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## MARITIME AI-NAV

Innovasjonskonferansen e-nav.no 2019

What is it all about?

*ARTIFICIAL INTELLIGENCE / MACHINE LEARNING SENSOR FUSION  
FOR AUTONOMOUS VESSEL NAVIGATION (MARITIME AI-NAV)*



Funded by



# *Topics*

Status and background

ESA project needs

Our Consortium

Project setup

Goals



Rolls-Royce testing remote operations

*General status of autonomous ship projects, achievements and activities*

# *WHERE ARE WE TODAY*

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# *Notable projects*

Research and players are currently quite concentrated to **North Europe and US**

Korea, Japan, China and Singapore also show activity

Remote control is already well demonstrated

A lot of work has been done in smaller **ASVs** (Autonomous Surface Vehicles) for military use



**MUNIN**  
(N. Europe)

**AAWA**  
(Rolls-Royce et al)

**One Sea**  
(DIMECC)

**Yara Birkeland**  
(Kongsberg, Yara)

**SIMAROS**  
(UK, NO)

**NYK**  
(et al in JP)

**UCSDA**  
(China)

**Svitzer, Svan**  
(RC ops)

**L3 ASV**  
**Sea Machines**





Test area

Yara Birkeland

AAWA + One Sea

Denmark

Test area

UK + LR

NL+BE test areas

Japan

Sea Machines

China

Singapore



*Maritime Unmanned Navigation  
through Intelligence in Networks*

MUNIN was essentially a feasibility study and test-bed development for an **Unmanned Cargo vessel**.

The project looked at technical, economical and legal feasibility.



<http://www.unmanned-ship.org>



MUNIN Vision © Fraunhofer CML



# AAWA *Advanced Autonomous Waterborne Applications Initiative*



The AAWA initiative looked at technology, safety, incentives (economics) and legal of autonomous vessels in general.



## Advanced Autonomous Waterborne Applications (AAWA) partners

### Company

Rolls-Royce  
Deltamarin  
Inmarsat  
DNV GL  
NAPA

### Input

System Integration and Automation Control  
Ship Design  
Satellite Communications Technology  
Classification and regulatory guidelines  
Software house providing solutions for ship design and operation



### Universities

Aalto / VTT (Technical Research Centre of Finland)  
Tampere University of Technology / University of Turku  
University of Turku  
Åbo Akademi / University of Turku

### Input

Safety and Security  
Technology Research  
Business Aspects  
Legal Aspects



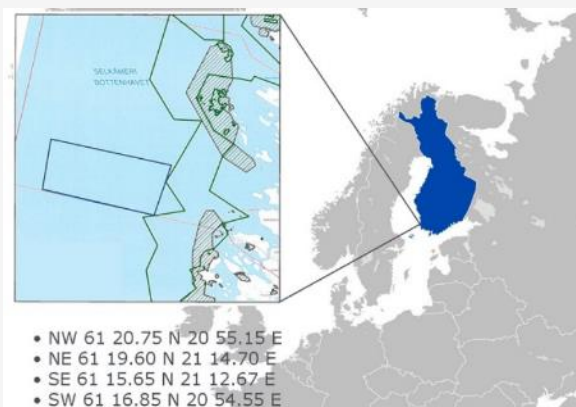
[Project whitepaper](#)



# One Sea

## Autonomous Maritime Ecosystem

One Sea is a Finnish Ecosystem (project), which aims at providing a solid ground for research, testing and collaboration reg. autonomous ships.



One Sea features an open test area "Jaakonmeri"

Similar test areas are found also in Norway and China

## DIMECC One Sea

### Timeline for autonomous ships

2017	2020	2023	2025
Remote monitoring	Fully remote controlled vessel (manned) – unmanned with special approval	Gradual increase of autonomous control	Autonomous ship traffic commercial
Test areas	National pilots	Several pilots globally	Full scale testing / validation
		Domestic authority approval / certificate	Class/IMO reg. in place
International collaboration	Design requirements for autonomous power and propulsion systems Autonomous automobile commercial	Developed data transfer tech eg. 5G (limited to ferries/ports) Satellite becomes cheaper Mobility as a service "Industry standards in place"	Strongly decreased data communication Infrastructure
Ethical issues			
Development of cyber security			
Projects, IPR, competences, education			
National, IMO and global legislation development			

ABB

ERICSSON

COMBITEC

Rolls-Royce

tieto

WARTSILA

FINNPOST

PortNet

BUSINESS FINLAND

Suomen Satumatkailu

Ships & Maritime

SHIPBROKERS FINLAND

DIMECC

<https://www.oneseaecosystem.net/>

# *Yara Birkeland*

*First ever electric and autonomous*



[Project facts](#)

# SIMAROS

*Safe Implementation of Autonomous  
and Remote Operation of Ships*

The SIMAROS project is one of several Norwegian undertakings. SIMAROS looked mainly at safety aspects.

Other notable Norwegian projects are:

AUTOSEA (Sensor fusion and collision avoidance for autonomous surface vehicles)

ROMAS (Remote Operation of Machinery and Automation Systems )

The Norwegian research is quite focused around **NTNU AMOS** (Centre for autonomous marine operations and systems), **Kongsberg** and **DNVGL**

## The SIMAROS project

### ■ SIMAROS: Safe Implementation of Autonomous and Remote Operation of Ships

- NFR application granted Dec 2016
- Research project 2017-2019
- Total Budget: 18MNOK
- Case: "Hrönn" offshore vessel
- Contracted 2017, in operation 2018
- Press release 01.11.2016

### ■ Partners:



### ■ Reference partner:

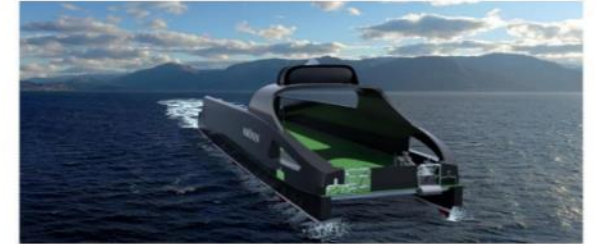


### Press Release



Automated Ships Ltd and KONGSBERG to build first unmanned and fully-automated vessel for offshore operations

- First full size unmanned ship to be built through UK and Norwegian co-operation
- Offshore vessel 'Hrönn', to be contracted January 2017 and in operation in 2018



Artist's impression of the 'Hrönn'

# NYK

## *Demonstration Project to Remotely Operate a Ship*

NYK, together with its research-arm MTI (and other Japanese companies) has announced plans to demonstrate **remote operations of a container ship** in Pacific trade.





*UCSDA*

This Chinese project is lead by the Chinese Classification Society CCS.



# *L3 ASV and Sea Machines*

In smaller work-boats and ASVs we have seen much more development and products are already in the market.

ASVs have been around for military use already a long time.

Smaller boats in restricted waters benefit from easier local rules, controlled traffic area and **easier connectivity**. And smaller boats cause less damage if they hit something 😊

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Remote DP



Finferries



Svitzer

# *Known tests*

Wärtsilä  
Rolls-Royce

*ESA project needs*

?

# *WHY THIS PROJECT*

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# *Challenges*

Autonomous  
tech is one of the  
solutions



Workforce



Transport volumes



Environment

# *Research and development efforts*



Business concepts  
(MUNIN, AAWA)



Legal  
(MUNIN, AAWA, IMO MASS etc)



Situational awareness  
(AUTOSEA etc)



This requires publicly  
funded research

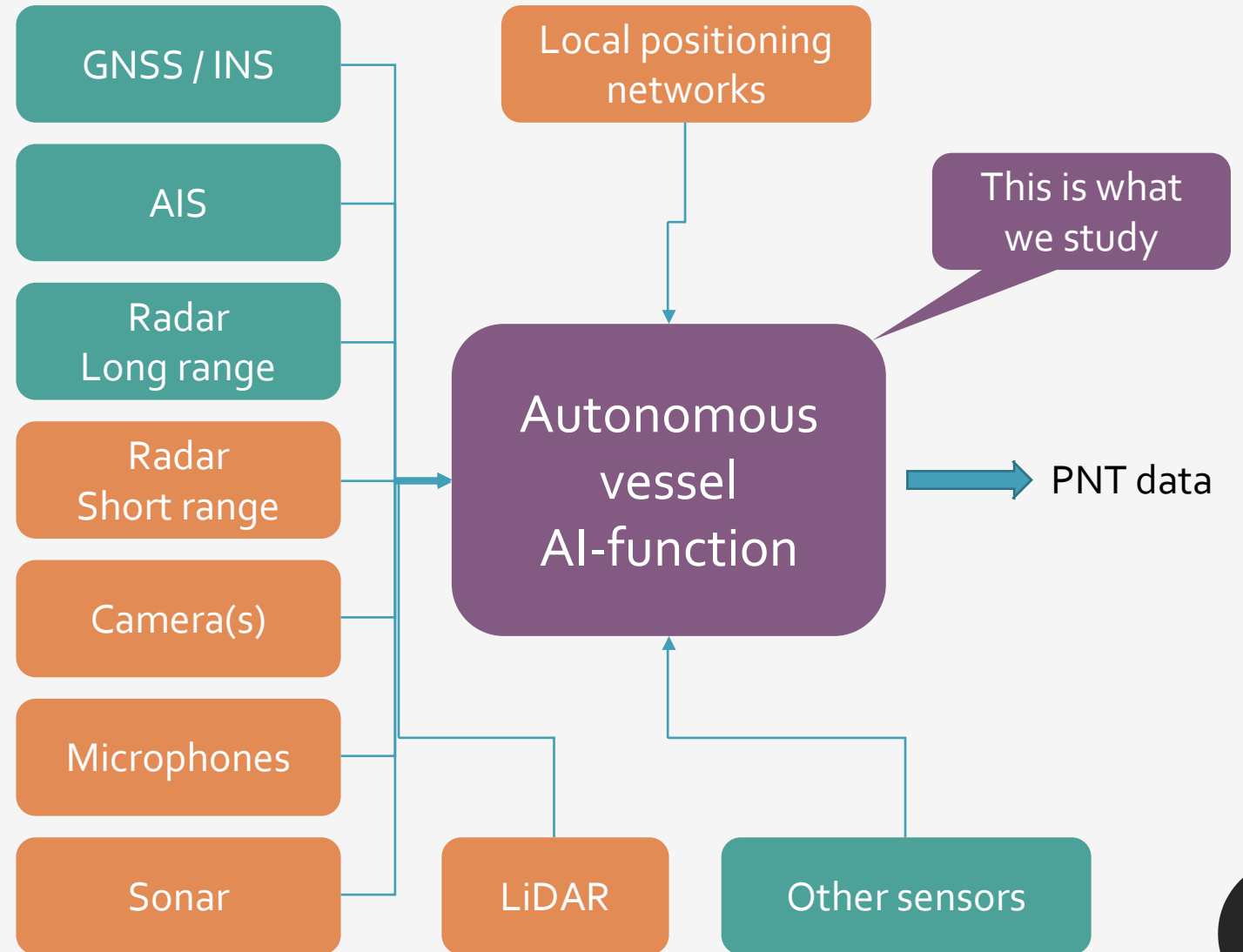


GNSS sensor fusion, AI+ML,  
Galileo



# *ESA needs*

Data from multiple sensors needs to be fused using AI and ML techniques



*FGI, Aalto Al ja Fleetrage*

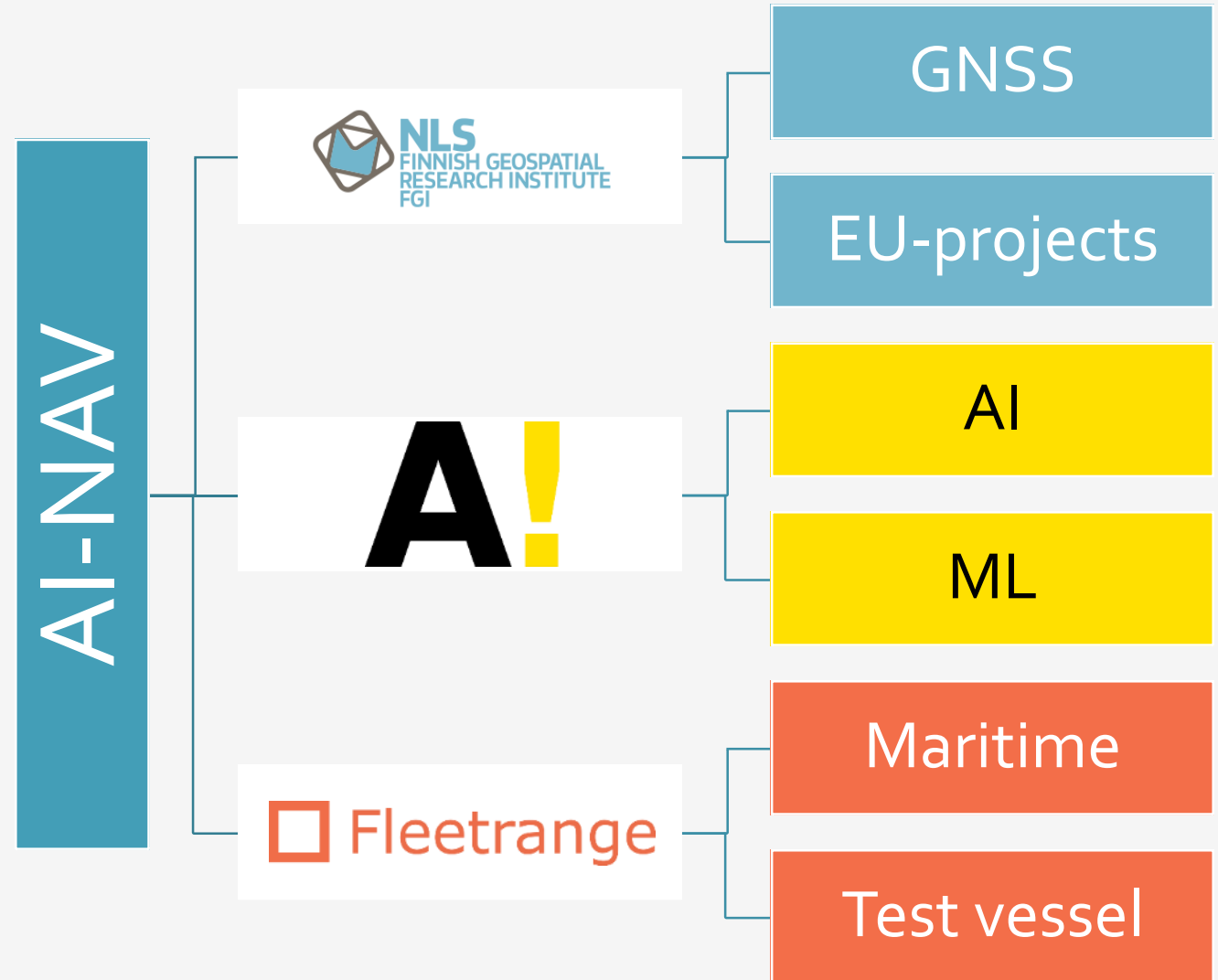
# *CONSORTIUM*

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# *Consortium*

Our consortium combines leading Finnish expertise in the areas of **GNSS**, **AI** and Maritime operational awareness



*Project description*

# *PROJECT*

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# Timeline

2 years 2019-20

Tests primarily 2020

Public results

		T0																								
		Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Meetings and Milestones	Kick-off (KO)																									
	System Requirements Review (SRR)	Video																								
	Design Review (DR)	ESTEC																								
	Test Readiness Review (TRR)	FGI																								
	Test Evaluation Review (TER)	FGI																								
	Final Acceptance Review (FAR)	ESTEC																								
WP1	WP 1100: State-of-the-art in sensor techniques																									
	WP 1200: State-of-the-art in AI methods																									
WP2	WP 2000: Requirement identification & test plans																									
WP3	WP 3100: AI techniques for image processing																									
	WP 3200: AI techniques for sound processing																									
WP4	WP 4100: RADAR and LIDAR																									
	WP 4200: Microphone array and weather station																									
	WP 4300: Stereo-camera system																									
	WP 4400: Absolute positioning with GNSS/INS																									
	WP 4500: AIS and databases																									
WP5	WP 5000: Assembly and integration																									
WP6	WP 6100: Laboratory tests																									
	WP 6200: Field tests																									
WP7	WP 7100: Validation field test campaign																									
	WP 7200: Conclusions and recommendations																									
WP8	WP 8100: Project management																									
	WP 8200: Dissemination																									

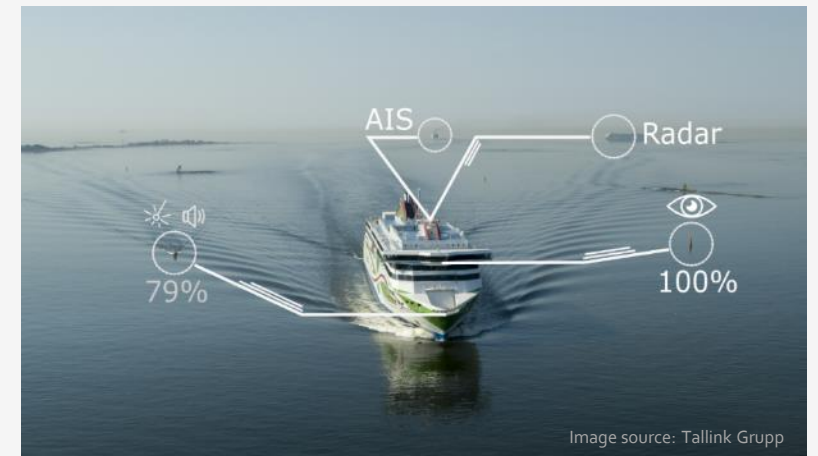
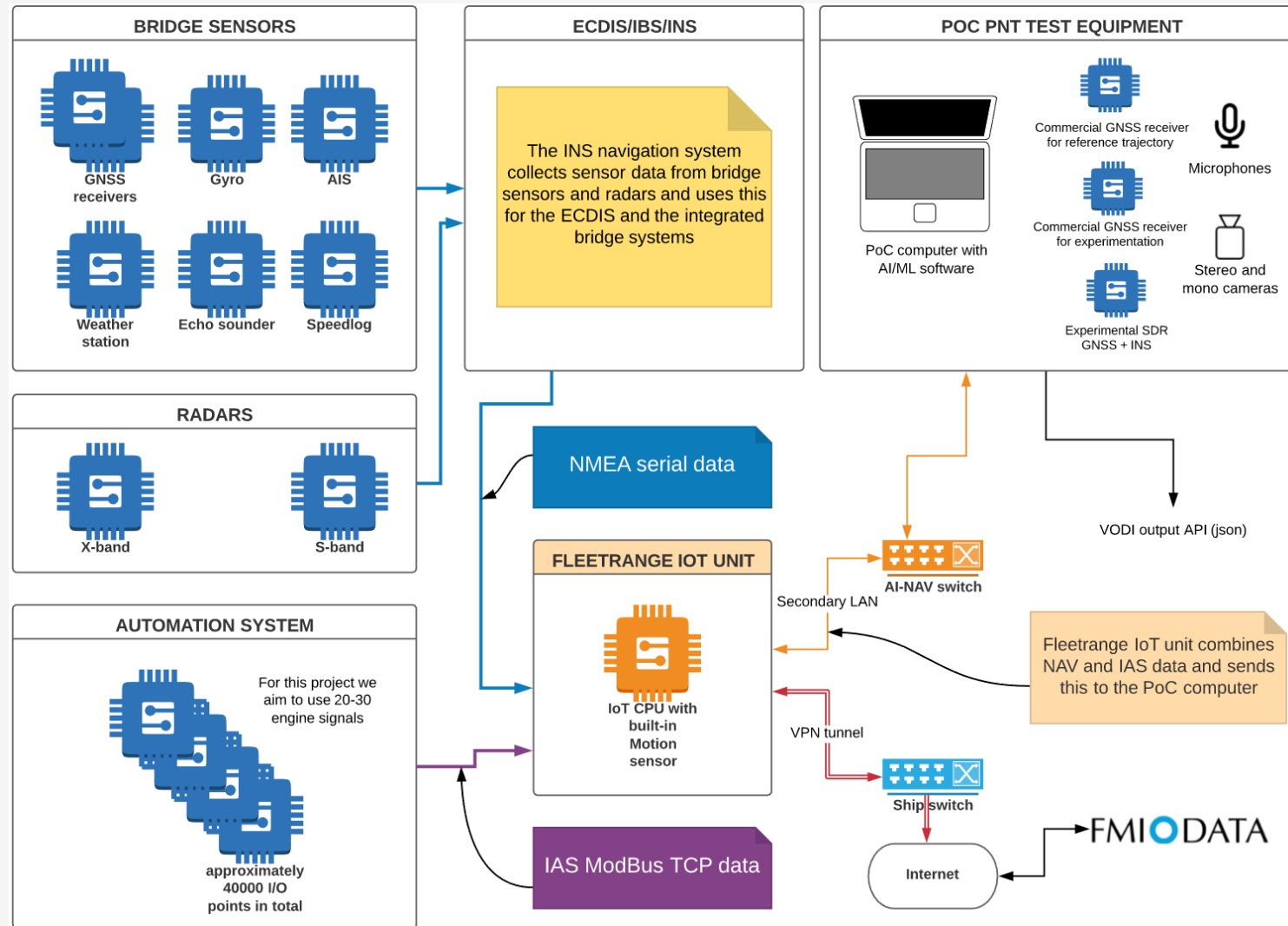


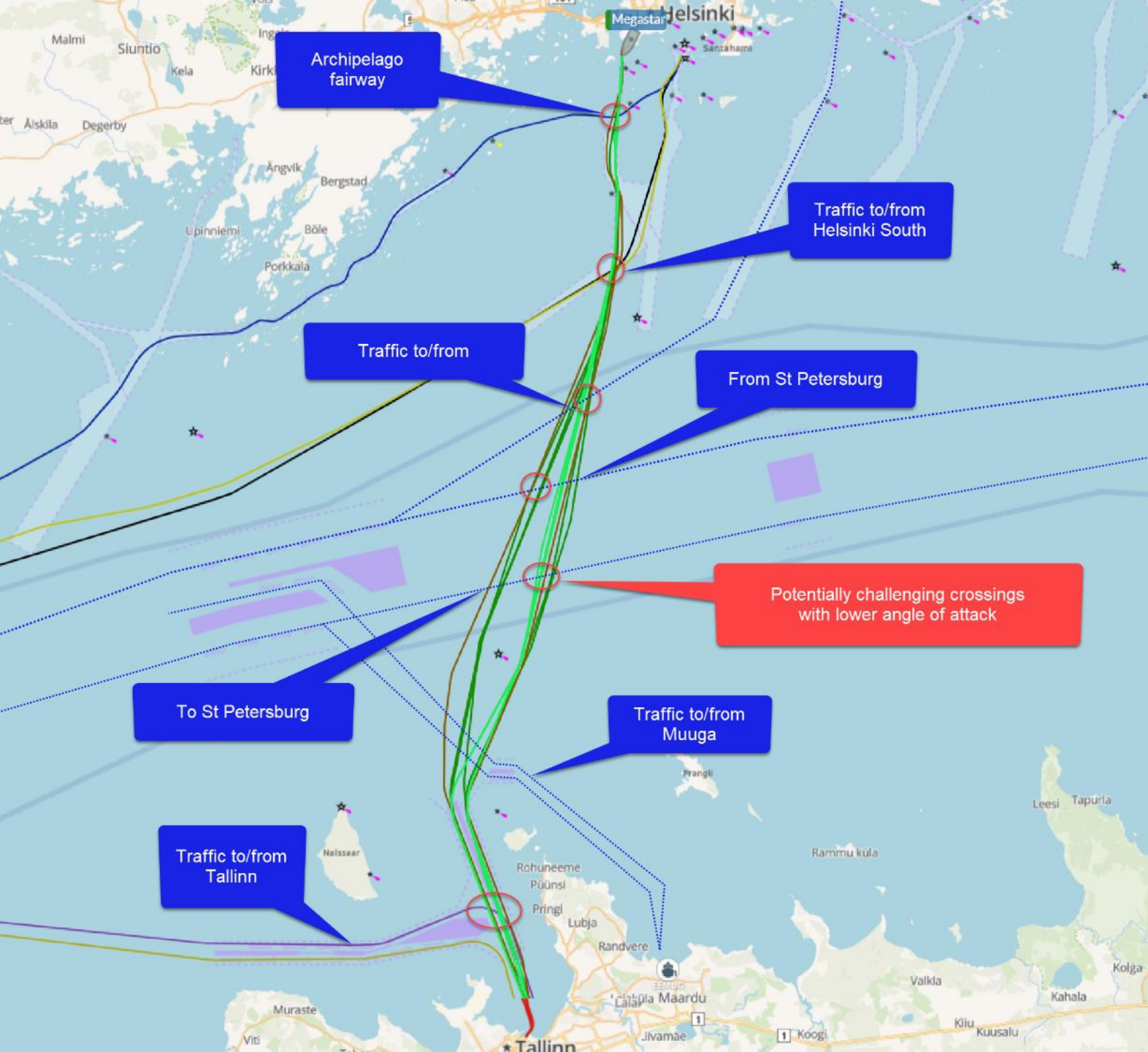
Image source: Tallink Grupp

Test vessel is M/V Megastar

# SYSTEM

*The test setup consists of PoC sensors as well as ship's own sensors*





# *TEST AREA*

*Helsinki-Tallinn is an  
EXCELLENT area for  
sensor testing*





Image source: Tallink Grupp

## *HELSINKI WEST HARBOUR*

*The West Harbour offers very good  
opportunities for operational challenges*

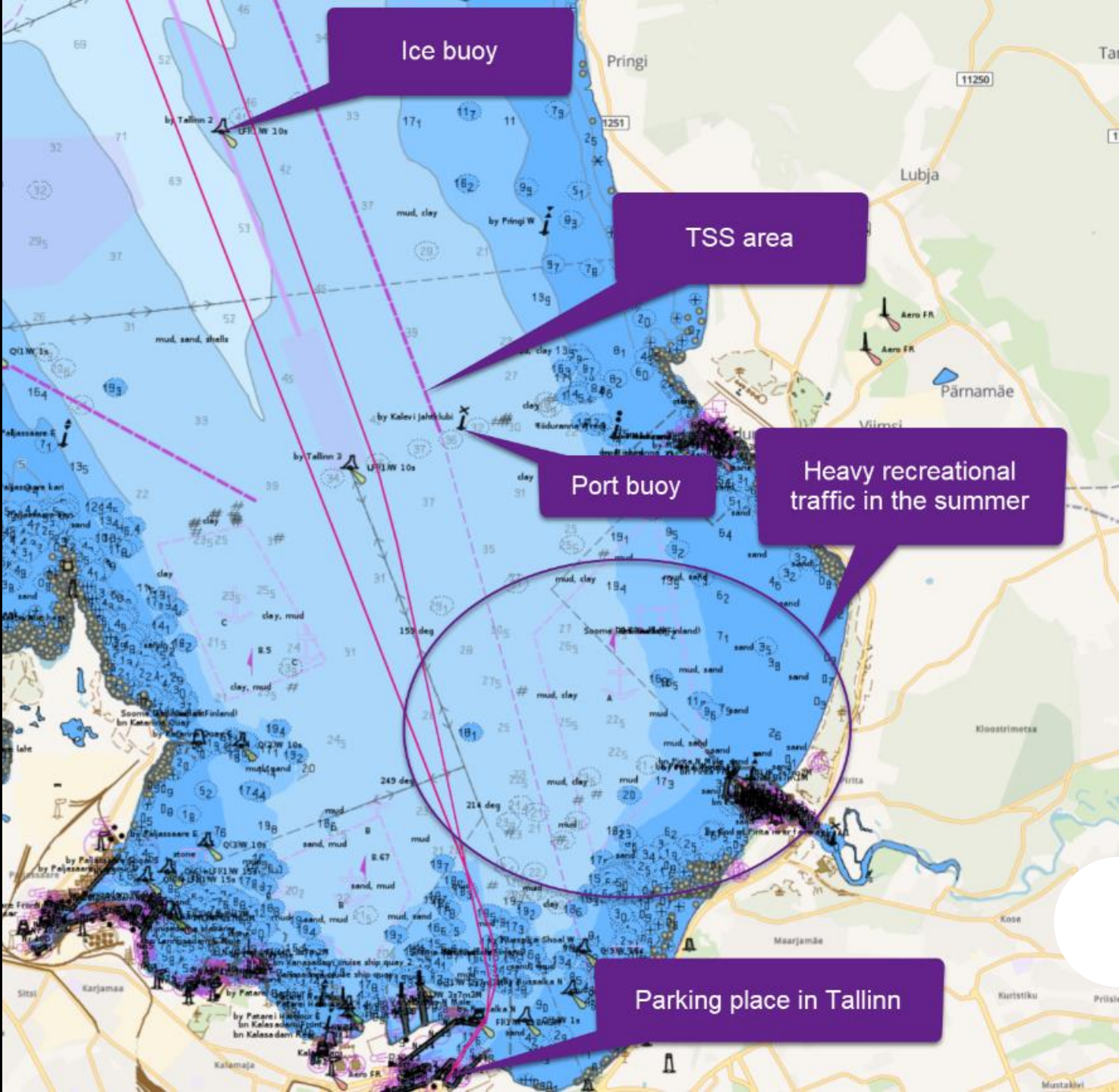
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# Tallinn

## Tallinn Bay offers:

- TSS areas
- Leisure boats
- Virtual AIS-targets



*AI-NAV project goals*

# *GOALS*

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# *Main goals*

AI/ML sensor fusion

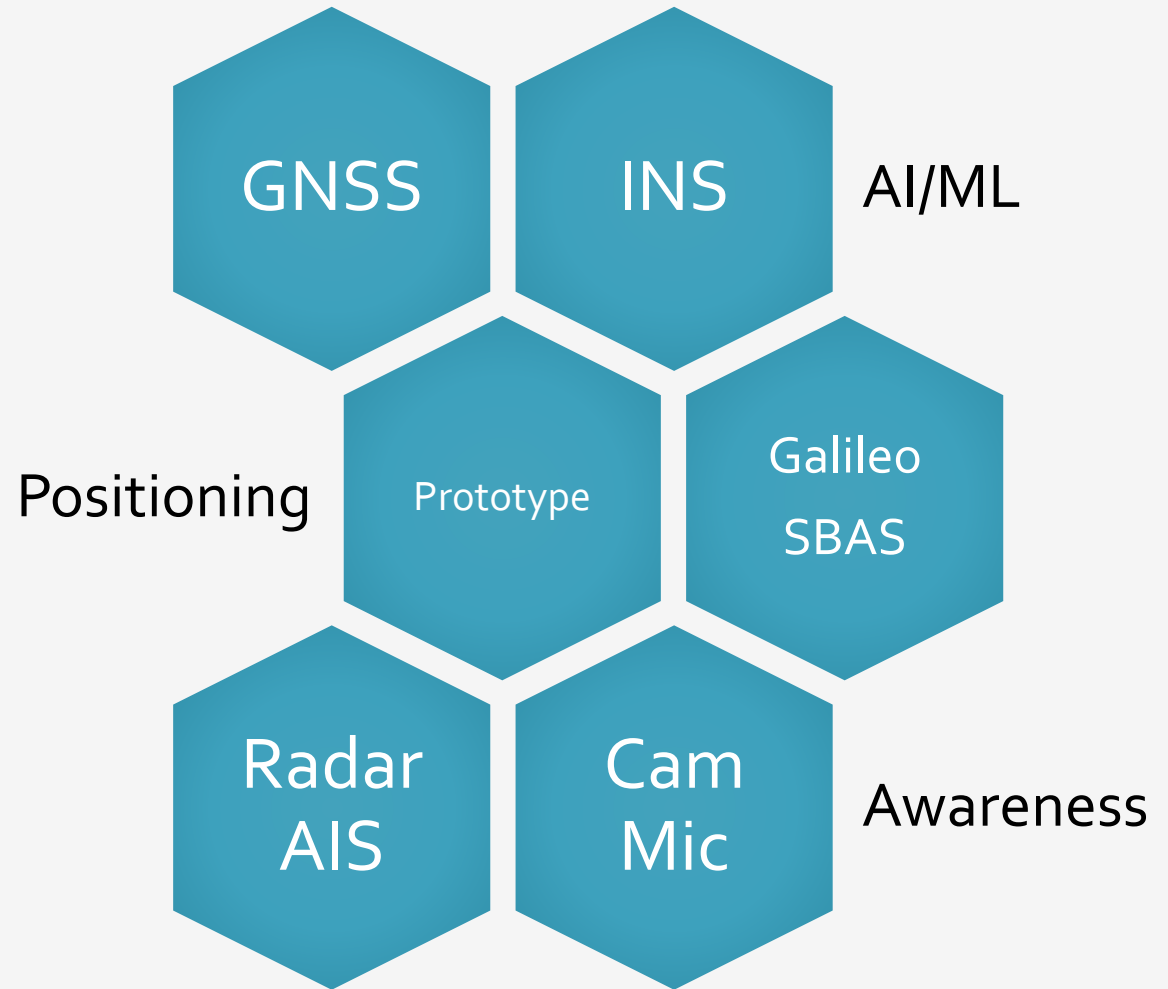
More accurate and robust **GNSS positioning** with prototype receiver

Utilisation of the **newest (European) GNSS services**

Improved **situational picture**

**Public** results

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<https://maritimeai.org/>