

# Countermeasures: eLoran and the ACCSEAS Multi-source Receiver

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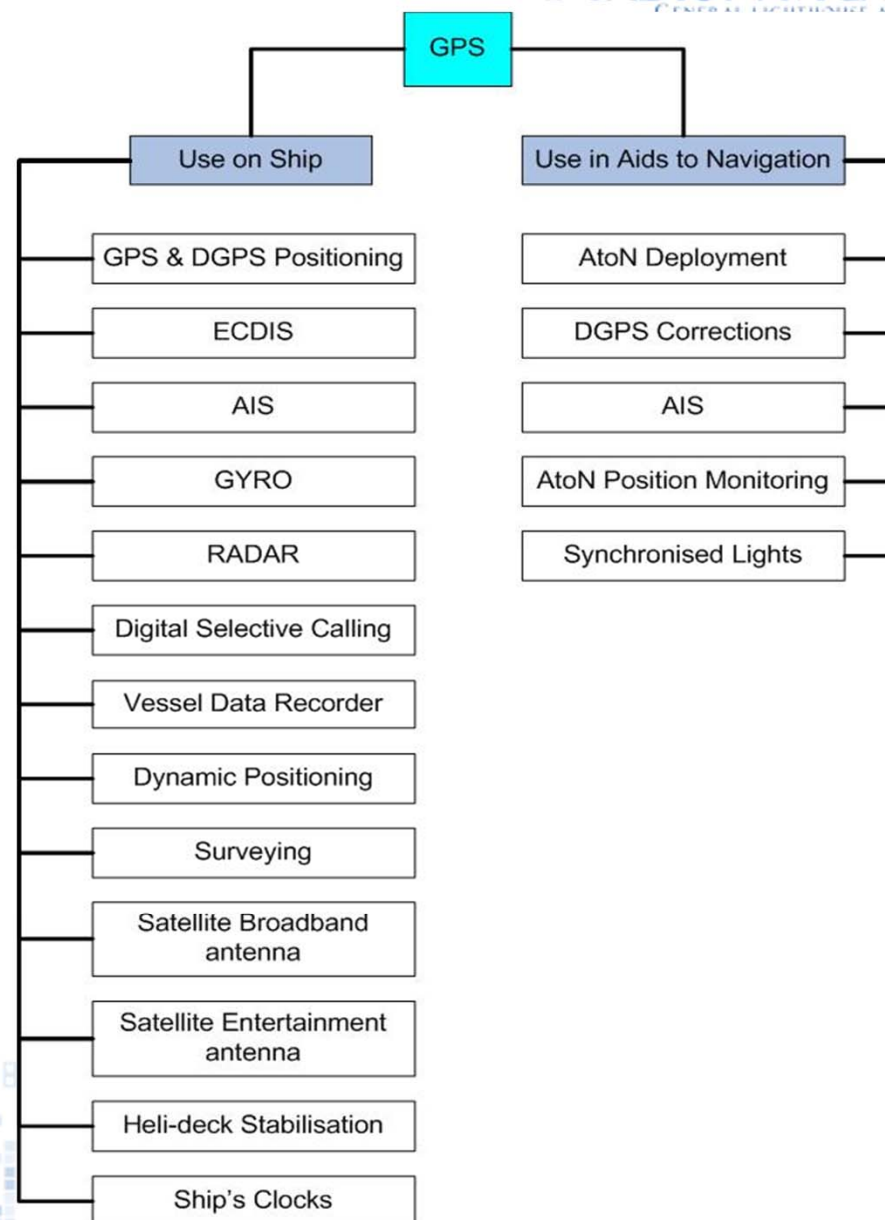


# Use of GPS in the Maritime Sector

GPS has become the normal means for maritime positioning, navigation and timing.

The level of integration onboard is different for each vessel depending on equipment fitted.

But GPS is everywhere!

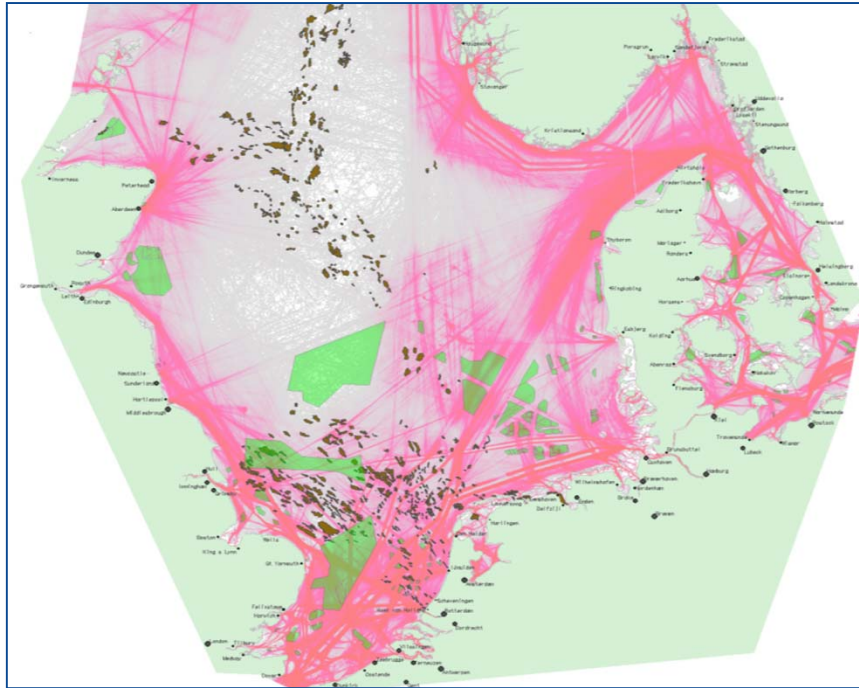


# ACCSEAS Overview

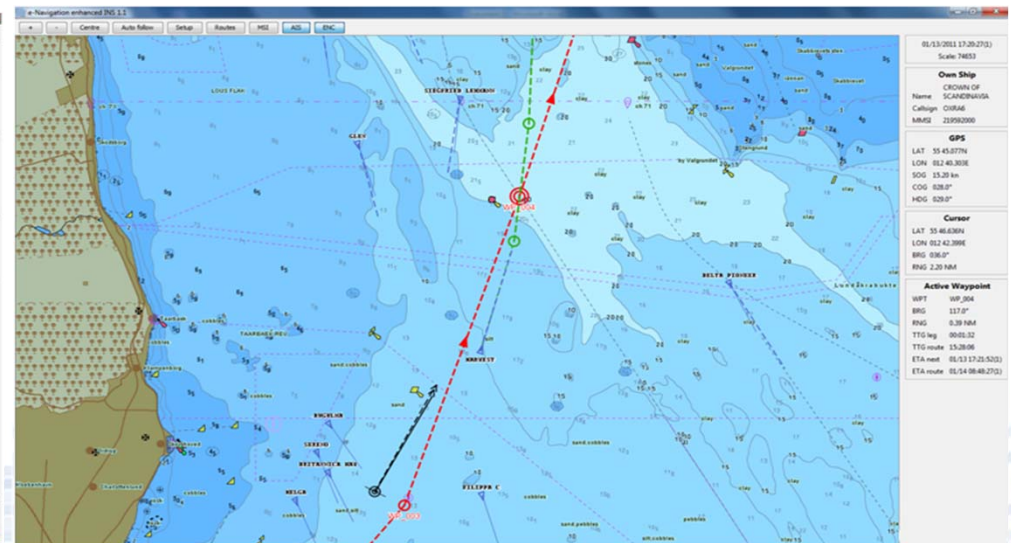
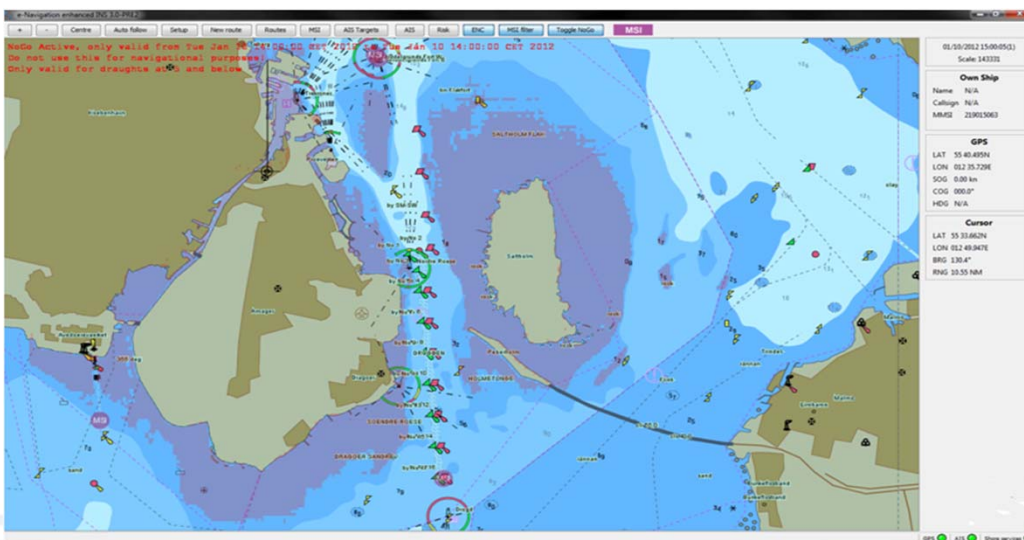
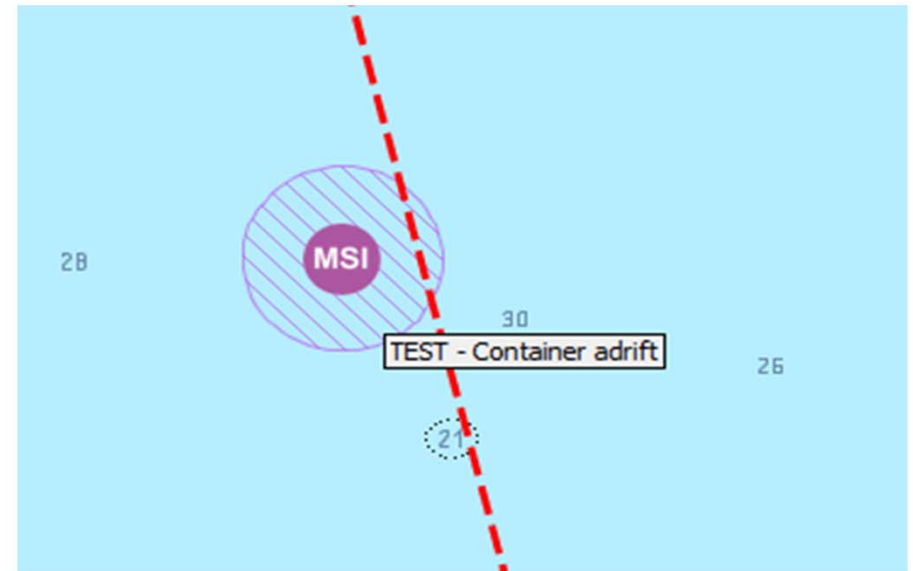
- **ACC**essibility for **S**hipping, **E**fficiency **A**dvantages and **S**ustainability
- [www.accseas.eu](http://www.accseas.eu)
- April 2012 to February 2015
- €5.6M budget
- 11 partners from Denmark, Germany, Netherlands, Norway, Sweden and UK (GLA, WSV, DMA, RWS, SMA, NCA, FUAS, NHL, CTH, SSPA, WMU)
- Develop:
  - An innovative test-bed of e-Navigation services
  - Resilient positioning, navigation and timing (PNT)
  - Safe and efficient berth-to-berth operations
  - Dynamic route planning, information exchange, display and decision aids
- Solving real problems, and demonstrating what e-Navigation can do for the mariner and shore-side operations



# The Problem and Some Solutions



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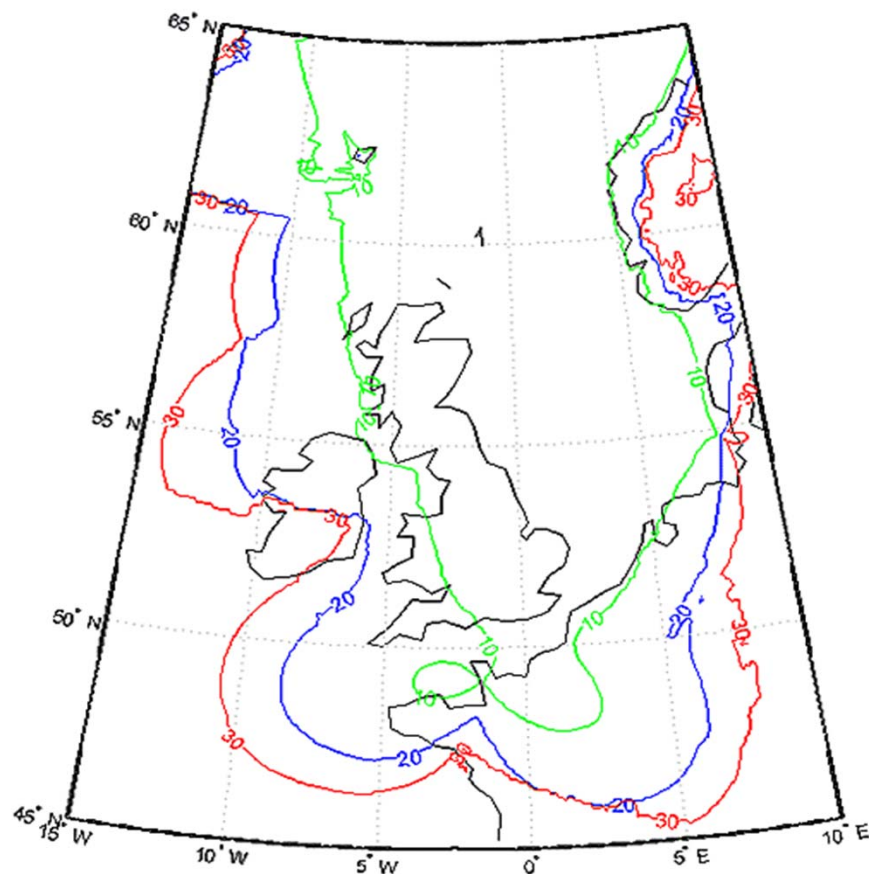


# ACCSEAS Resilient PNT

- ACCSEAS GPS Jamming trial and video:  
[https://www.youtube.com/watch?v=CNAr8eQQ\\_9E](https://www.youtube.com/watch?v=CNAr8eQQ_9E)
- Radar Absolute Positioning Trial
- R-Mode study on MF IALA DGPS and VHF AIS
- Multi-Source Positioning Service
- ACCSEAS Multi-Source Receiver
  - Together with UrsaNav ACCSEAS developed the world's first prototype Multi-Source Resilient PNT Receiver.
  - Based on GPS as primary PNT source, integrity algorithms and eLoran as the backup
- ACCSEAS Resilient PNT video:  
[https://www.youtube.com/watch?v=Sl4sMgP4\\_qs&index=4&list=PLoOjVKFIwaM\\_PyLEj\\_kWtwjFksvboYhir](https://www.youtube.com/watch?v=Sl4sMgP4_qs&index=4&list=PLoOjVKFIwaM_PyLEj_kWtwjFksvboYhir)



# eLoran in the NSR



Runs continuously; available since May 2010;  
10-20m accuracy in ports with differential service (green area)

# Complementary approaches to Resilient PNT

## ■ R-Mode (Ranging Mode) on radio-beacon MF DGPS broadcasts and VHF AIS

- feasibility study completed
- technical demonstration performed
- regulatory process not started yet
- potential integration with eLoran

## ■ Radar absolute positioning

- trial complete with good results
- limited effective range
- no backup for 'T'
- introduction would take decades



## Maritime focus with fewer cross-sector benefits

Technology less mature and less capable

More extensive shore infrastructure – higher cost

Longer regulatory timescales – beyond introduction of e-Navigation

Greater complexity and costs of ship equipage

# Precise Timing

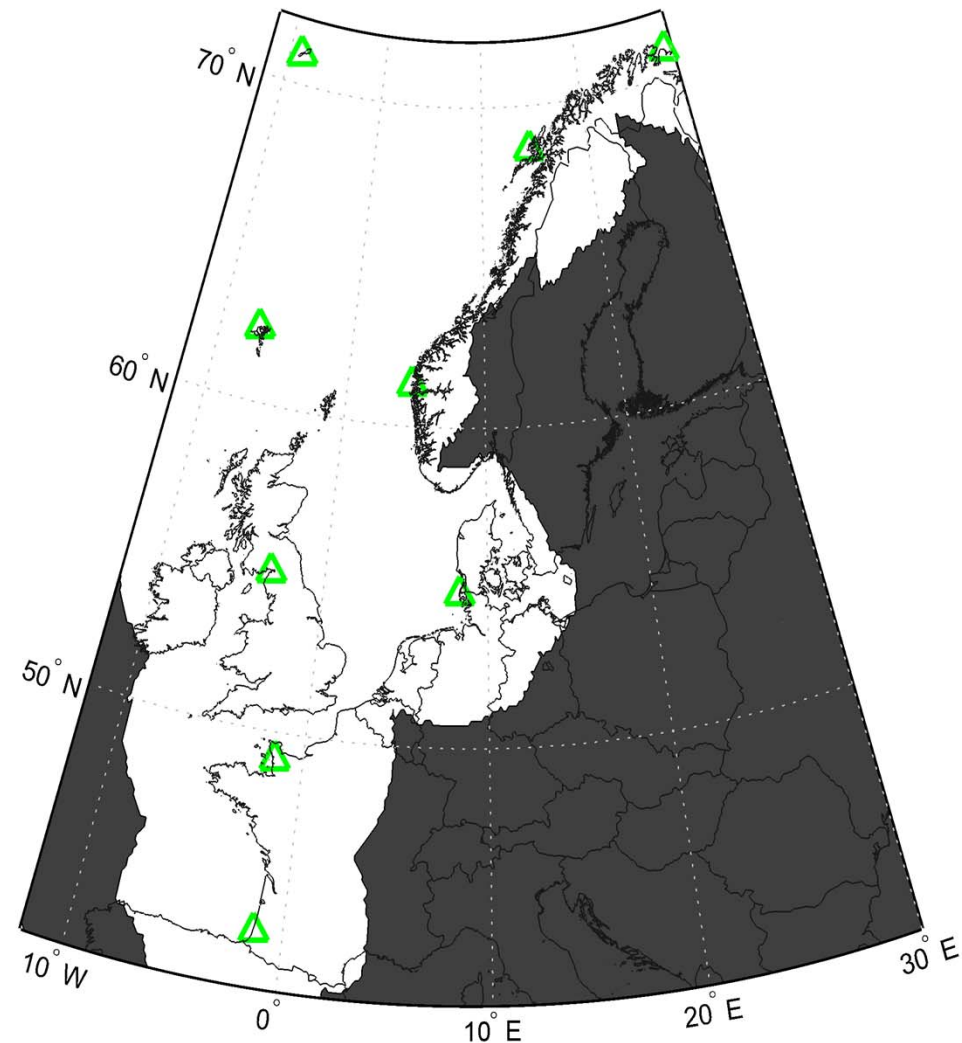
Precise timing requires 2 Tx - receipt of signals and LDC

Second (backup) transmitter signal provides high availability and continuity

Wide coverage area < 500ns with indoors antenna - regional differential correction (Data Channel encryption)

Inclusion in CEPT ECC report on TDD Networks Synchronisation

Strong industry interest: Orange/France Telecom, SFR, EE, BT, Three, Boloretelecom ....



Coverage (indoor) of eLoran timing across Europe



# Benefits to UK of continued eLoran

## eLoran is the most mature technology as a PNT backup to GNSS

- **supports both maritime and cross-sector CNI**
- proven technology with further LF advances possible (enhanced data capability)
- high performance levels of accuracy, integrity, availability and continuity of service

## eLoran is cost effective

- evidence of GLA maritime business case submitted to UK DfT (September 2010)
- even greater cross-sector benefits, for modest additional costs
- £M eLoran c.f. €4Bn spend on Galileo (PRS has very limited interference mitigation)

## eLoran is ready for cross-sector exploitation and promoting industrial growth

- wealth of innovative LF technology in UK (also France, Netherlands and Belgium)
- strong R&D base for developments (e.g. multi sensor integration, multi system Rx)
- SISTALS ('Solutions for Integrated Seamless Transport Across Land and Sea' with RELM (land mobile component))

# Thank you!

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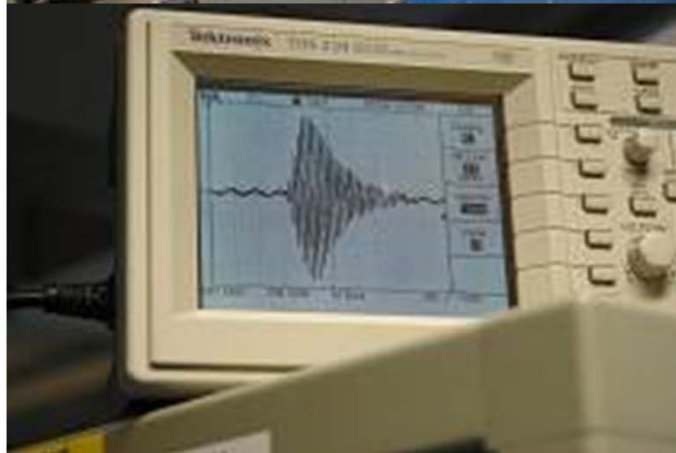
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Loran Station Anthorn

54° 54' 40.35"N  
003° 17' 14.21"W

# Extra Slides!



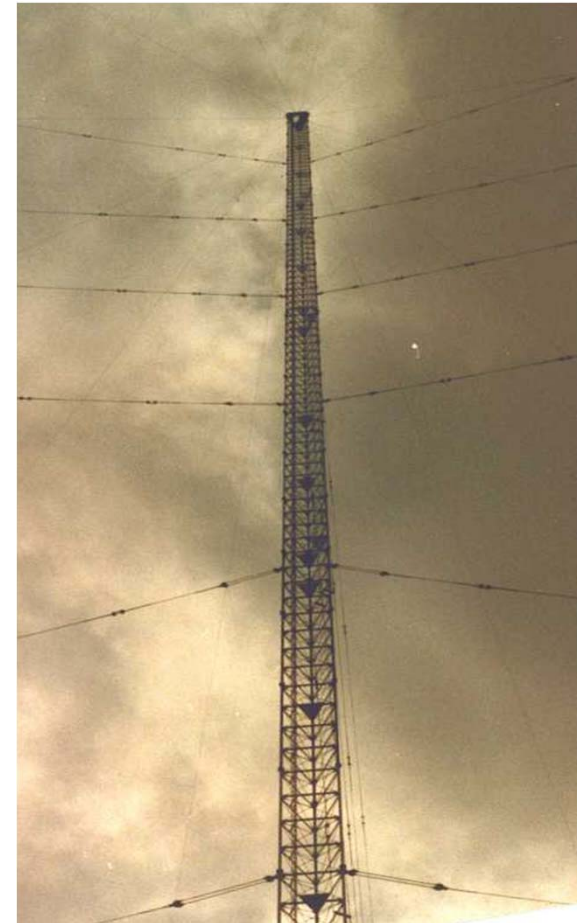


# Current (e)Loran in Europe



9 transmitters on air

- France 2
  - Lessay, Soustons
- UK 1 - Anthorn
- Denmark (Faeroes) 1
  - Eide
- Germany 1 - Sylt
- Norway 4
  - Vaerlandet, Boe
  - Jan Mayen, Berlevåg



NW Europe region: Coordinated by France  
Administered by Control Centre Brest (CCB)

# Receiver Standards

## IMO: NCSR

- Developing Multi-Source Receiver Performance Standard
- Not stipulating what systems to use, but calls for system diversity in terms of frequency, systems and resilience.
- Hope to be completed by March 2015, whereupon final draft will be sent to MSC later in the year

## IEC

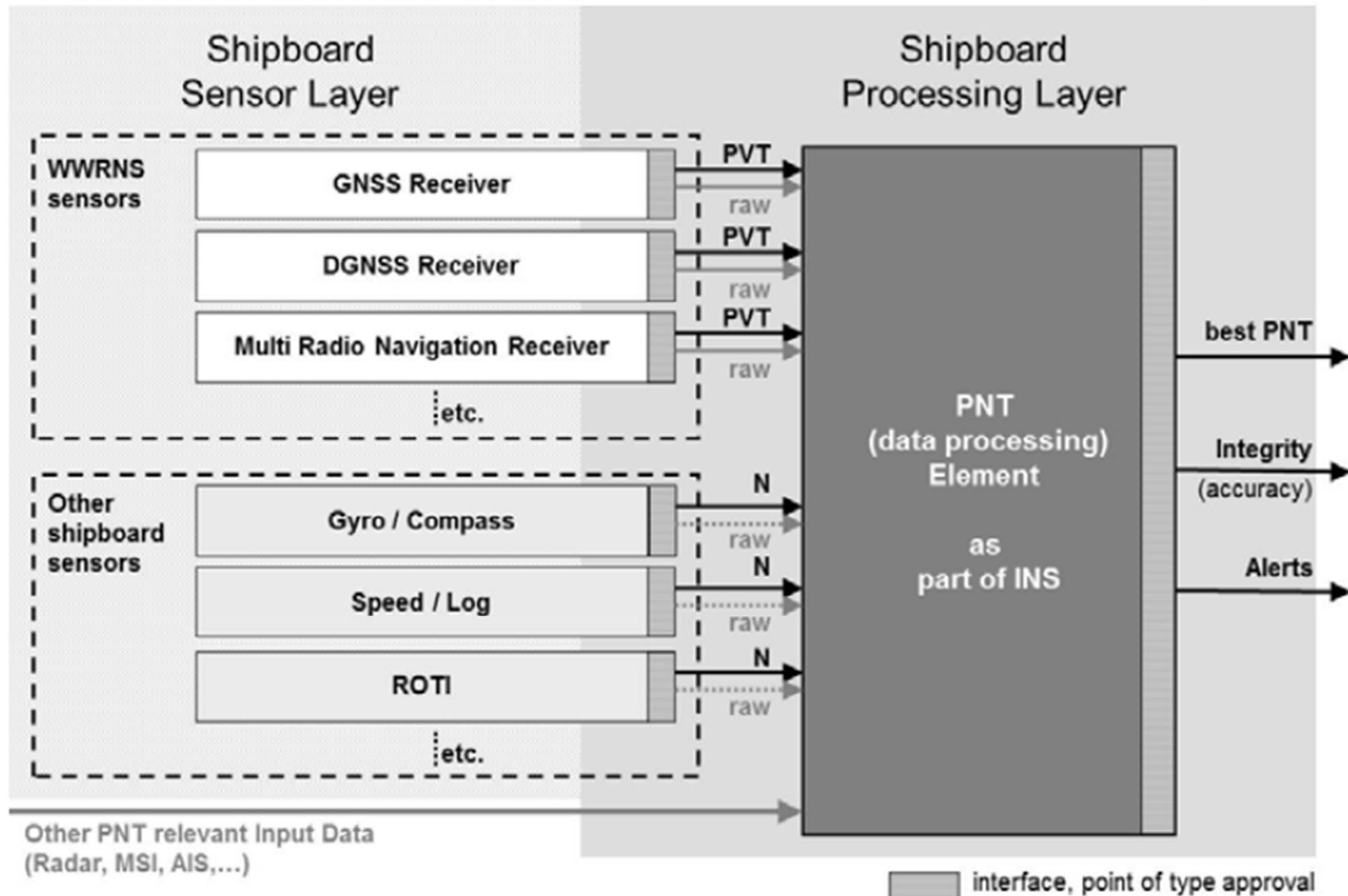
- Receiver test standards
- Generally waits for IMO approval and works to their standards, but can start earlier
- RTCM SC-131 is drafting test specification
- IEC will likely take 2 years to complete specification

## RTCM

- Starting point for technical specifications
- SC-131 – MSRX, SC-127 – eLoran, SC-104 – DGPS (MF R-Mode)

**Likely not going to be mandatory carriage requirements, but ship owners will upgrade as part of their normal equipment replacement schedules.**

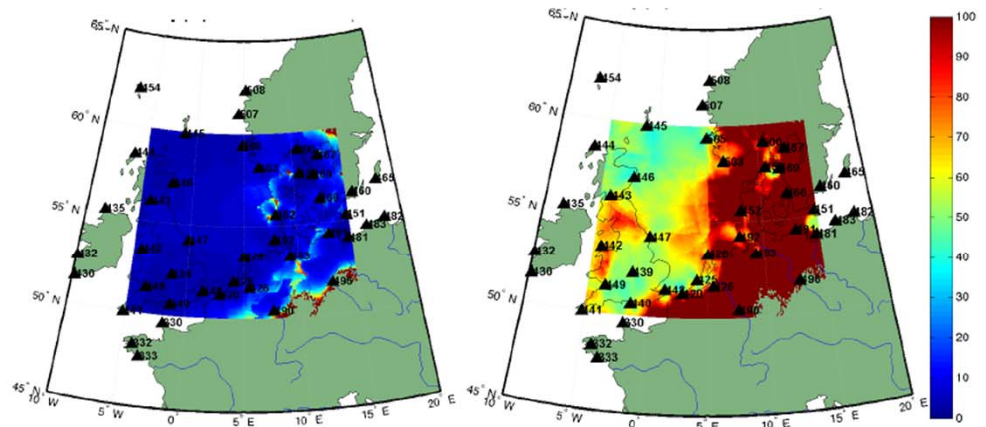
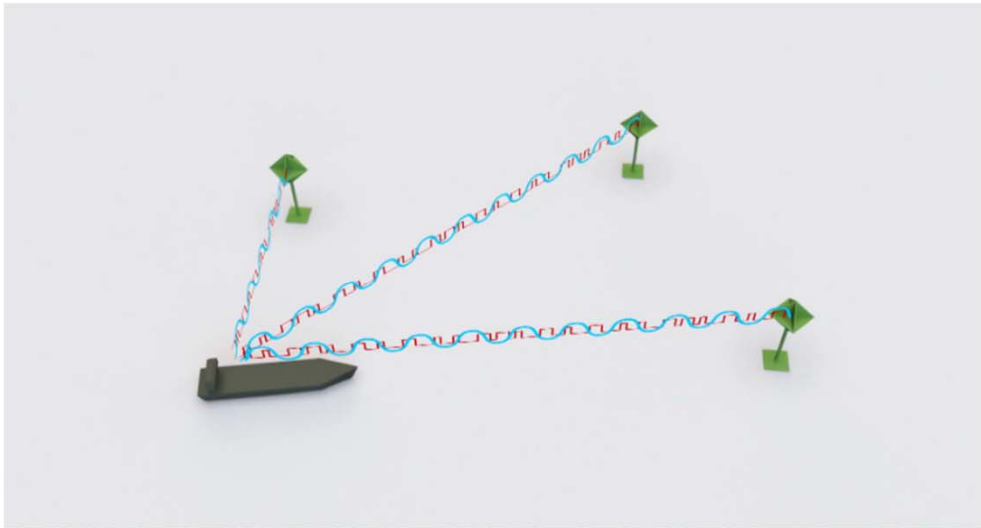
# IMO: Ship-side Resilient PNT





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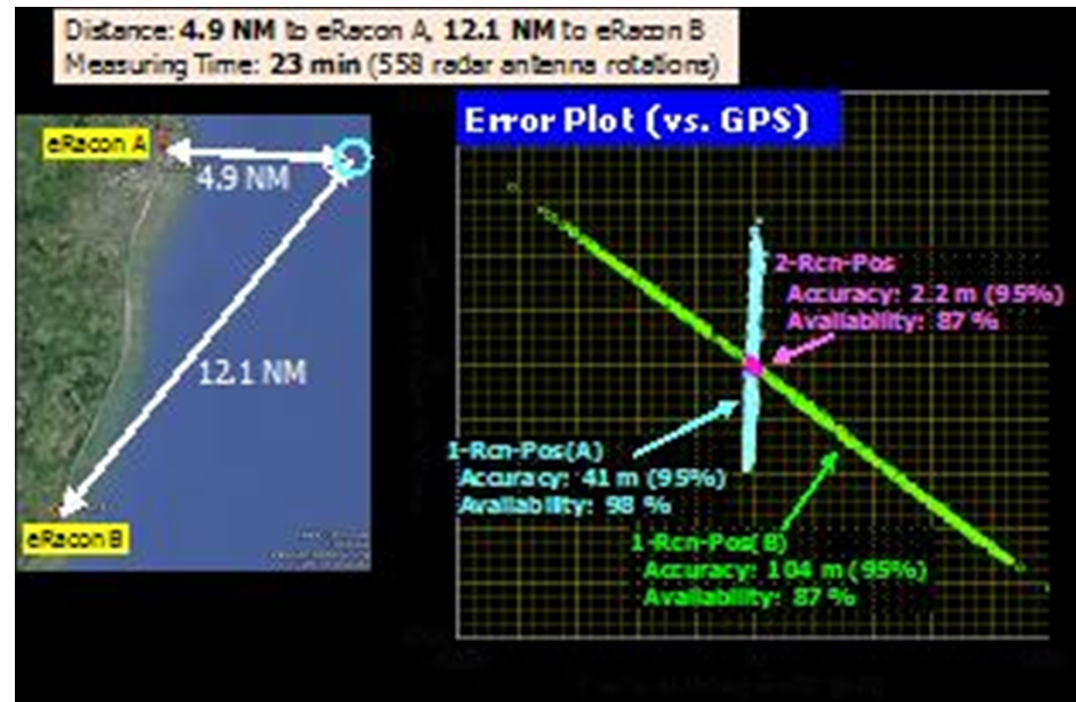
- [illegible]



**Figure 1: Daytime (left) and night time (right) predicted positioning accuracy (m) using a 0-100m scale.**

# RADAR Absolute Positioning: Results of Static Tests

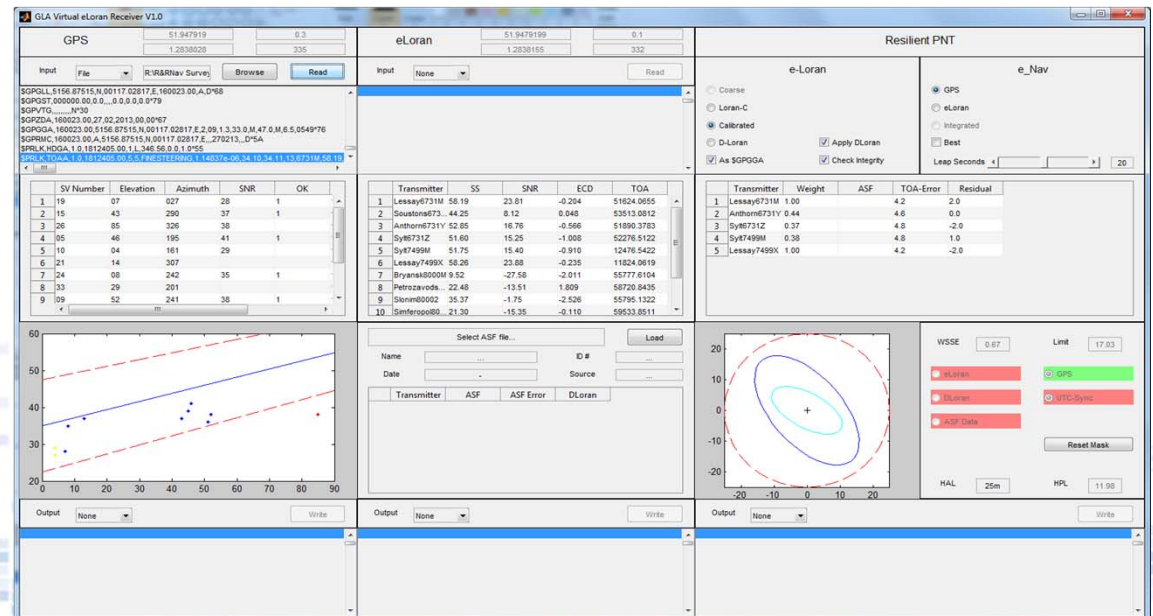
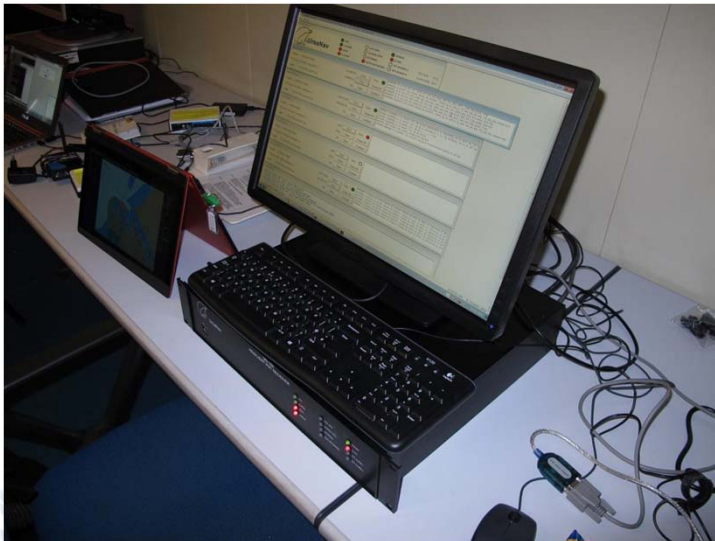
- Derive Latitude and Longitude from one or more RADAR returns
- Single eRacon accuracy 40 m within 5 M, 100 m at 12 M
- With two eRacons, 2 m accuracy achieved
- Availability of single eRacon fix at under 5 M was 98%
- Availability of two-eRacon fix dictated by more distant eRacon at 87%





# Multi-Source Positioning Receiver

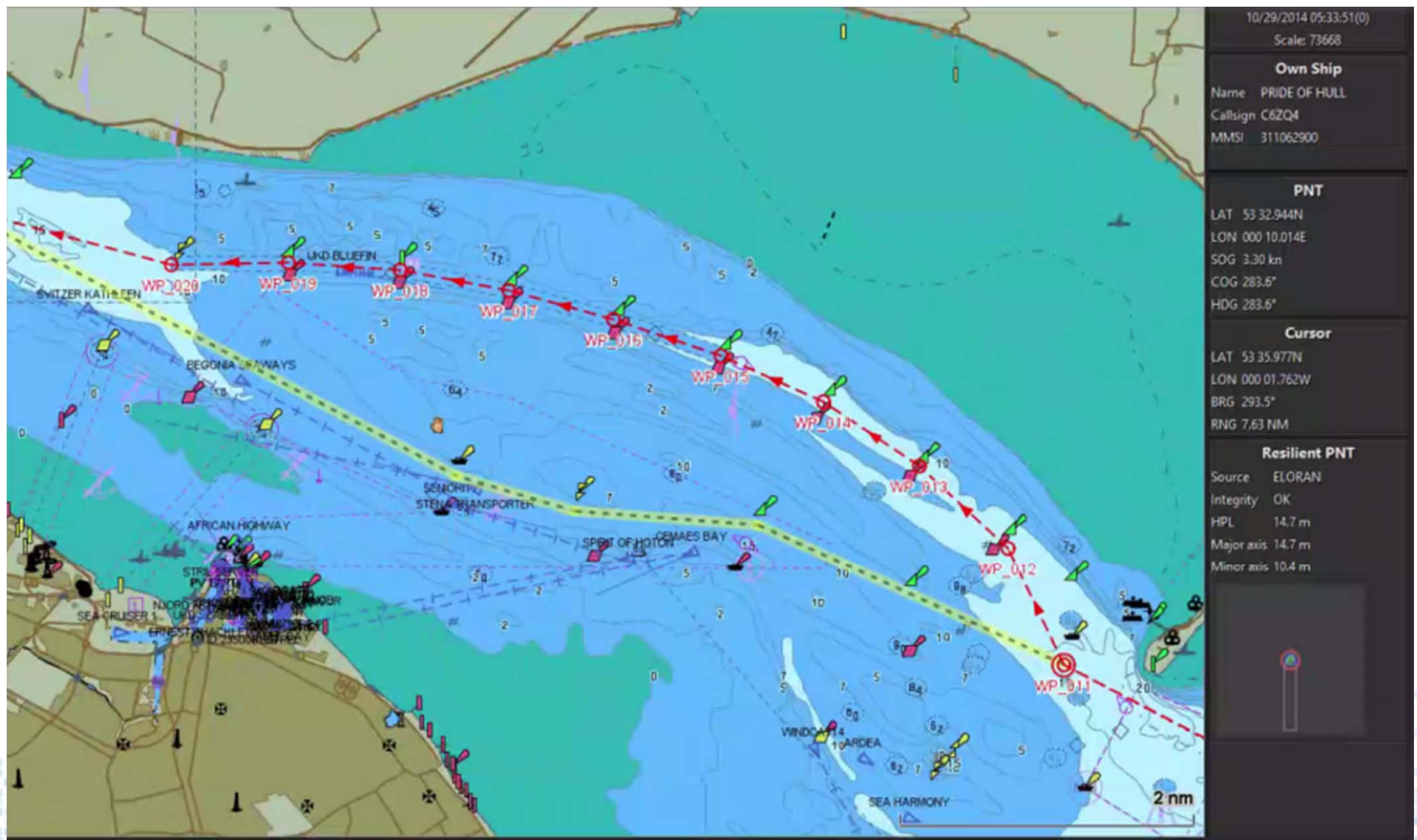
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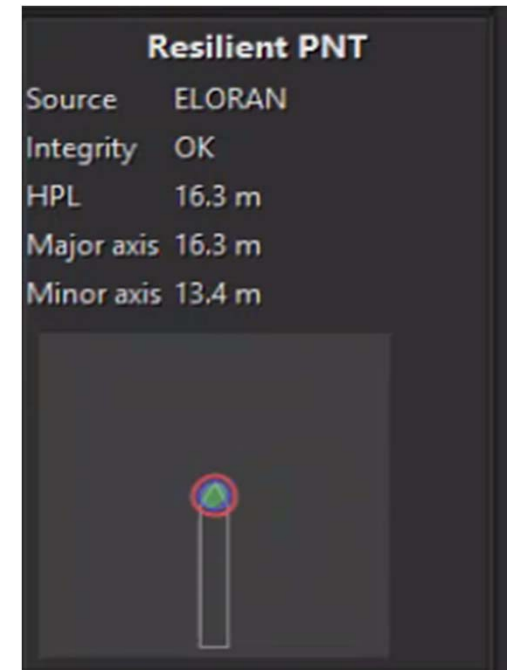
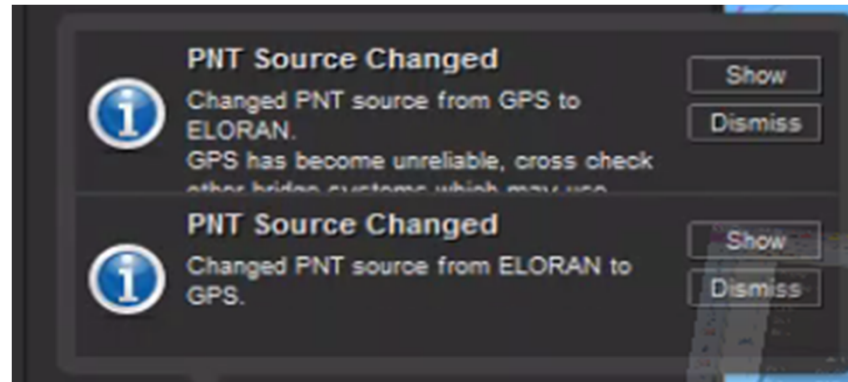
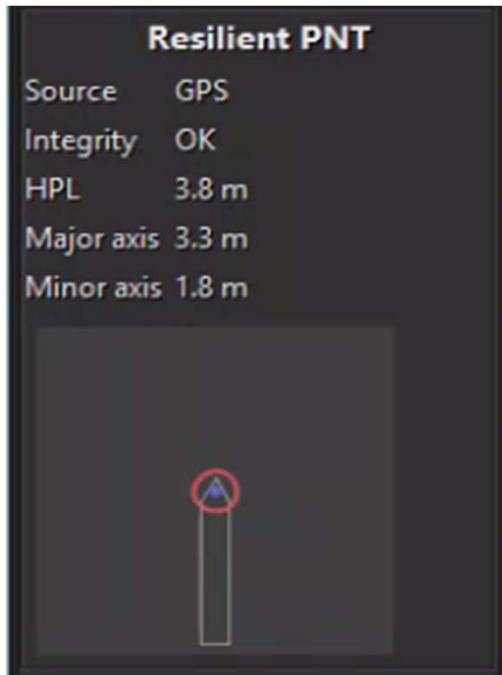


# Resilient PNT Portrayal

- EPD – e-Navigation Prototype Display



# ACCEAS: Resilient PNT Portrayal





# Vessel Installations – P&O Pride of Hull

- Ro-Ro Cargo and Passenger
  - 59,925 Gross Tons
  - Length: 215m
  - Beam: 32m
  - Draft: 6m
- ACCSEAS receiver installed in equipment room for trial
- Video available!

