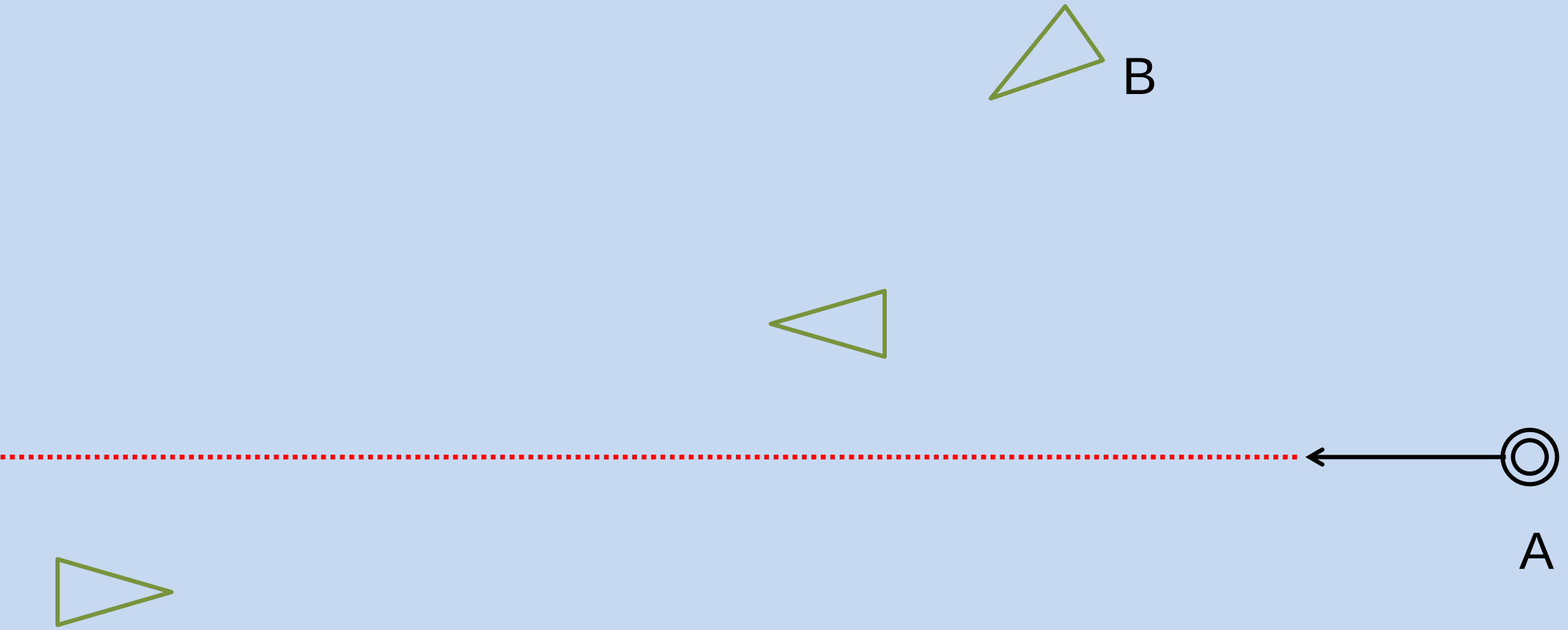
https://www.km.kongsberg.com/ks/web/nokbg0240.nsf/AllWeb/4B8113B707A50A4FC125811D00407045?OpenDocument [acc. 2018-02-04]


Brevik
VTS
Frierflauane
Blekebakken
Steinholmen
Krabberødstranda
Strømtangen
Brevik
Setre
Trosvik
Oya
Blokkhustangen
Ormborsnes
Flauodden
52 m
Iso(1)G 2s8m3M
Iso(1)R 2s8m3M
Iso(1)R 2s9m3M
FG 3M
mud
rock
sand
clr 2.0

NTNU

The autonomous shipping environment where anti-collision algorithms must work





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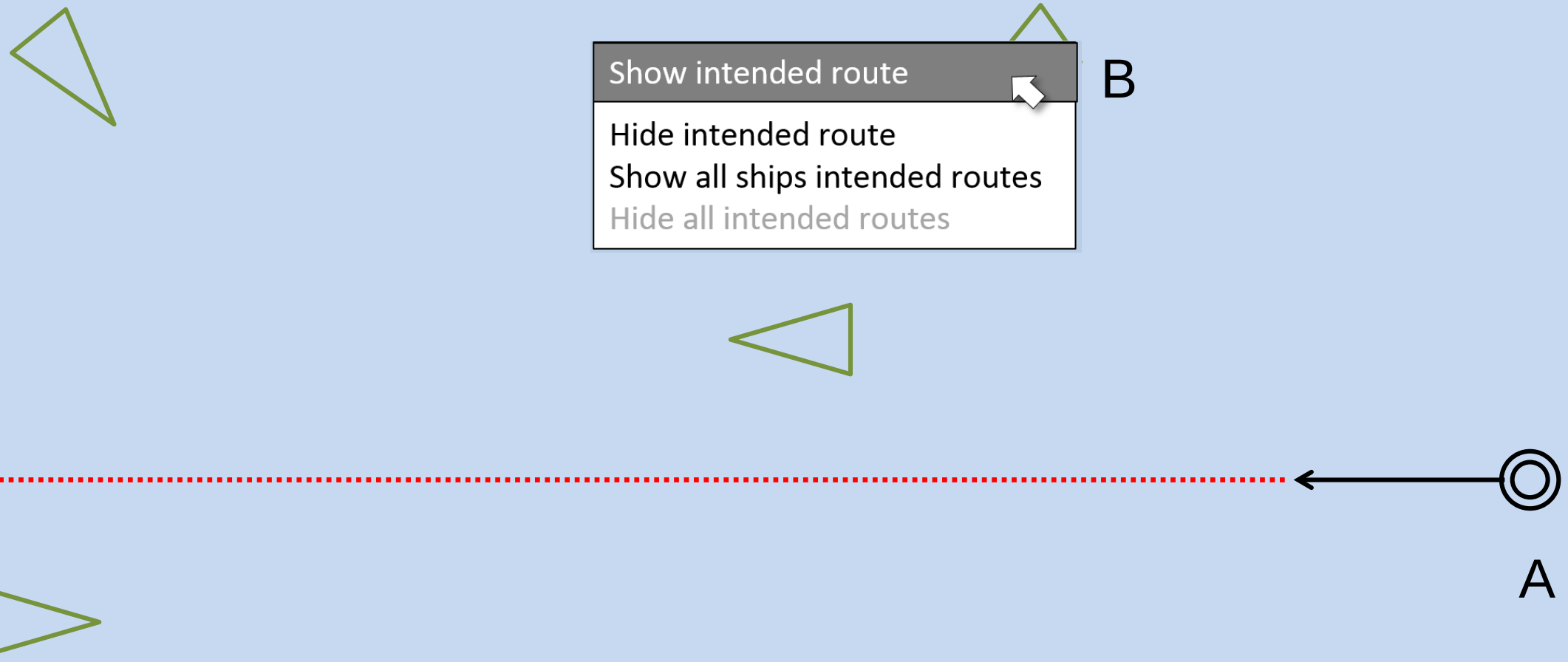

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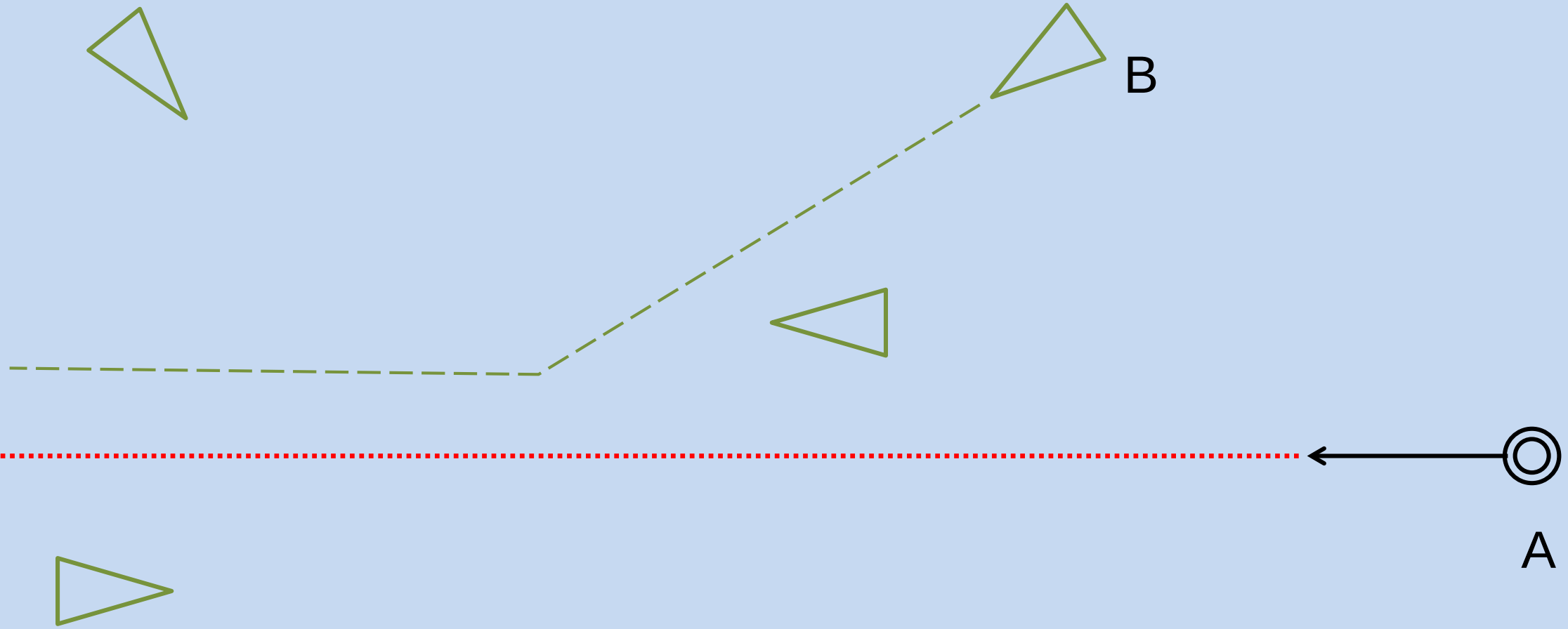

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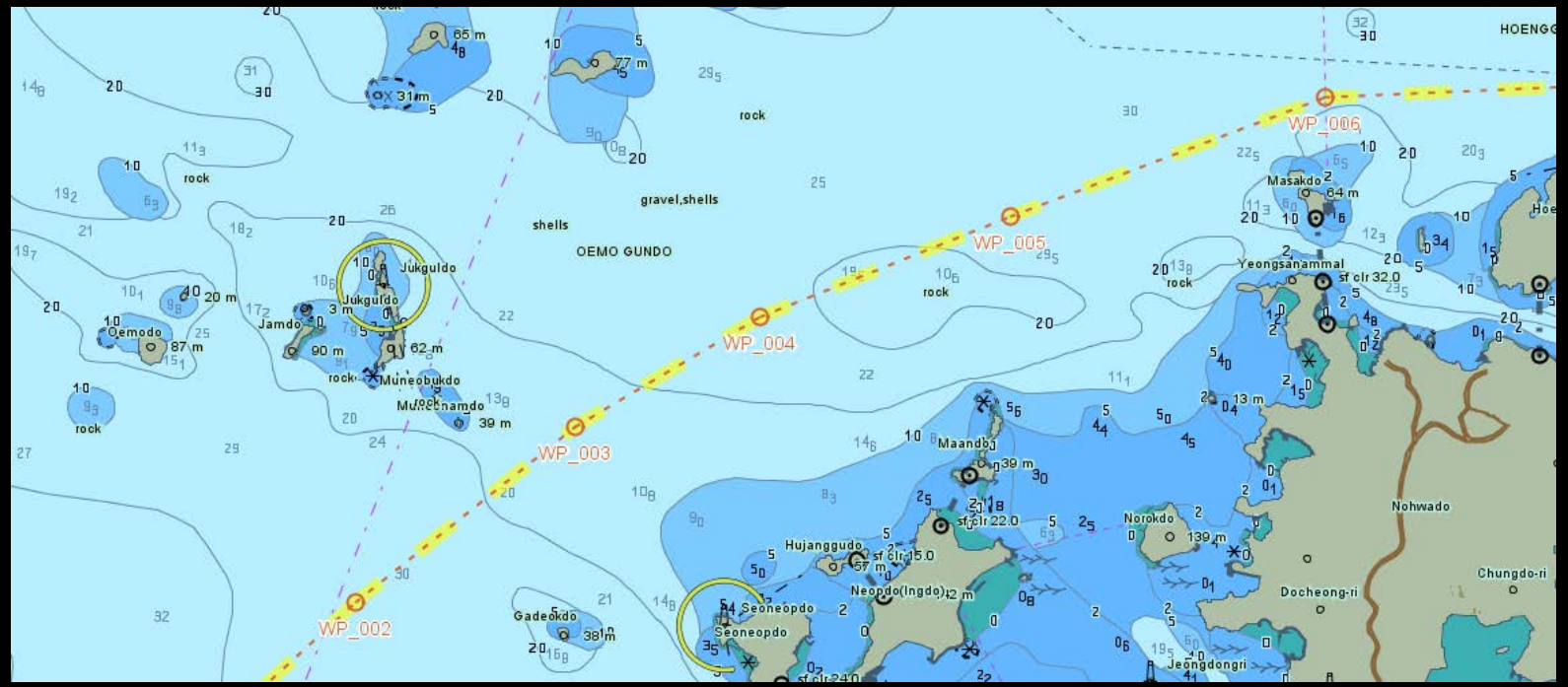
Ship Name
T/S *Hanbada of KMOU*

T/S *Sae Nuri of MMU*

Brödje, A.; Weber, R; Camre, D.; Borup, O.; & Porathe, T. (2015). **Supporting Voice Communication Between Navigator and VTS by Visual Solutions-Exploring the Use of the" Route Suggestion" Functionality within VTS.** In *Information, Communication and Environment: Marine Navigation and Safety of Sea Transportation*. CRC Press, 267-274

Porathe, T., Brodje, A., Weber, R., Camre, D., & Borup, O. (2015). **Supporting Situation Awareness on the bridge: testing route exchange in a practical e-Navigation study**. In A. Weintrit, & T. Neumann (Eds.) *Information, Communication and Environment: Marine Navigation and Safety of Sea Transportation*, London: CRC Press, 85-92.

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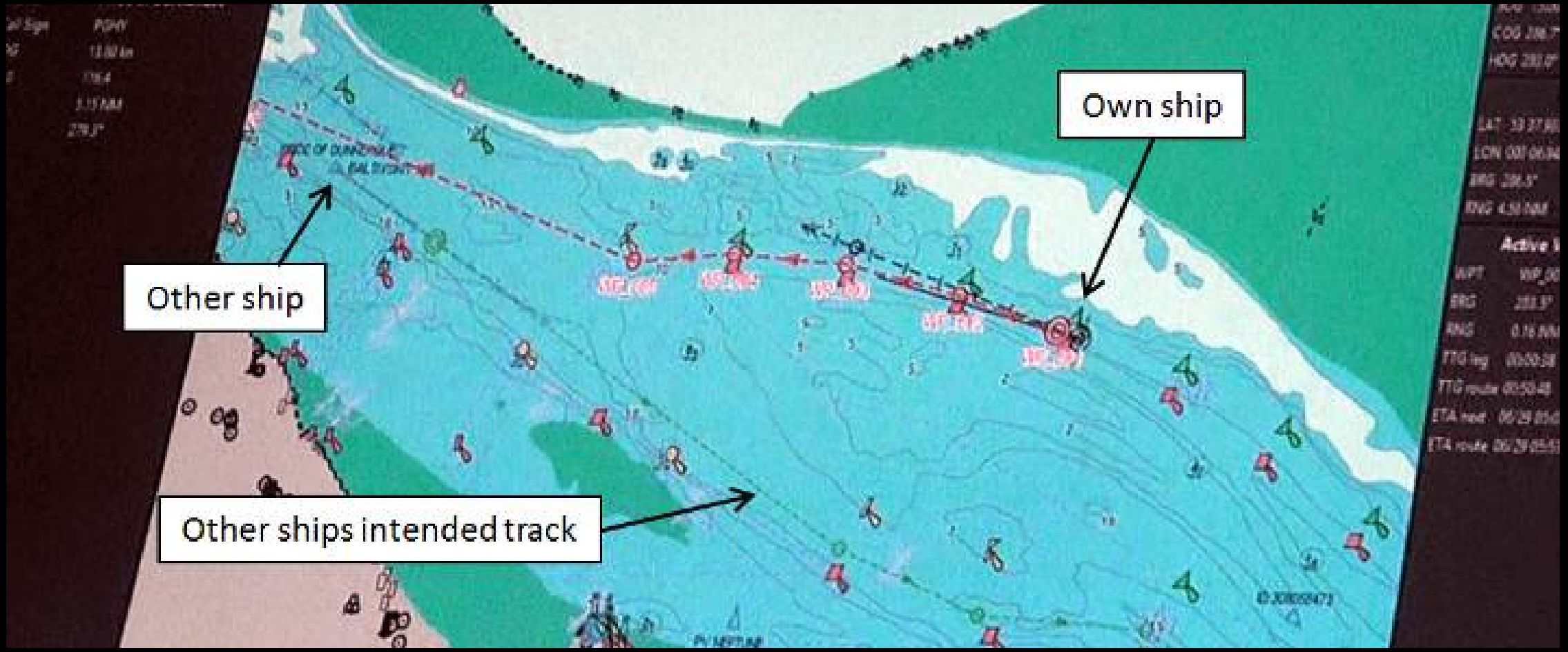

Porathe, T. (2012). Transmitting intended and suggested routes in ship operations: cognitive off-loading by placing knowledge in the world. Work, 41 (Supplement: 1) pp. 4873-4878.

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It is important for trust and cooperation that MASS shows intentions.
We call this **Automation transparency**

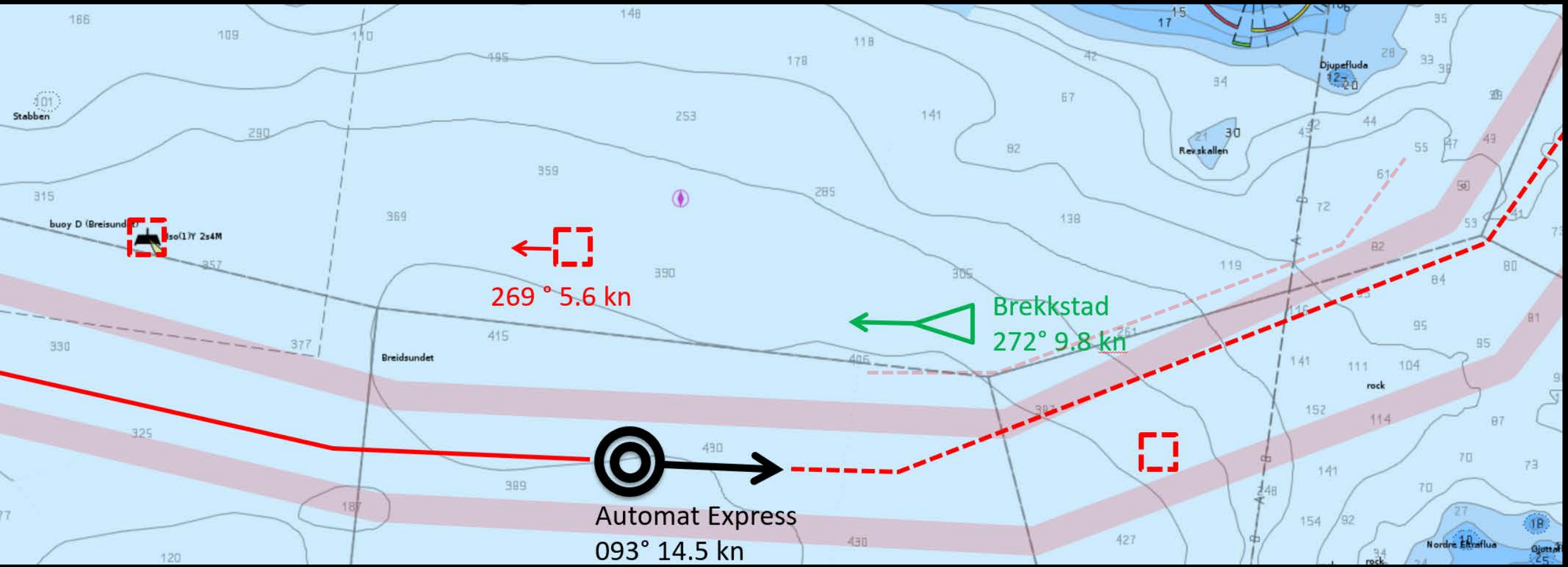
Possible examples of Automation Transparency

1. **Identification**. This is a ship in autonomous mode (marking)
   Special dedicated fairways
   Special dedicated times

2. **Awareness.** Has the autonomous vessel seen me?

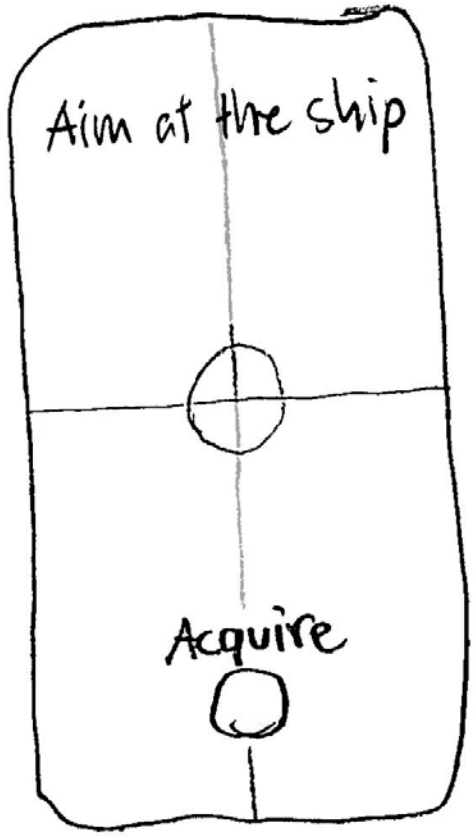
3. **Intentions.** What is its intentions?

Awareness and intentions through ECDIS communication
On-line web portal: the autonomous ship's Situation Awareness and intentions



Non-SOLAS vessels

See and report your presence in a phone app



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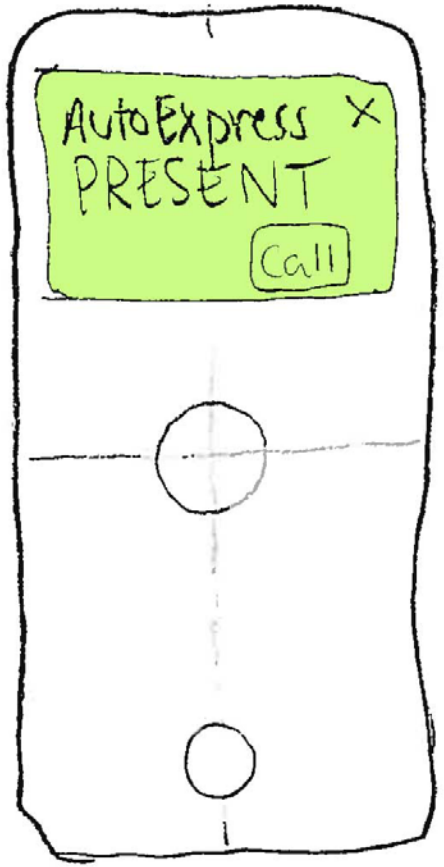

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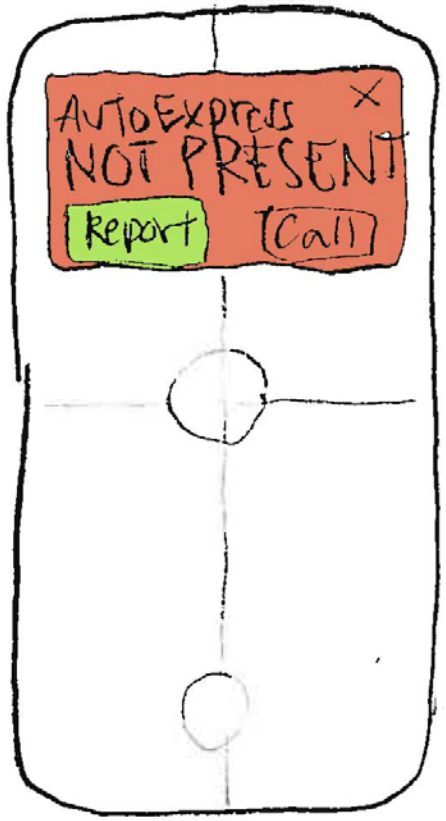

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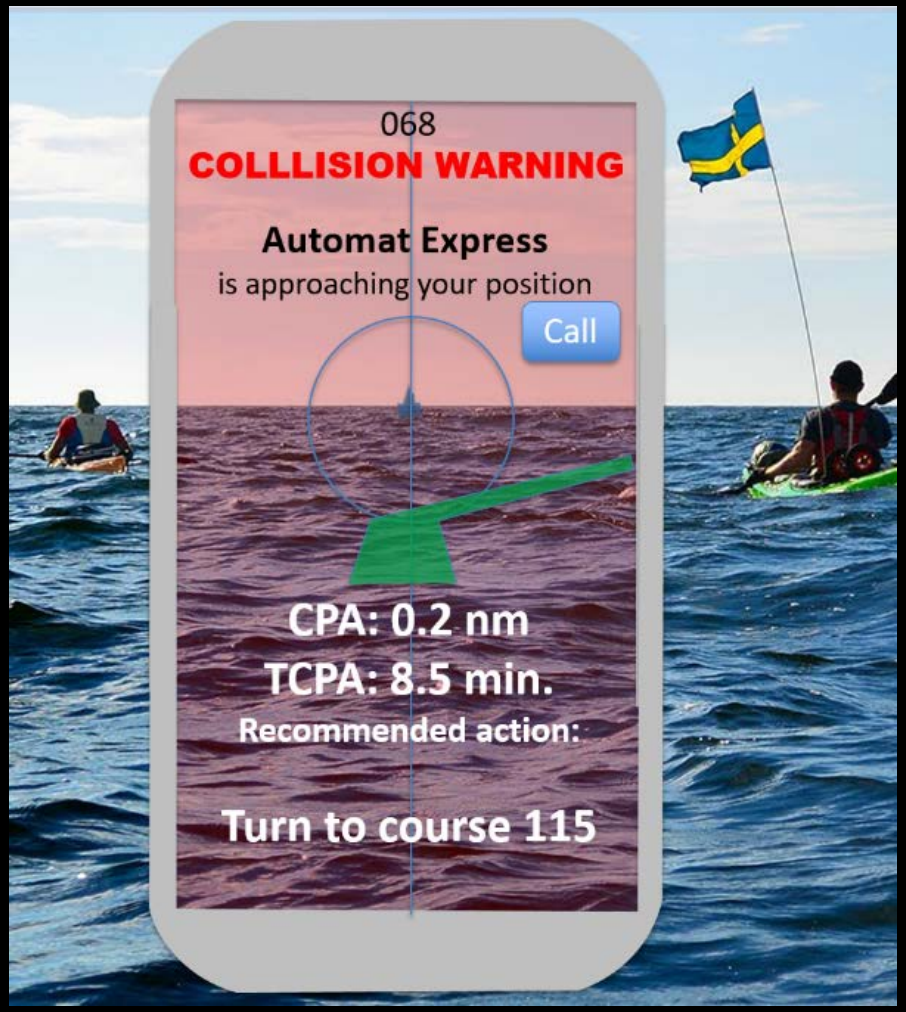
068
COLLLISION WARNING
Automat Express
is approaching your position
Call
CPA: 0.2 nm
TCPA: 8.5 min.
Recommended action:
Turn to course 115