Prepare Ships

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H2020 Project

THE PREPARE SHIPS PROJECT – ACCURATE POSITIONING FOR INCREASED MARITIME SAFETY

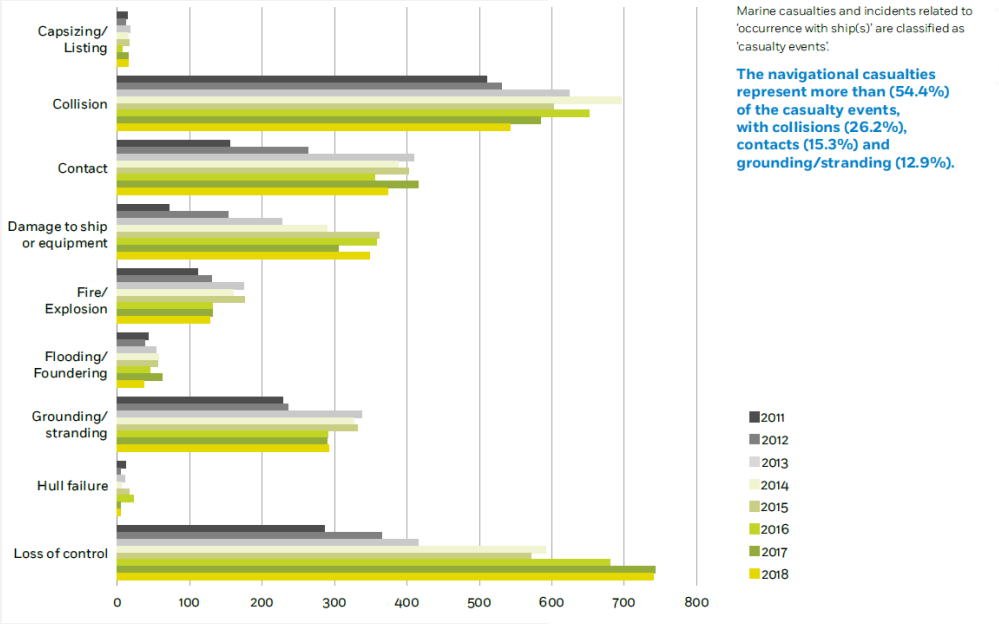
2021-03-23

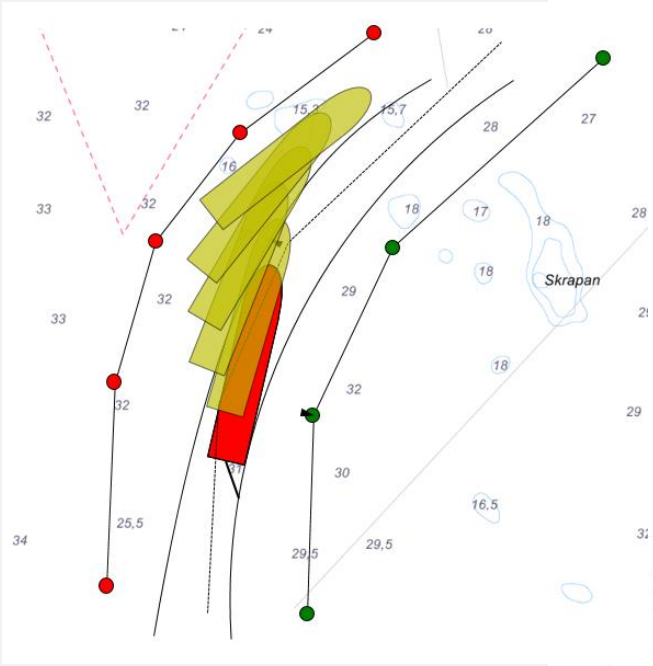
WHY INCREASED POSITION INFORMATION IN SHIPPING?

Navigational casualties represent 54% of the accidents in the EU.

- Limited situational awareness is the single most contributing factor.
- Ships future movements can be predicted with high confidence.
- Information can be exchanged between ships and to/ from shore via VDES solutions increasing situational awareness.
- Environmental impact reduced by the predictor.

Close quarter situations occur as often as 2-3 per 1000 sailing hours





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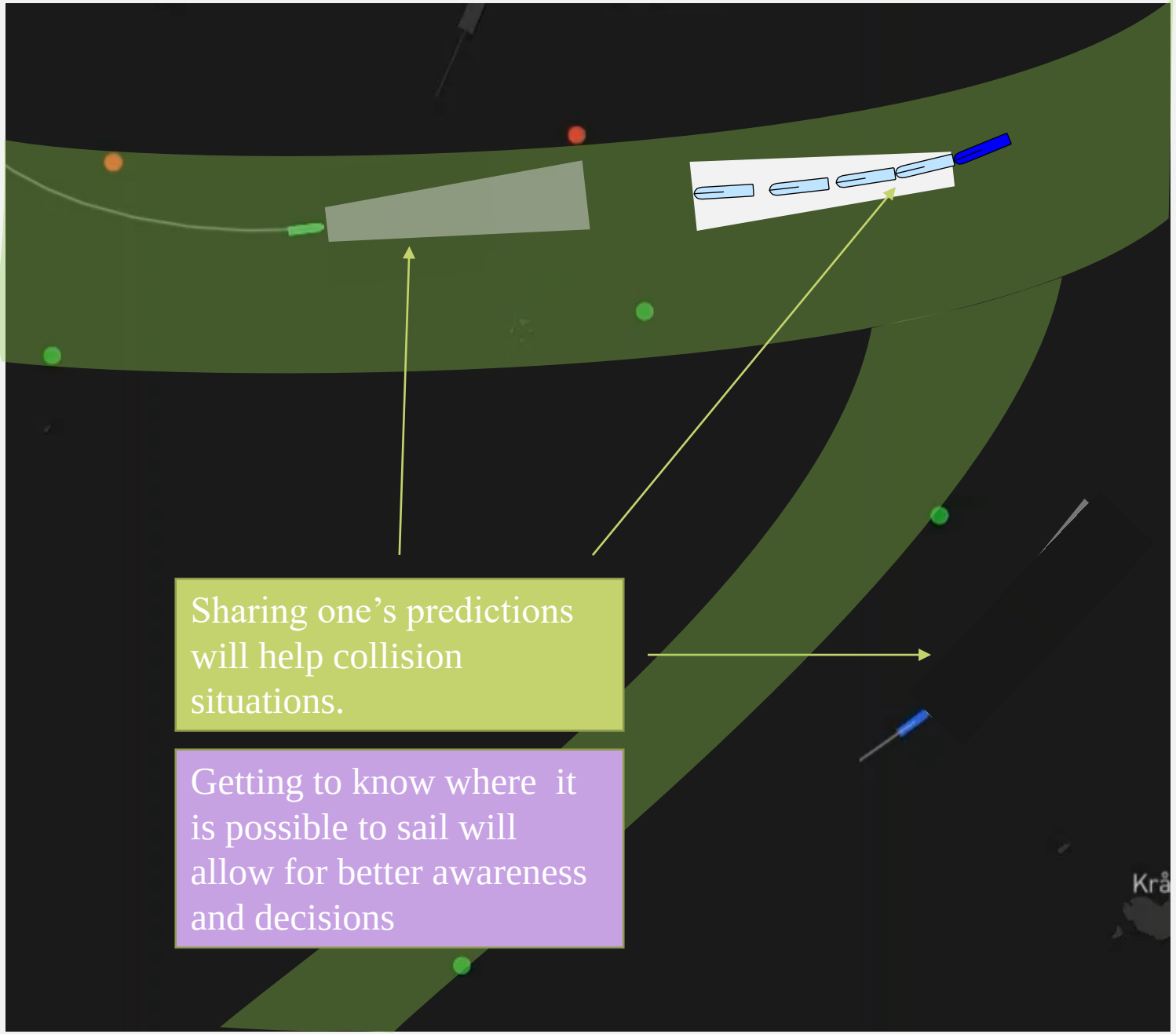

Dynamic Predictor and "Go-Areas"

- Where can I sail with my current draught?
- Where will I be in the near future?
- Where will other vessels be in the near future?
- Where will we meet?
- Which decisions can I make and how do I affect the others?

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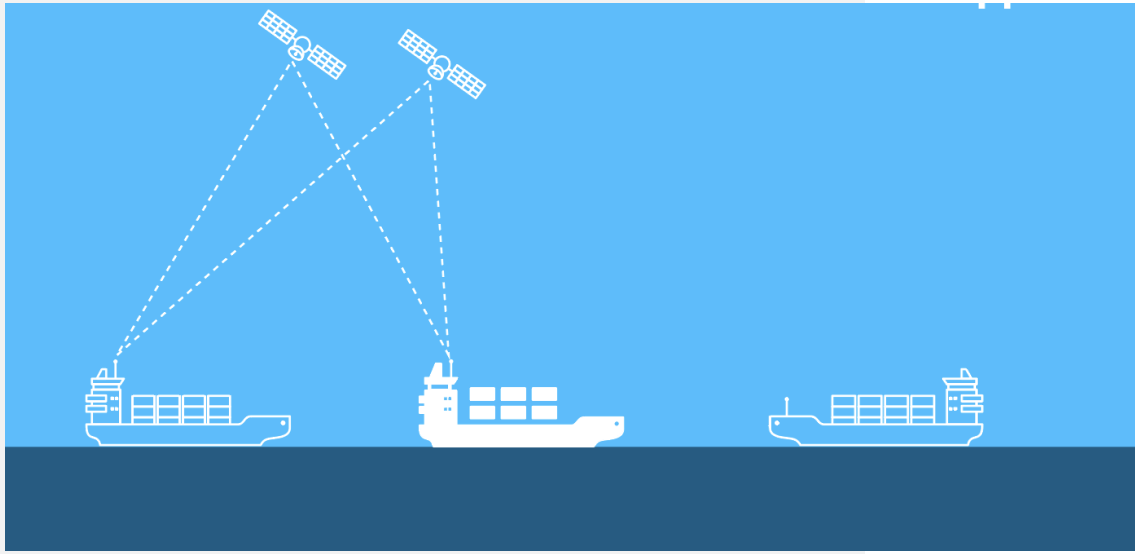
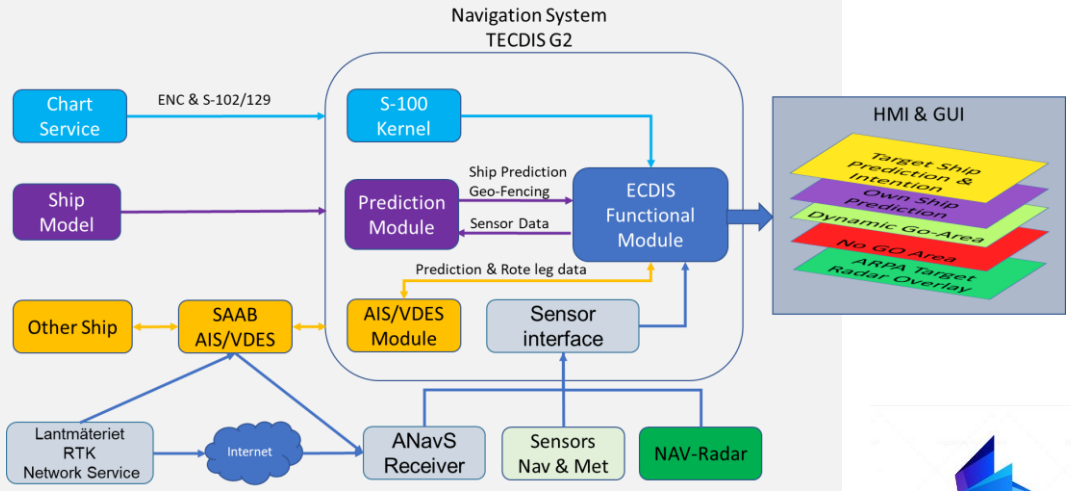
- develops a robust and accurate navigation solution based on the features of Galileo signals in combination with other in-ship sensors.
- reduces the risk for ship collisions,
- provide decision-support in fairway navigation,
- decrease environmental impact and emissions and
- provide a cornerstone for future automated navigation.





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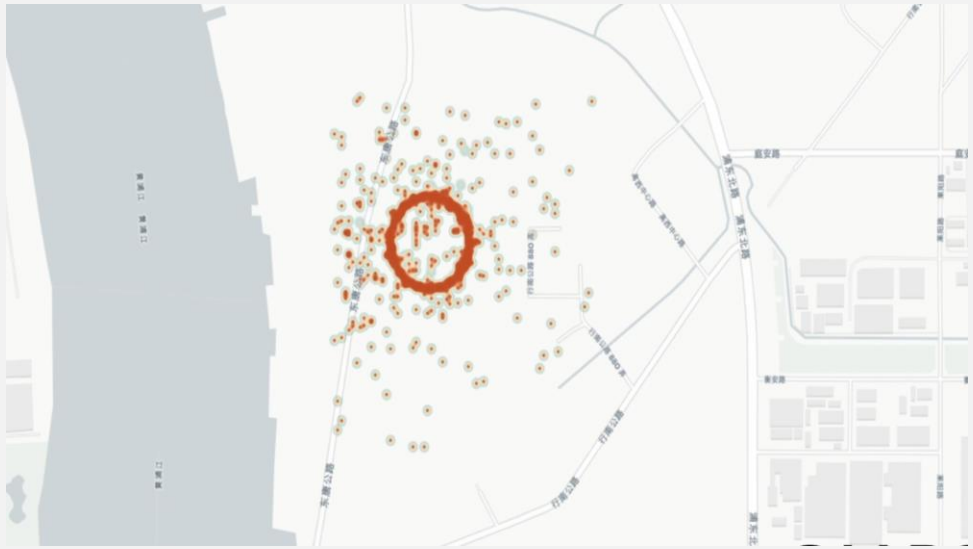
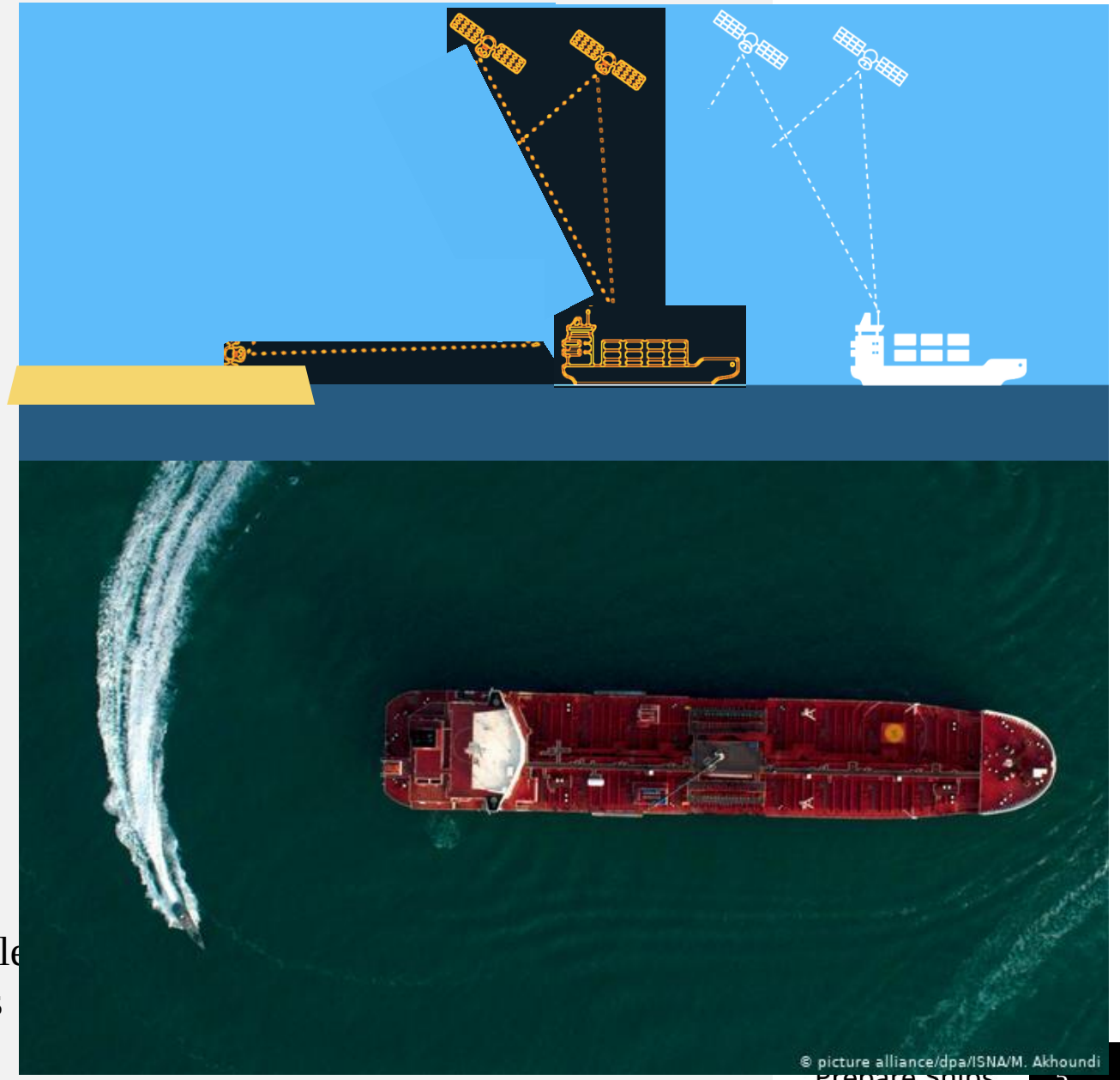
CYBER SECURITY GPS SPOOFING AND JAMMING





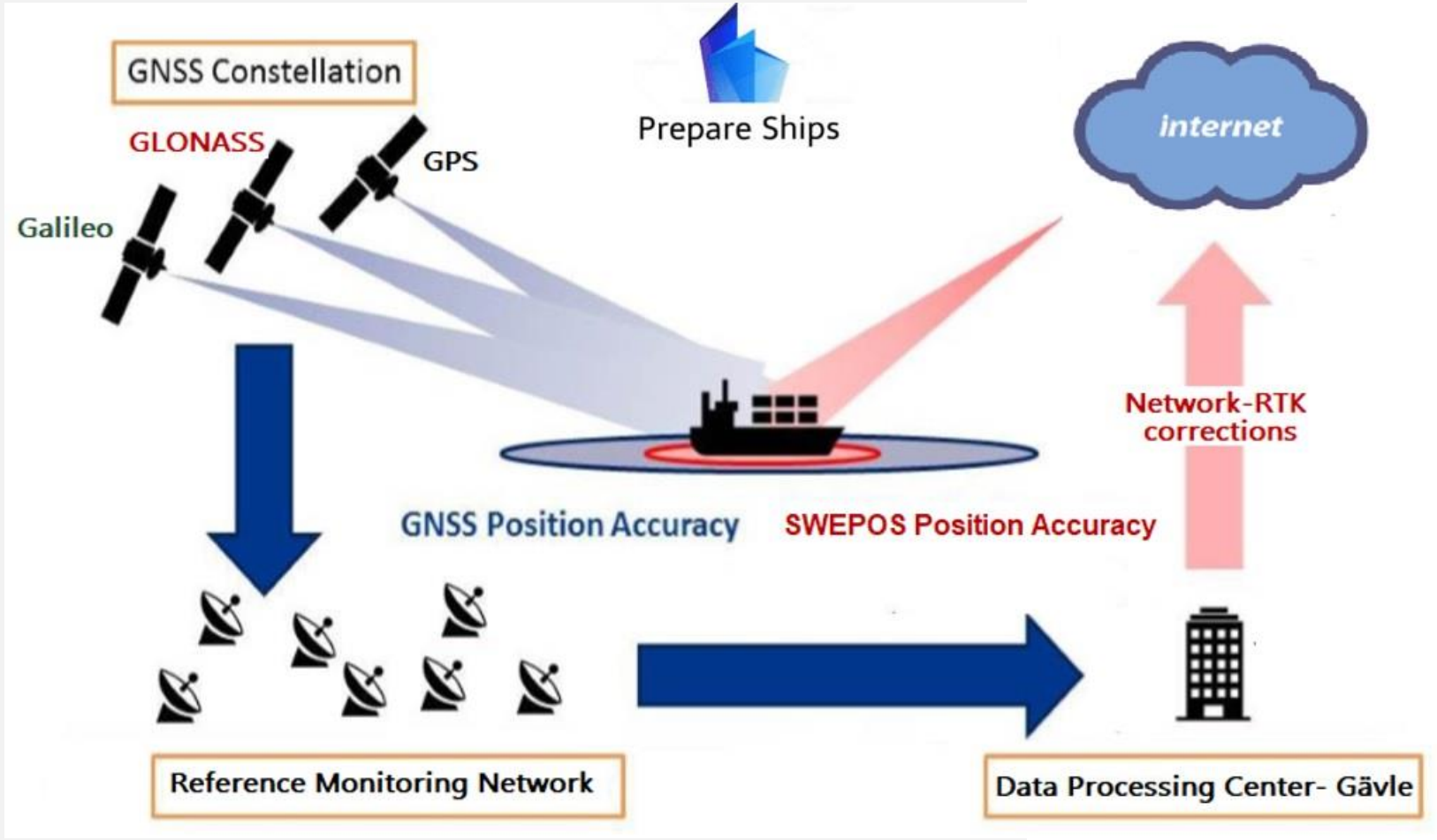
Port of Shanghai: Attack caused the transponders on multiple ships at once to show various erroneous positions that forms odd ring-like patterns “crop circles”

HIGH ACCURACY AND INTEGRITY IN POSITION

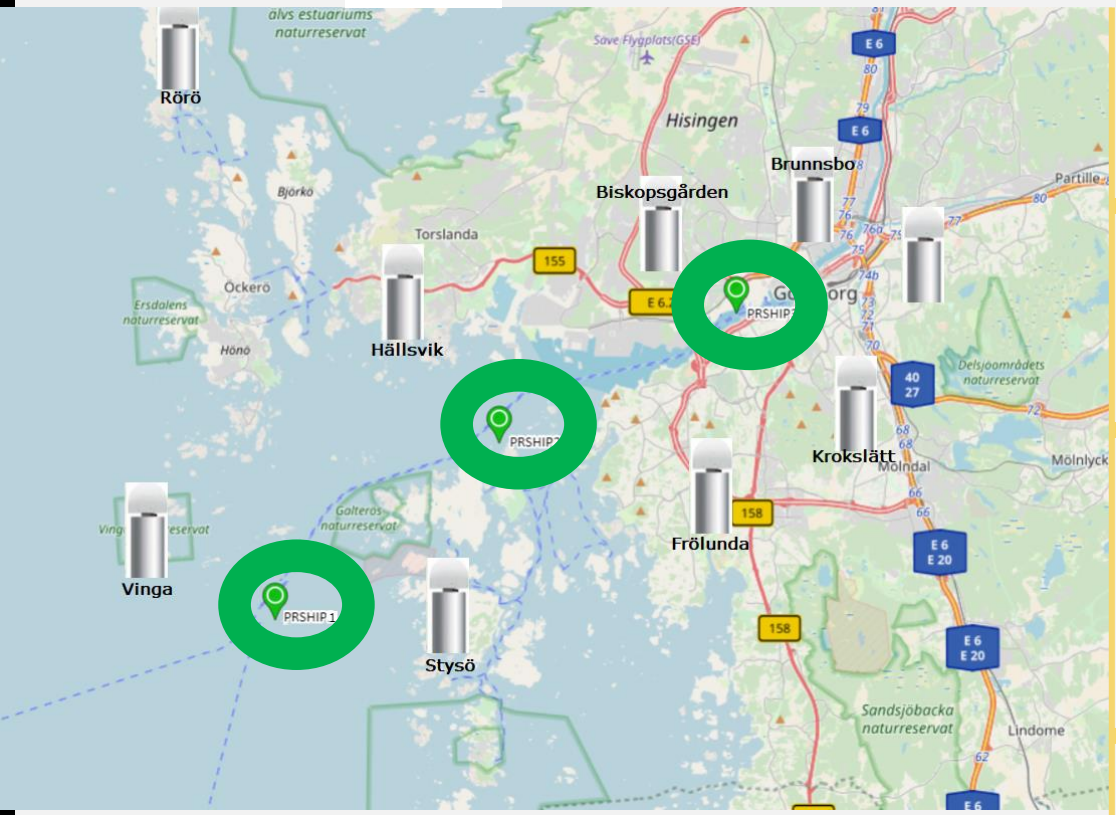
Prepare Ships System will receive position, attitude and velocity data from the ANAVS GNSS receiver using the Galileo Open Service.

The ANAVS receiver use

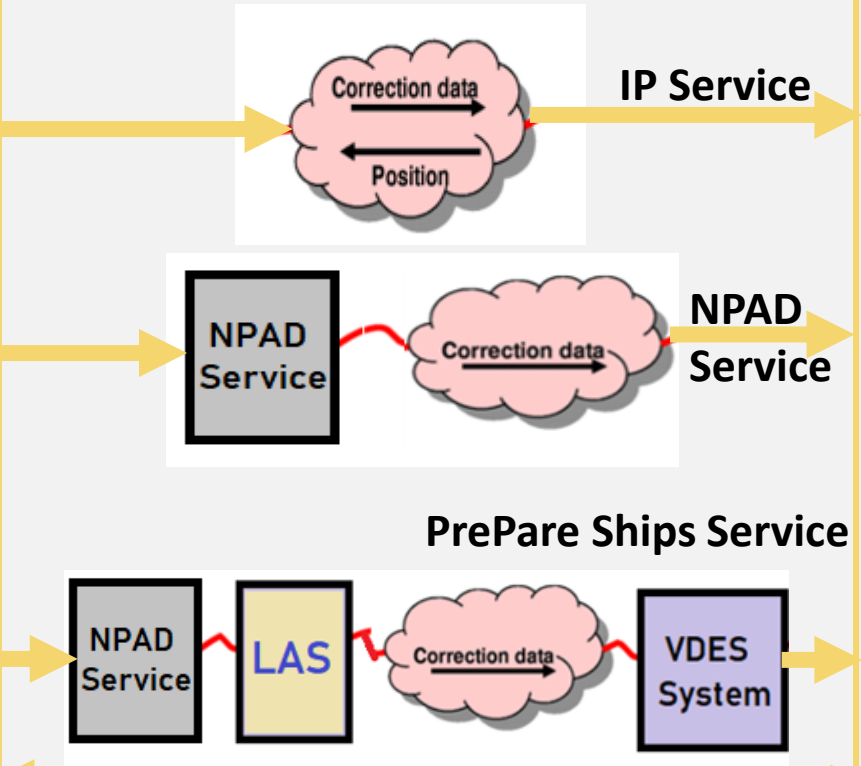
- the signals from Galileo satellites
- the carrier-phase positioning corrections from Network-RTK supported from Lantmäteriet (SWEPOS)
- information about the integrity of the RTK corrections
- ANAVS provides a reliable positioning service using sensor fusion.



STATUS AND RESULTS RTK CORRECTIONS



- Establishing the reference stations in the test area.
- Test the reference stations.
- Implementation the VRS's



Distribution the N-RTK correction data
Deliverable D2.2

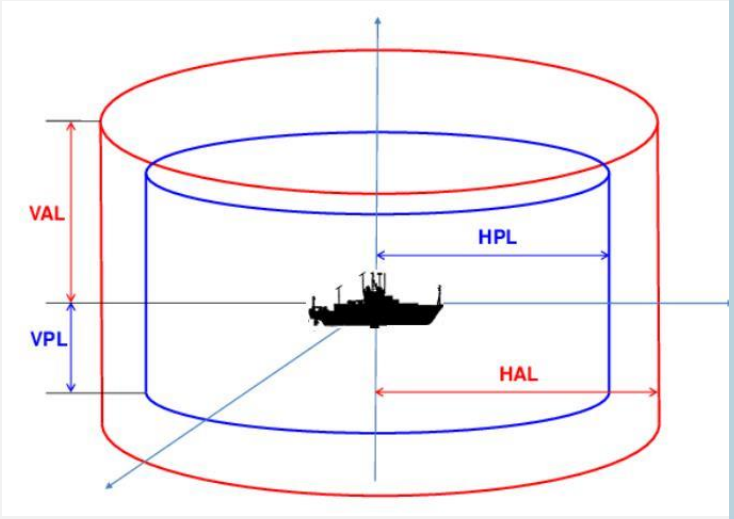
EGNSS Rx

Ongoing work:

-Providing integrity data.
-Plan for testing HAS.

SWEPOS integrity data Level 2

(VRS Computation integrity)



PRELIMINARY RESULTS GNSS RECEIVERS

Typical accuracy achieved with RTK corrections: 4-5 cm

4G not a reliable transmission link for RTK corrections → outages degraded accuracy to 20-80 cm

PPP positioning accuracy will be:
30 cm Horizontal

60 cm Vertical

The RTK accuracy is by factor of 10 better than the PPP accuracy as the HAS PPP corrections for the orbits and clocks are specified with an accuracy of only 20 cm.

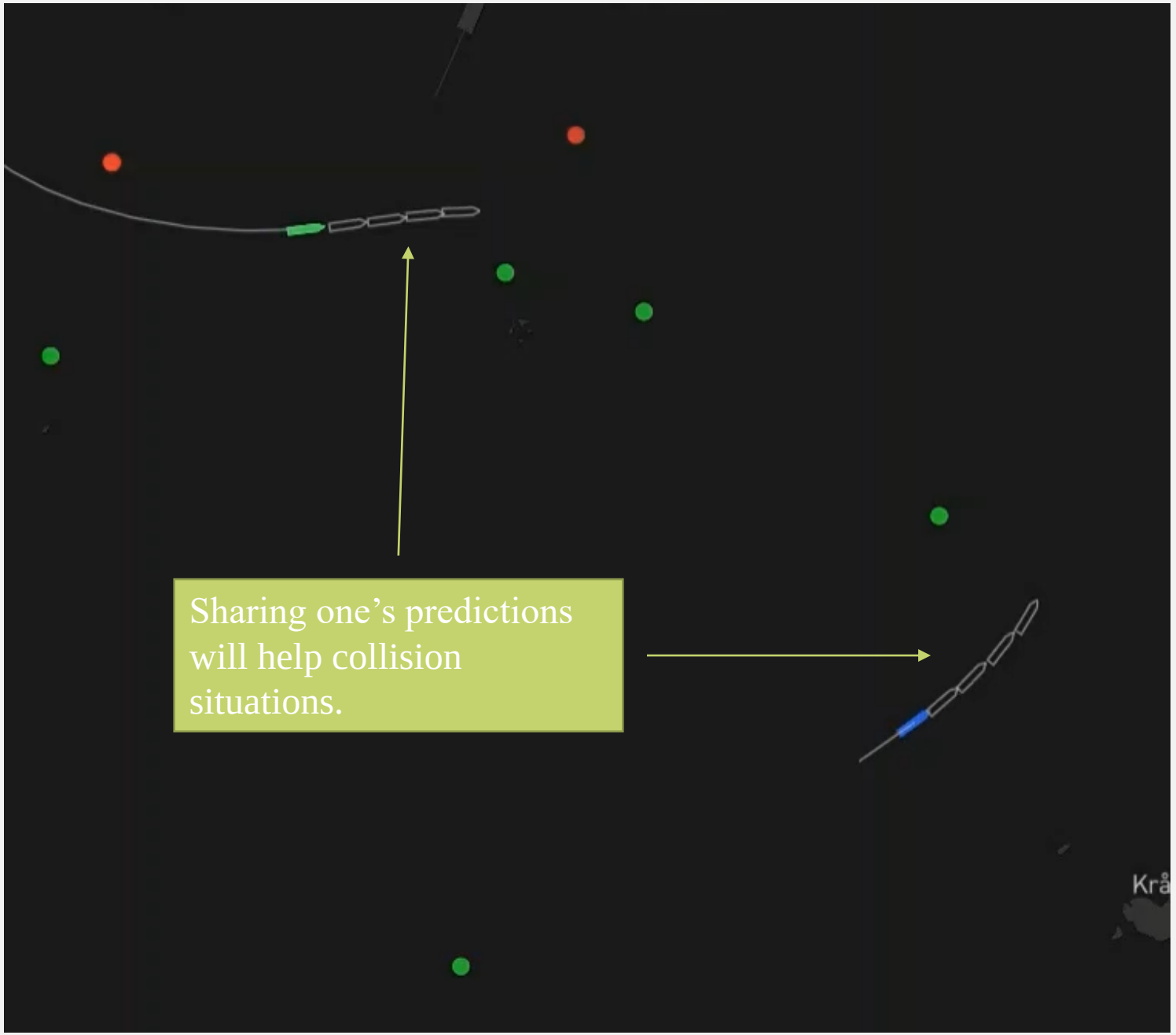
Attitude accuracy:

Heading: 0.5°/ baseline length

Pitch/ roll angle: 1.0°/ baseline length

Dynamic Predictor

Where will a vessel be in the near future?



1. RESULTS OF THE PPP ALGORITHM AND THE PPP TO RTK COMPARISON

1.3. Statistical analysis of the PPP-to-RTK offset

Position offset	6 s < t < 20 min			t ≥ 20 min		
	Max (abs.)	Mean (abs.)	Mean (bias)	Max (abs.)	Mean (abs.)	Mean (bias)
North	1.850 m	0.246 m	-0.048 m	0.501 m	0.120 m	-0.060 m
East	1.161 m	0.243 m	-0.008 m	0.237 m	0.048 m	-0.040 m
Vertical	3.755 m	0.606 m	+0.501 m	0.512 m	0.137 m	+0.099 m
Horizontal (2D-RMS)	1.936 m	0.381 m	x	0.501 m	0.137 m	x
Position (3D-RMS)	3.789 m	0.764 m	x	0.627 m	0.224 m	x

- Bias consistency to a few cm
- Longer convergence time for the vertical offset
- After convergence (20 min): mean absolute consistency 14 cm horizontally, 22 cm 3D-RMS

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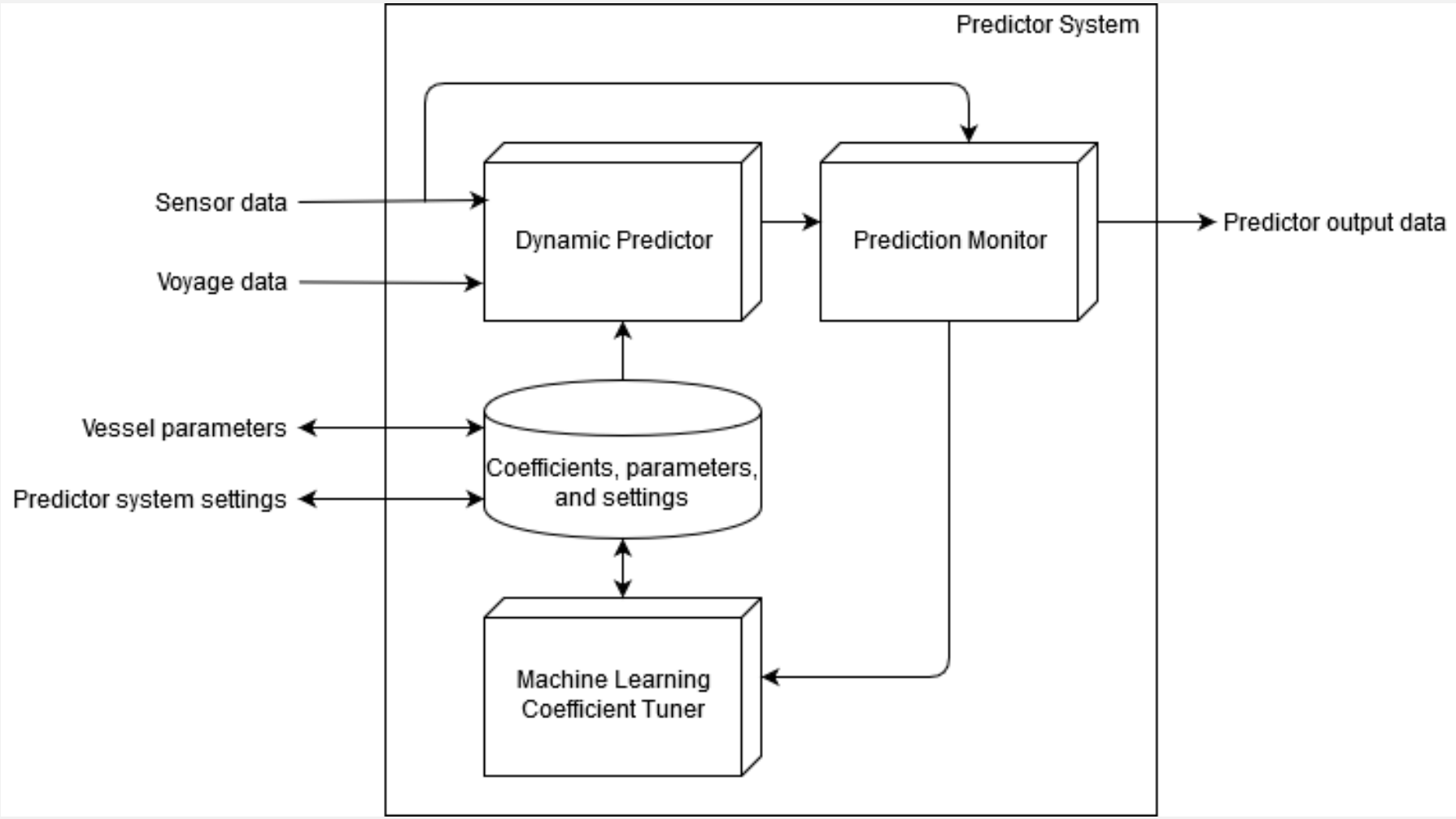
Prediction System



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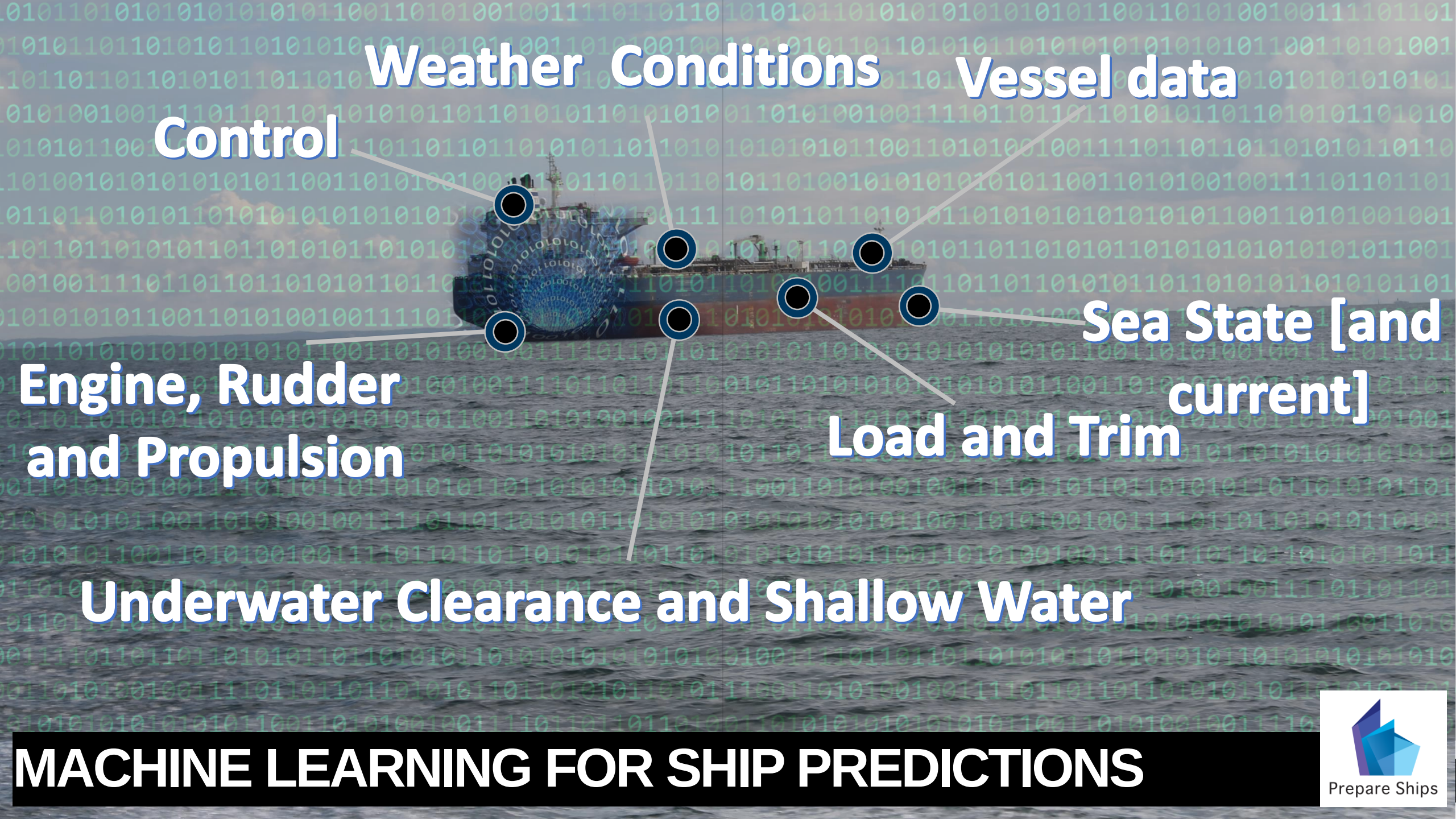

MACHINE LEARNING FOR SHIP PREDICTIONS

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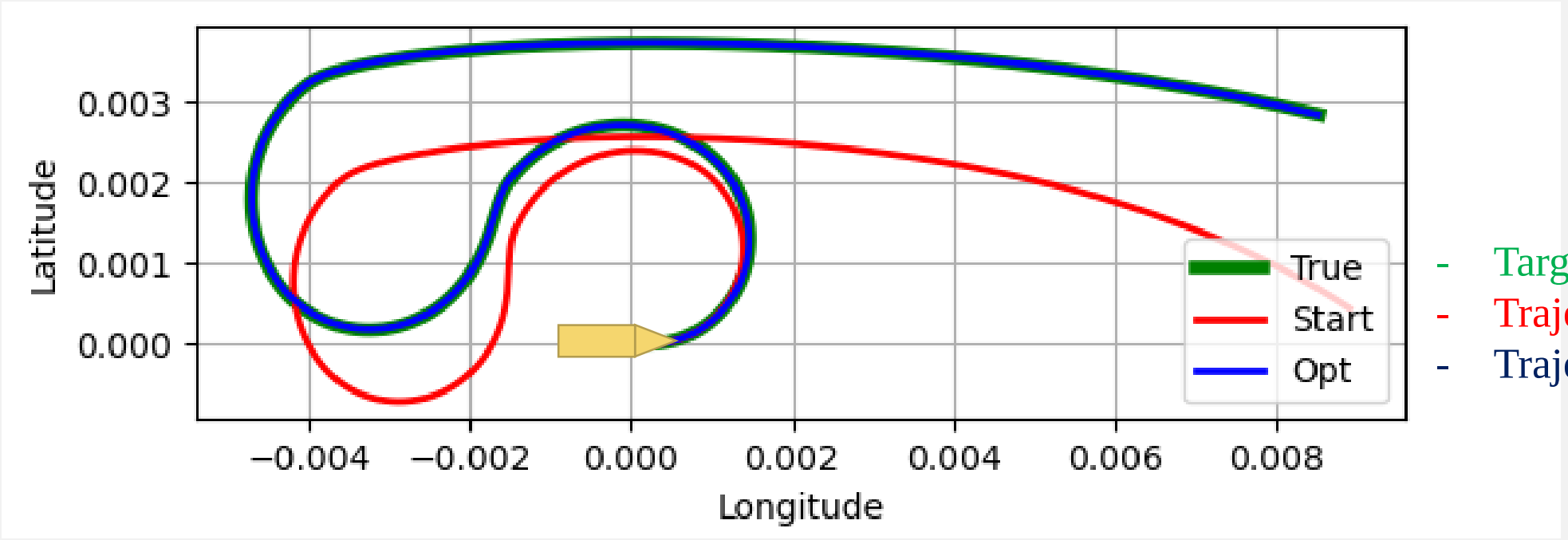
DYNAMIC PREDICTOR: COEFFICIENT TUNING



- Target trajectory
- Trajectory BEFORE tuning
- Trajectory AFTER tuning

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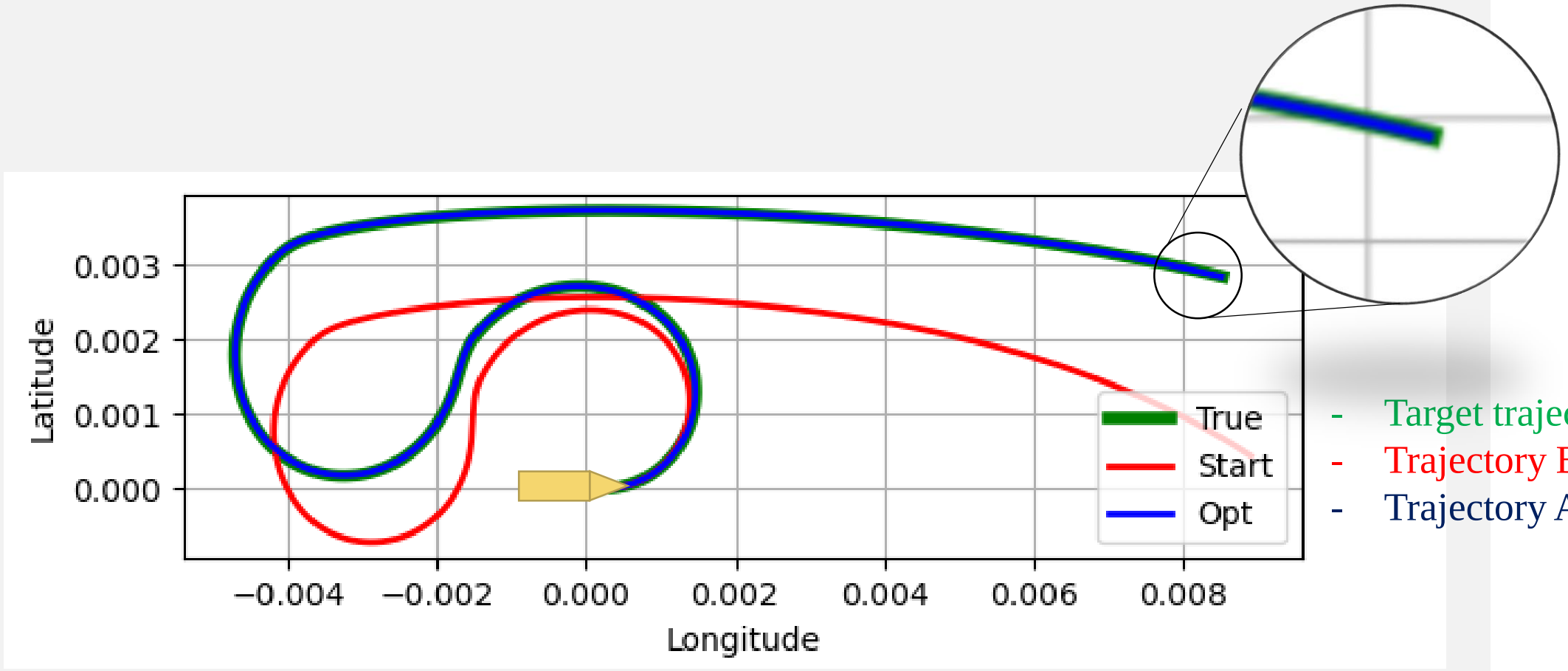
DYNAMIC PREDICTOR: COEFFICIENT TUNING



- Target trajectory
- Trajectory BEFORE tuning
- Trajectory AFTER tuning

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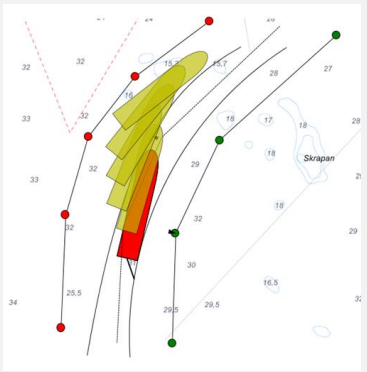
PRELIMINARY RESULTS VDES COMMUNICATION

- 4G and future 5G not as reliable as required
- VDES is next generation AIS
- Prototypes for shipborne and shore trials by june 2021
- Dynamic Predictor and Network RTK payloads will be sent over high speed terrestrial VDES (VDES.VDE Link ID 19)
- VDES gives high integrity and reliability of signals for advanced applications and is not affected by high sea, harsh weather conditions or multipath in harbours.

Shipborne VDES unit

Base Staion VDES unit



Shipborne Predictor over VDES.VDE

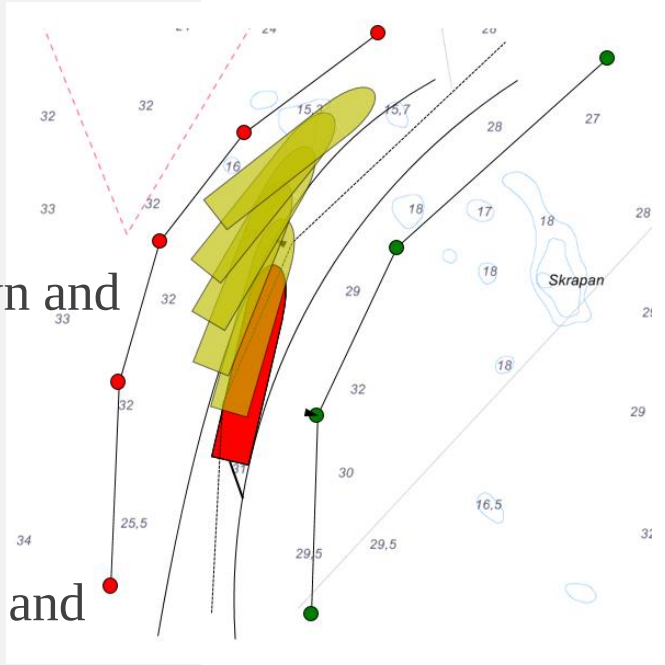
Vessels for shipborne trials of R6 VDES Supreme from may 2021 to mar 2022 and including testing applications of STM, shipborne predictor and network RTK corrections (via R60 and R6 equipped with VDES.VDE)

THE PREPARE SHIP PROJECT

PREPARE SHIPS provides smart positioning solution by developing and demonstrating a data fusion of different sensor and signal sources to enable a robust navigation application.

Cornerstones are:

- accurate and high-integrity positioning based on EGNSS,
- data and machine-learning should be able to predict and future positions of the own and nearby vessels
- make use of state-of-the-art GNSS receiver including PPP for PNT,
- “go-areas” based on the S100 chart information in the next generation ECDIS
- Noval use of VRS (Virtual Reference Station) technique from SWEPOS (NRTK), and
- VDES, the next generation AIS, to communicate RTK correction and ship to ship exchange of the predictor.
- Internal (e.g. ship system) and external (e.g. Copernicus) data sources



THANKS!

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“This project has received funding from the European GNSS Agency under the European Union’s Horizon 2020 research and innovation programme under grant agreement No 870239.”