WTD 71
RESEARCH

UNDERWATER MARITIME SITUATIONAL AWARENESS USING CIVILIAN OFFSHORE INFRASTRUCTURE

Navy TECH SoS, 12. February 2025, Helsinki, FINLAND

Ivor Nissen, Max Görler, Finn Reikowski

BUNDESWEHR

THIS IS NOT THE FIRST TIME AND WILL NOT BE THE LAST …

Forbes

Investigating the Chinese Ship That 'Accidentally' Hit Undersea Lines

Eric Tegler Former Contributor ⓘ Nov 28, 2023, 09:30am EST

The Newnew Polar Bear, seen here in its previous guise as the Baltic Fulmar in the Port of ...
[+] WIKIMEDIA COMMONS, ALF VAN BEEM

Finland and Estonia are formally investigating a Chinese vessel that drug its anchor over 100 nautical miles though the Gulf of Finland, hitting telecom and gas lines.

The Guardian

Eur ⌄ Tue 19 Nov 2024

We assume damage to Baltic Sea cables was sabotage, German minister says

Boris Pistorius says 'no one believes' two undersea fibre-optic communications cables were cut accidentally

Boris Pistorius speaking in Brussels on Tuesday. Photograph: Anadolu/Getty Images

Source: TeleGeography

BBC

Estonia navy to protect undersea power link after main cable damaged

27 December 2024 Share Save

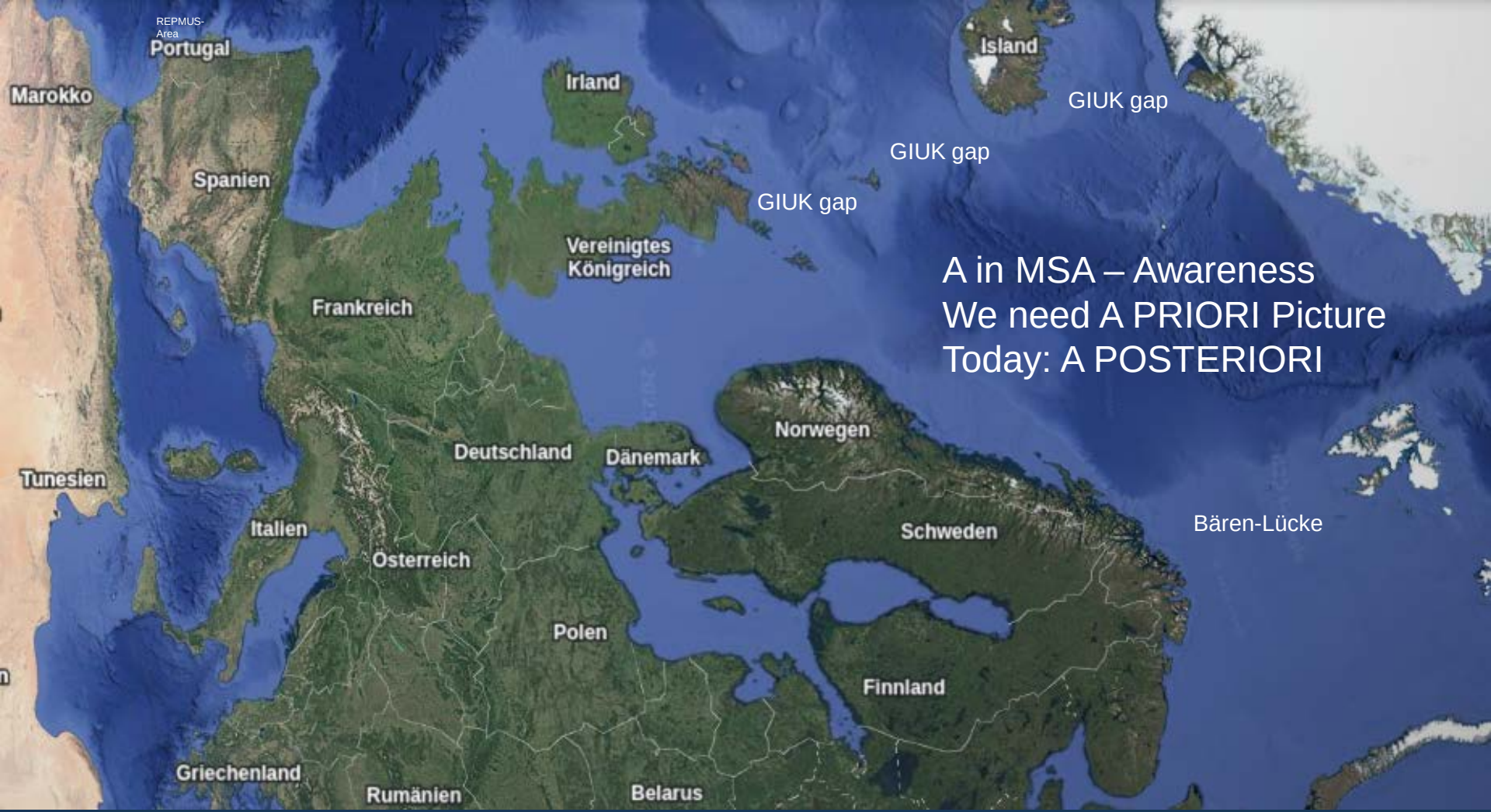
Paul Kirby
Europe digital editor

The patrol boat Raju's main task will be to protect the Estlink 1 power cable

Nato has said it will enhance its military presence in the Baltic Sea, and Estonia has sent a patrol ship to protect its Estlink1 undersea power cable, after Russia was accused of sabotaging its main power link in the Gulf of Finland.

A ship named as Eagle S is suspected of damaging the Estlink 2 cable and Finnish coast guard crew have boarded the oil tanker and steered it into Finnish waters.

The EU said the Eagle S was part of "Russia's shadow fleet" and the failure of the undersea cable was **the "latest in a series of suspected attacks on critical infrastructure"**.


REPMUS-
Area
Portugal
Marokko
Spanien
Irland
Island
GIUK gap
GIUK gap
GIUK gap
Vereinigtes
Königreich
Frankreich
Deutschland
Dänemark
Norwegen
Tunesien
Italien
Österreich
Schweden
Bären-Lücke
Polen
Finnland
Griechenland
Rumänien
Belarus
A in MSA – Awareness
We need A PRIORI Picture
Today: A POSTERIORI

MISSING COMMON UNDERWATER APRIORI PICTURE SINCE YEARS

15 декабря 2016, 00:01 | Армия | Николай Сурков | написать авторам

Российские подлодки напугали эскадру НАТО

http://izvestia.ru/news/651813 last inspection 03.02.25

Американские самолеты в Средиземном море ищут российские субмарины, появившиеся вблизи авианосцев США и Франции

Russian submarines have terrified a NATO squadron

"They had no practice for a long time. We returned to the world ocean, but their anti-submarine forces were not prepared for it," the expert noted. "In addition, we now have new tactical operational experience and technical capabilities, and the lack of signatures has improved significantly. That's why they missed the boats when they passed Gibraltar and then discovered them with great surprise near their carrier strike groups."

Former submariner Igor Kurdin told IZVESTIYA that the weakening of NATO's anti-submarine forces is something completely normal.

ENHANCING MSA WITH NEW SONAR MULTI-STATIC-CONCEPTS

Российские подлодки напугали эскадру НАТО

http://izvestia.ru/news/651813

Task Group Composition

1 KUZNETSOV CV-063 – *Admiral Kuznetsov*

2 KIROV CGN-99 – *Petr Veliki*

3 UDALOY I DDG-619 – Severomorsk

4 UDALOY I DDG-626 – Vice Admiral Kulakov

5 BAKLAZHAN ATS – Nikolay Chiker

6 KALININGRADNEFT AO – Kama

7 MOD INGUL ARS – Altay

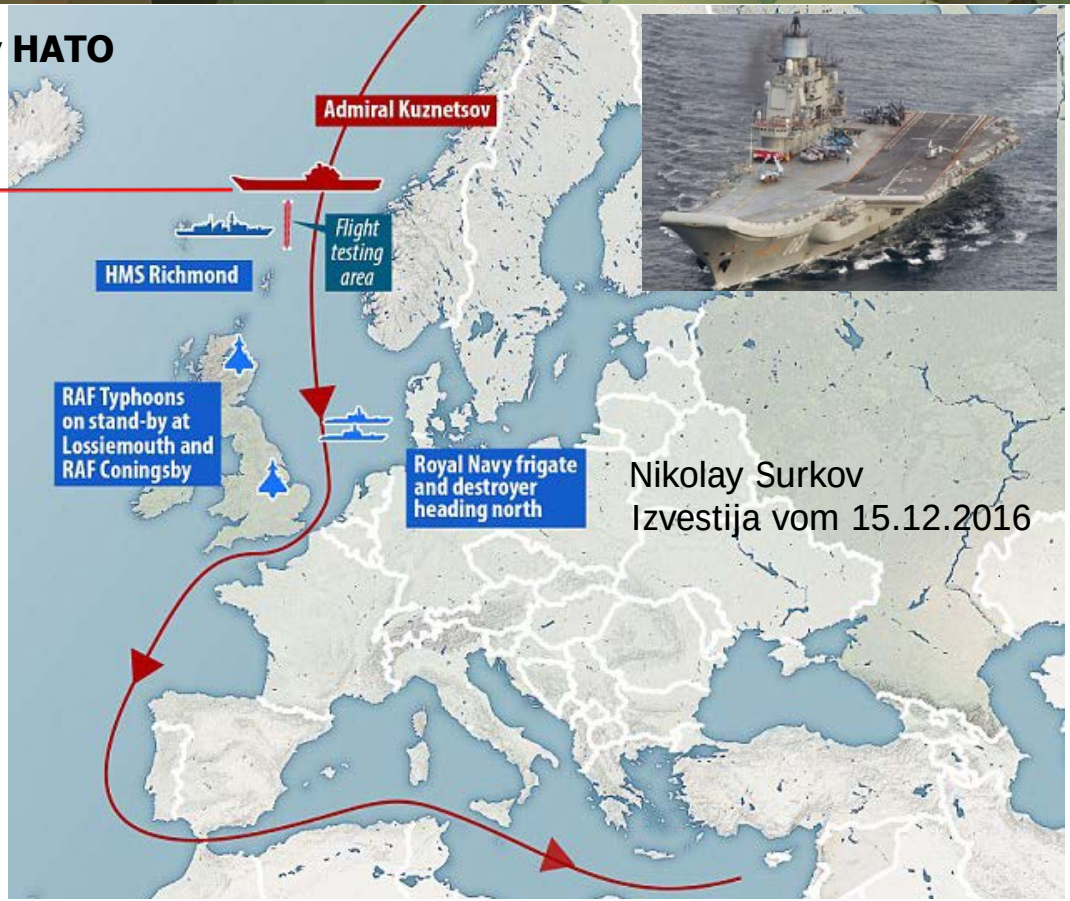
8 DUBNA AOR – Dubna

9 BORIS CHILIKIN AOR – Sergey Osipov

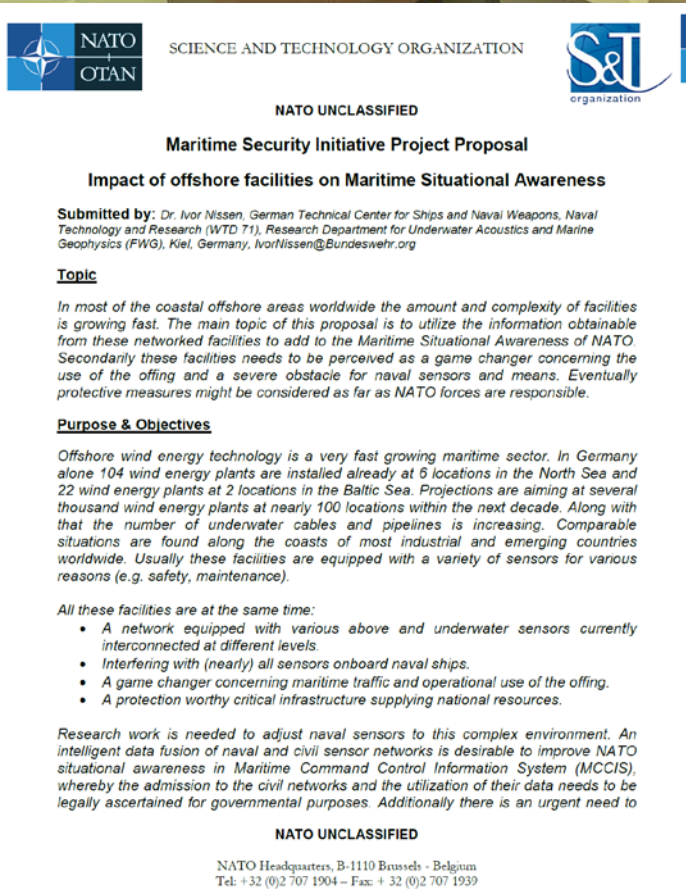
What about the underwater domain?

SOA: 12kn

Agenda: Training – Flight Ops (NOTAM)



CIVILIAN INFRASTRUCTURE AS SENSOR AND ACTOR



SCIENCE AND TECHNOLOGY ORGANIZATION

NATO UNCLASSIFIED

Maritime Security Initiative Project Proposal

Impact of offshore facilities on Maritime Situational Awareness

Submitted by: *Dr. Ivor Nissen, German Technical Center for Ships and Naval Weapons, Naval Technology and Research (WTD 71), Research Department for Underwater Acoustics and Marine Geophysics (FWG), Kiel, Germany, IvorNissen@Bundeswehr.org*

Topic

In most of the coastal offshore areas worldwide the amount and complexity of facilities is growing fast. The main topic of this proposal is to utilize the information obtainable from these networked facilities to add to the Maritime Situational Awareness of NATO. Secondarily these facilities needs to be perceived as a game changer concerning the use of the offing and a severe obstacle for naval sensors and means. Eventually protective measures might be considered as far as NATO forces are responsible.

Purpose & Objectives

Offshore wind energy technology is a very fast growing maritime sector. In Germany alone 104 wind energy plants are installed already at 6 locations in the North Sea and 22 wind energy plants at 2 locations in the Baltic Sea. Projections are aiming at several thousand wind energy plants at nearly 100 locations within the next decade. Along with that the number of underwater cables and pipelines is increasing. Comparable situations are found along the coasts of most industrial and emerging countries worldwide. Usually these facilities are equipped with a variety of sensors for various reasons (e.g. safety, maintenance).

All these facilities are at the same time:

- *A network equipped with various above and underwater sensors currently interconnected at different levels.*
- *Interfering with (nearly) all sensors onboard naval ships.*
- *A game changer concerning maritime traffic and operational use of the offing.*
- *A protection worthy critical infrastructure supplying national resources.*

Research work is needed to adjust naval sensors to this complex environment. An intelligent data fusion of naval and civil sensor networks is desirable to improve NATO situational awareness in Maritime Command Control Information System (MCCIS), whereby the admission to the civil networks and the utilization of their data needs to be legally ascertained for governmental purposes. Additionally there is an urgent need to

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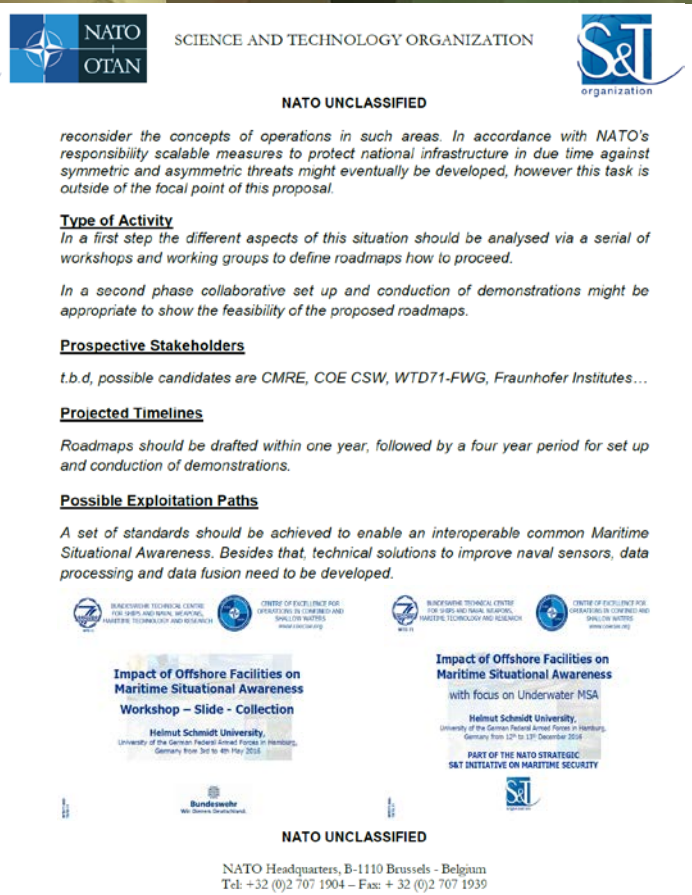

SCIENCE AND TECHNOLOGY ORGANIZATION

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reconsider the concepts of operations in such areas. In accordance with NATO's responsibility scalable measures to protect national infrastructure in due time against symmetric and asymmetric threats might eventually be developed, however this task is outside of the focal point of this proposal.

Type of Activity

In a first step the different aspects of this situation should be analysed via a serial of workshops and working groups to define roadmaps how to proceed.

In a second phase collaborative set up and conduction of demonstrations might be appropriate to show the feasibility of the proposed roadmaps.

Prospective Stakeholders

t.b.d, possible candidates are CMRE, COE CSW, WTD71-FWG, Fraunhofer Institutes…

Projected Timelines

Roadmaps should be drafted within one year, followed by a four year period for set up and conduction of demonstrations.

Possible Exploitation Paths

A set of standards should be achieved to enable an interoperable common Maritime Situational Awareness. Besides that, technical solutions to improve naval sensors, data processing and data fusion need to be developed.

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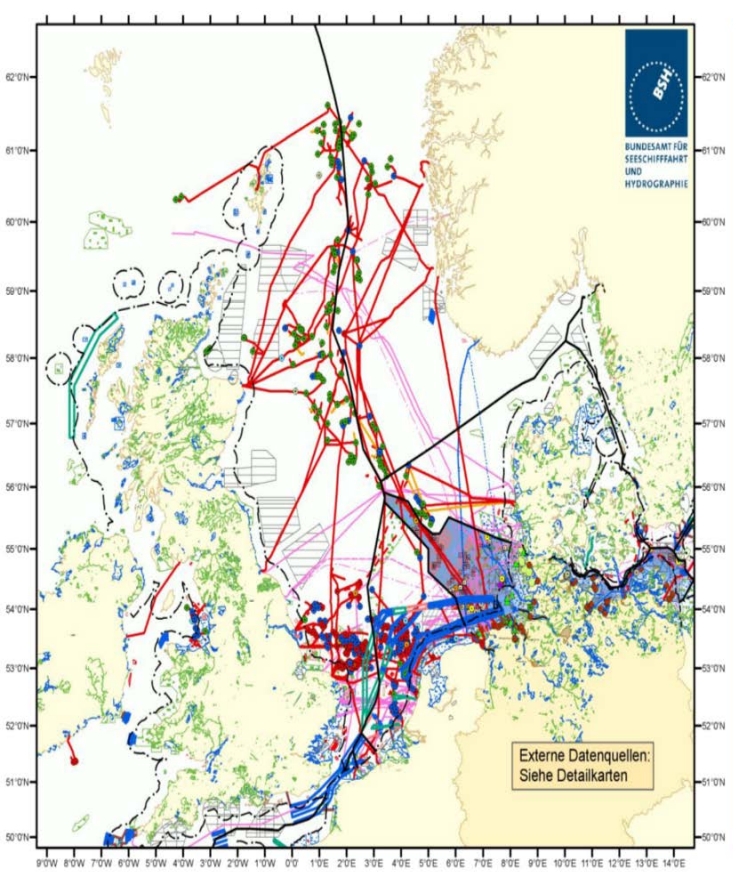
Ships and aircrafts are energy and cost intensive in 24/7-operations over years.

Idea: use
3D maritime surveillance in consideration of offshore infrastructure in confined and shallow waters to save ship / aircraft resources.

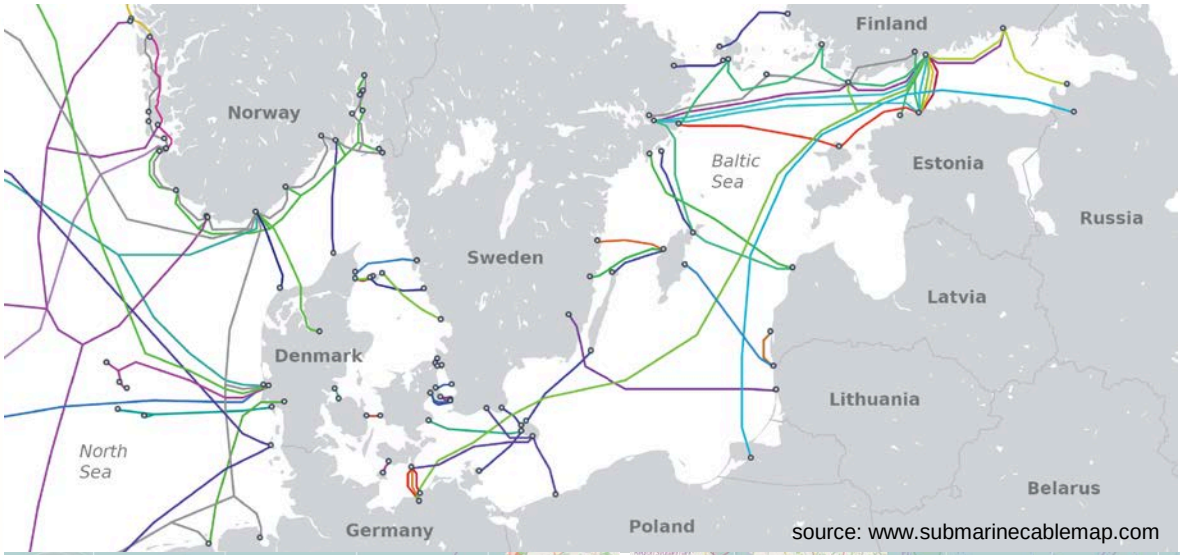
Advantages for CUI-MSA:

- enough energy (24/7)
- no drift, stationary
- navigation (no movements, low noise)
- broad communication (wired, broadband, multistatic)

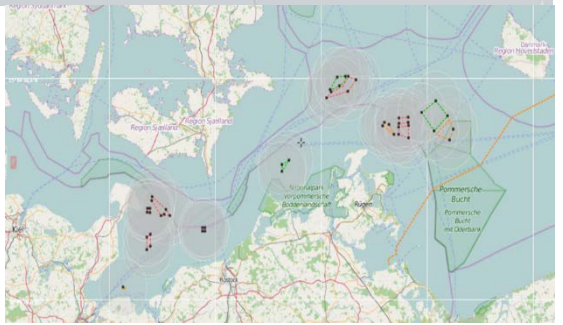
MAPS WITH CIVILIAN UNDERWATER INFRASTRUCTURE



http://www.bsh.de/de/Meeresnutzung/Wirtschaft/CONTIS-Informationssystem/index.jsp



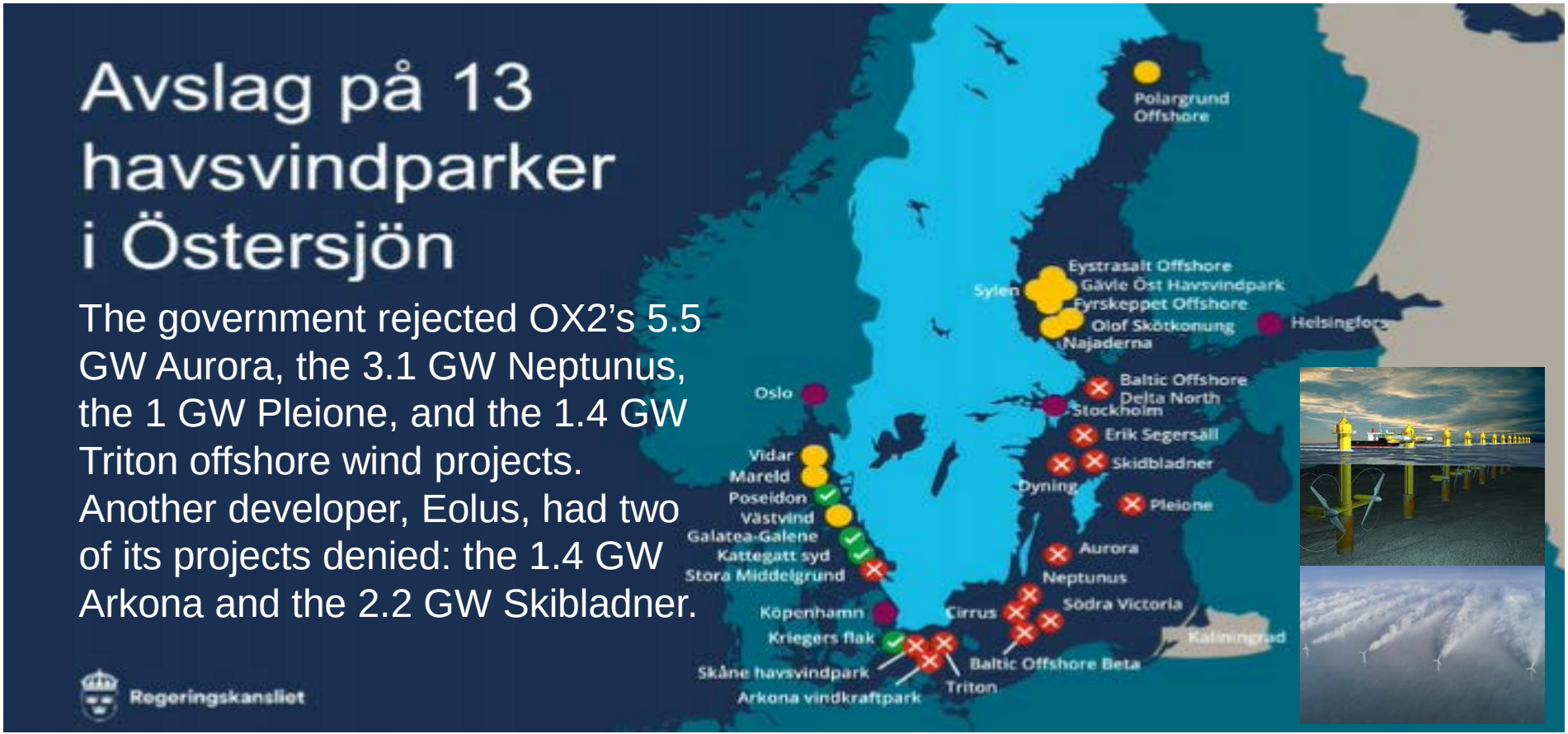
source: www.submarinecablemap.com



CIVILIAN INFRASTRUCTURE IS NOT HELPFUL - IF NOT INCLUDED IN C5ISTAR

Avslag på 13 havsvindparker i Östersjön

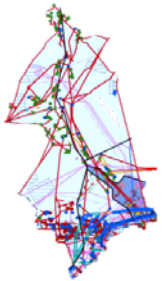
The government rejected OX2's 5.5 GW Aurora, the 3.1 GW Neptunus, the 1 GW Pleione, and the 1.4 GW Triton offshore wind projects. Another developer, Eolus, had two of its projects denied: the 1.4 GW Arkona and the 2.2 GW Skibladner.



ENHANCING MSA WITH NEW SONAR MULTI-STATIC-CONCEPTS

But, if we included CUI into C5ISTAR

Active as MULTI-STATIC-CONCEPT!

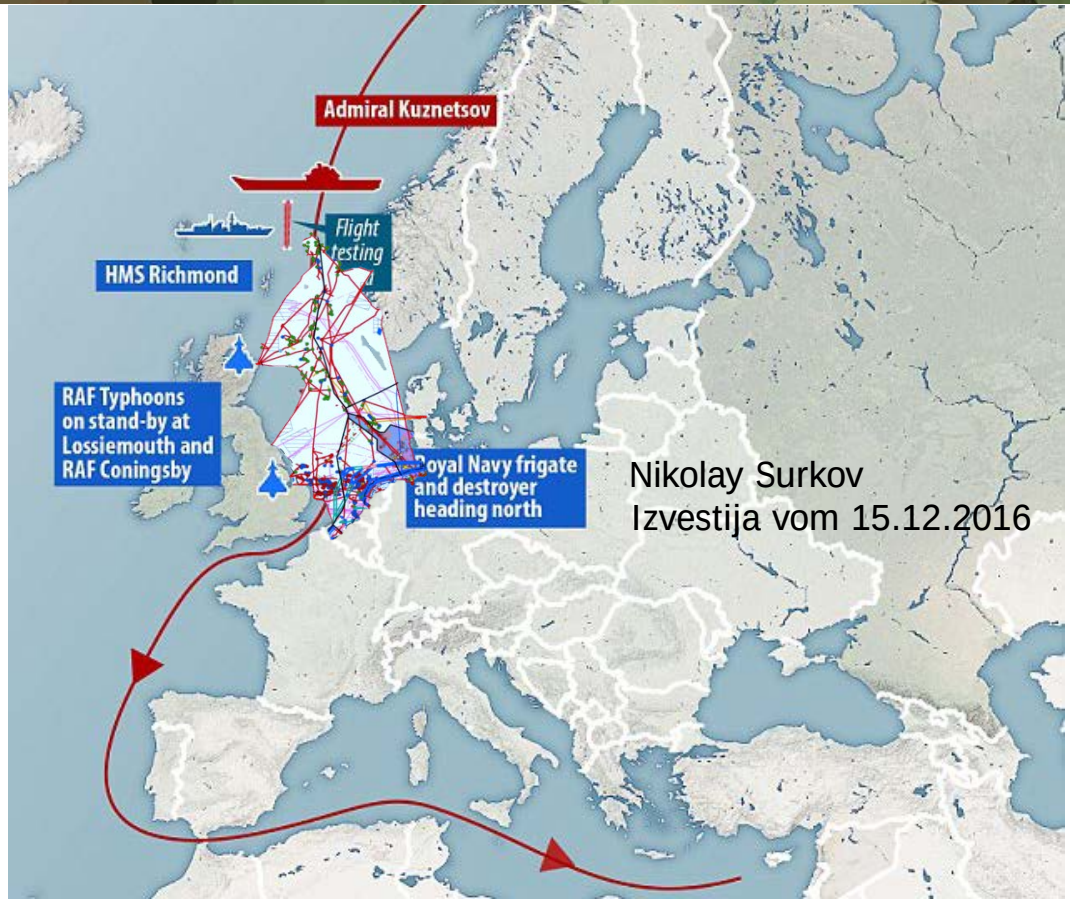


Outcome in 2016 from both CUI workshops and the online survey:

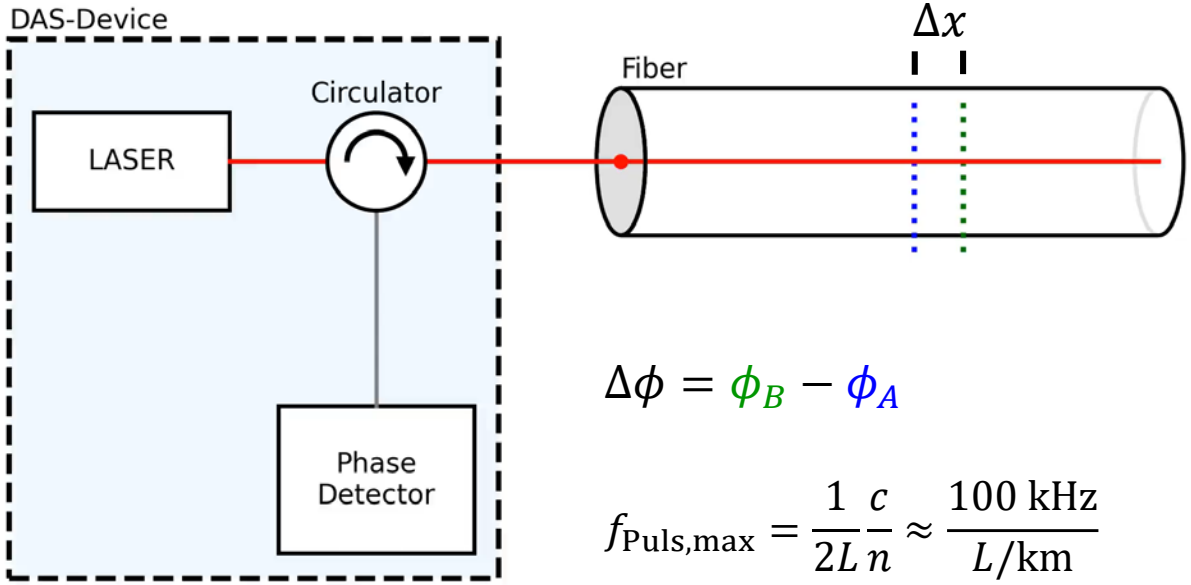
1) UW part very vulnerable, great damage to the national economy can occur here
2) Two technologies identified:
   a) Sonartransponders and
   b) DAS (technical feasibility proved)
3) *Cooperation with owners, data exchange, overcoming legal hurdles*

Goal: Data fusion & anomaly detection using SONAR-transponders and DAS in two steps:

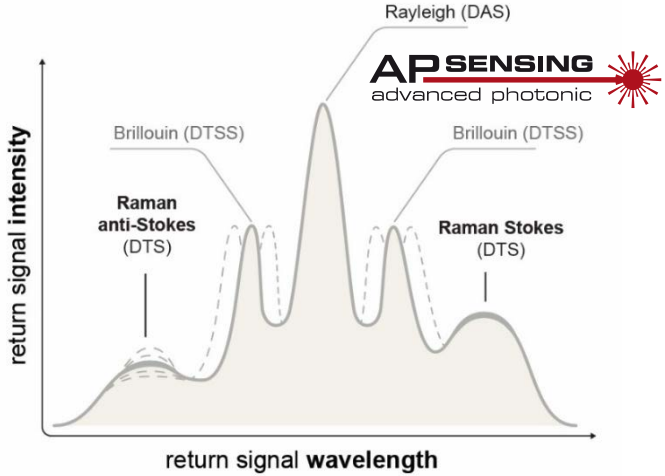
a) coarse DETECTION with DAS
b) fine DETECTION with active SONAR-Transponders from Offshore Wind parks.



A) DISTRIBUTED ACOUSTIC SENSING (DAS)



$$\Delta\phi = \phi_B - \phi_A$$



$$f_{\mathrm{Puls,max}} = \frac{1}{2L}\frac{c}{n} \approx \frac{100\ \mathrm{kHz}}{L/\mathrm{km}}$$

$$\frac{f_{\mathrm{Puls}}}{\mathrm{kHz}} \cdot \frac{L}{\mathrm{km}} \leq 100$$

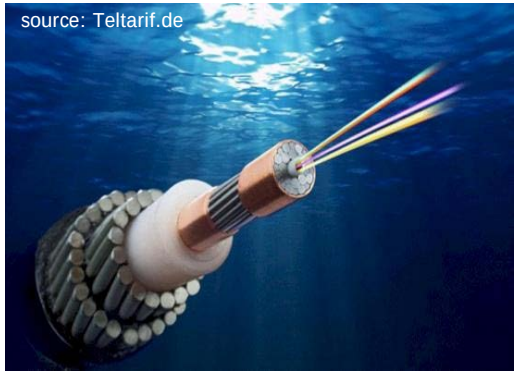
DAS measures local stretching/ compression of the fiber

Changes of
- Temperature
- Slow pressure (waves, pressure profile of objects)
- Fast pressure (sound)

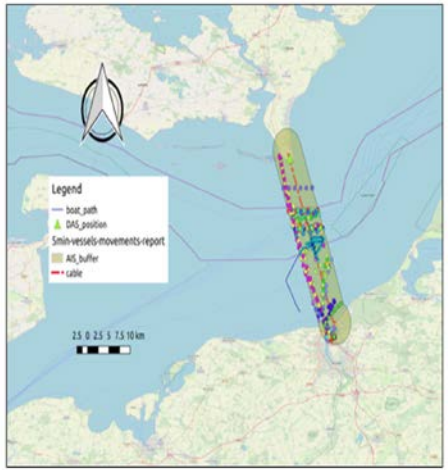
DAS N52-Serie

Cable length L [km]	Puls-Frequency f_{puls} [kHz]	Effect
100	1	Audio up to 500 Hz, engine noise, propeller noise, pressure
10	10	Audio up to 5 kHz, SONAR waveforms
1	100	Audio up to 50 kHz, underwater communication waveforms

COST 2018 – FIRST SEA TRIAL FOR VALIDATION OF DAS IN GERMANY

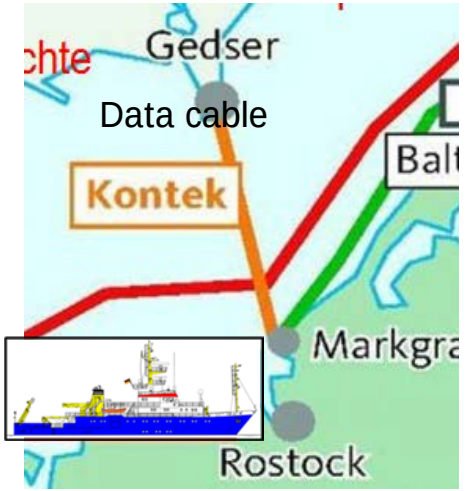


Date	Action **COST 2018**
04. Sep	Departure around 18.00h from Kiel
05. Sep	**First test cycle** 7:00h in the sea area, deploying broadcasting system (0.9 - 5 kHz ?) Tracks without emissions, measuring the speed of sound
18. Sep	**Second test cycle** 20.00 h in the sea area
19. Sep	deploying broadcasting system starting 2nd set of measurements
20. Sep	21:00 Return to Kiel



Different
- cables,
- marine sediments,
- water depths,
- weather conditions,
- objects,
- burial depths.

→ Different measurements over long time periods needed to find regularities.



DAS - ACTIVITIES

Distributed acoustic sensing for near-surface imaging using submarine telecommunication cable: A case study in the Trondheimsfjord, Norway

Article · Full-text available · June 2021 · Geophysics

Kittinat Taweesintananon · Martin Landro · Jan Kristoffer Brenne · Aksel Haukanes

Distributed acoustic sensing (DAS) transforms submarine telecommunication cables into densely sampled seismic receivers. To demonstrate DAS applications for seismic imaging, we use an optical cable on the seafloor in the Trondheimsfjord, Norway, to...

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Analysis of a Local Earthquake in the Arctic Using a 120 KM Long Fibre-Optic Cable

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June 2022 · 83rd EAGE Annual Conference & Exhibition

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July 2022 · Frontiers in Marine Science

Léa Bouffaut · Kittinat Taweesintananon · Hannah Joy Kriesell · [...] · Frode Storvik

In a post-industrial whaling world, flagship and charismatic baleen whale species are indicators of the health of our oceans. However, traditional monitoring methods provide spatially and temporally undersampled data to evaluate and mitigate the...

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zenodo

DAS4Whale: Svalbard distributed acoustic sensing dataset for baleen whale monitoring

EUROPEAN DEFENCE FUND

EUROPEAN UNION

FIBERSENSE

Using fiber optical cables for maritime situational awareness

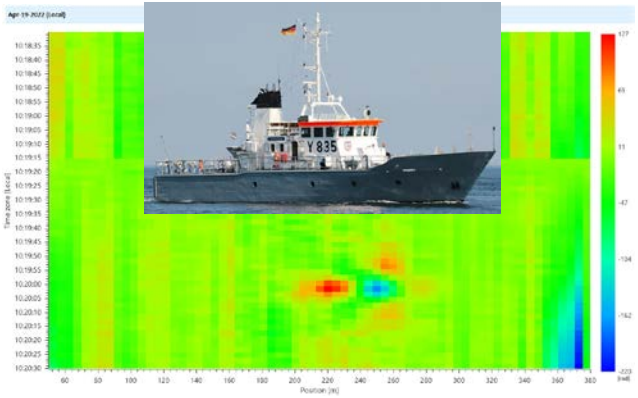
SELECTED PROJECTS EUROPEAN DEFENCE FUND (EDF) 2021

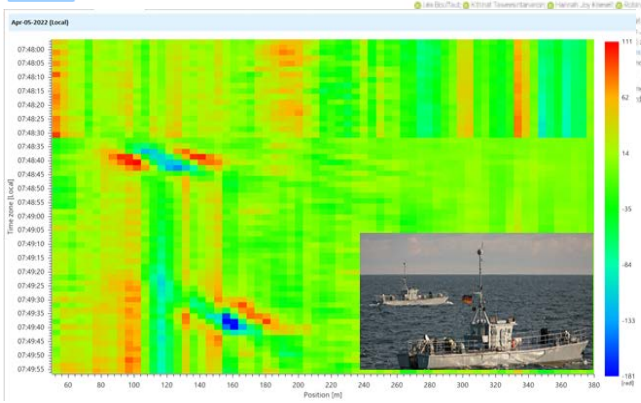
CALL TITLE:	Open call dedicated to SMEs for research of innovative and future-oriented defence solutions
TOPIC TITLE:	Research on innovative and future-oriented defence solutions
DURATION OF THE PROJECT:	36 months
TYPE(S) OF ACTIVITIES:	Generating knowledge; Integrating knowledge; Studies; Design
ESTIMATED TOTAL COST:	€ 3,386,861.61
MAXIMUM EU CONTRIBUTION :	€ 3,386,861.61

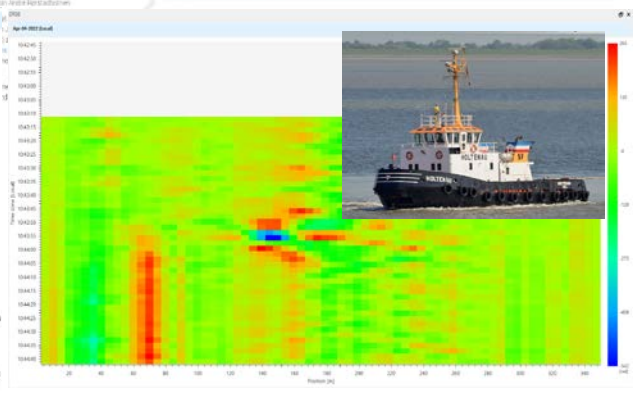
SHORT DESCRIPTION OF THE PROJECT:

FIBERSENSE will focus on and advance the Distributed Acoustic Sensing (DAS) technology.

The project "Using fiber optical cables for maritime situational awareness" (FIBERSENSE) will focus on and advance the Distributed Acoustic Sensing (DAS) technology. DAS exploits the laser - induced Rayleigh backscattering in the Fiber Optic Cable (FOC) to detect incident acoustic waves. Feasibility studies will be performed, including in an isolated-controlled environment for underwater testing, and in real operational environments, also for extended testing periods. The expected impact is increased functional life time and reduction in costs of use.

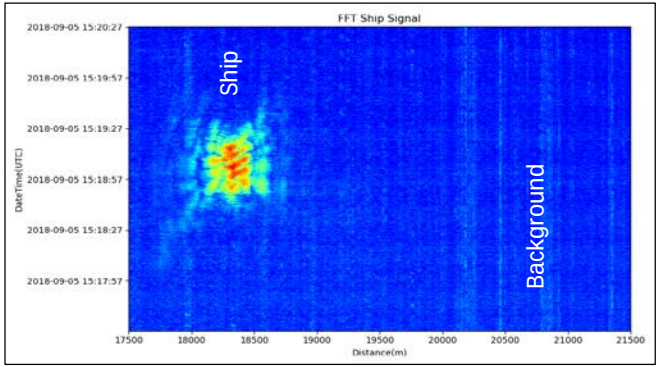




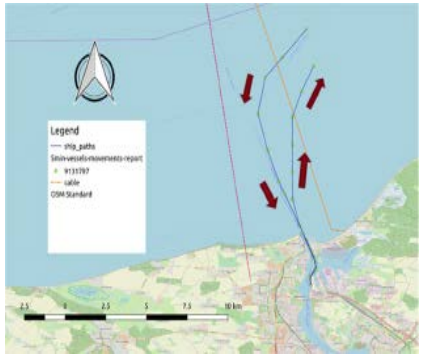


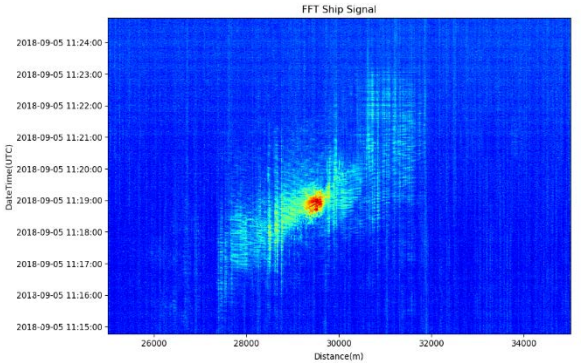
DAS - OUTPUT

Gross Tonnage: 136,980 t Length x Breadth: 315m x 50m Draught: 12.1m

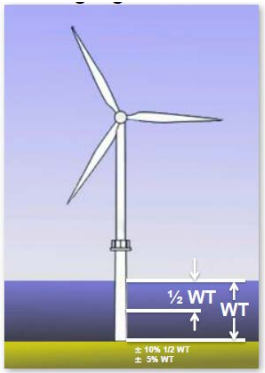


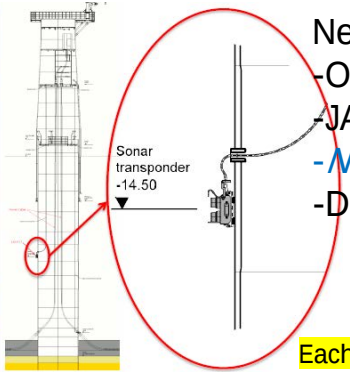
Gross Tonnage: 37,987 t Length x Breadth: 200m x 29m Draught: 6.3m





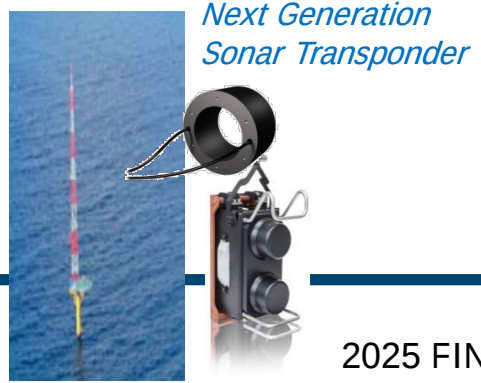
B) SONAR TRANSPONDERS



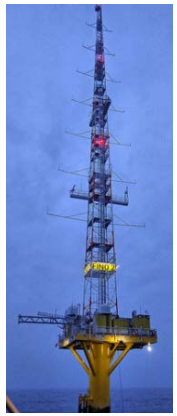


Next Generation: Extension with:
-One hydrophone, LF transducer
-JANUS / UT comms
-Noise measurements
-Detectors for Click-/Sweep-signals / CAS

Each transponder is TRANSMITTER AND RECEIVER



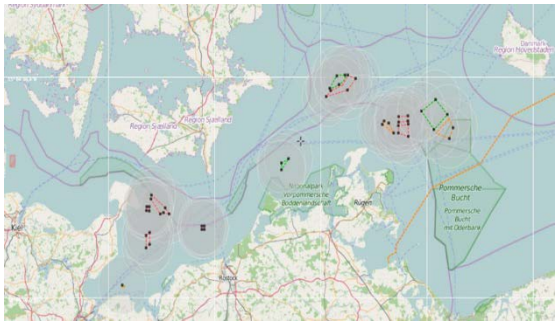
Next Generation Sonar Transponder



2004 — 2015 — 2016 FINO 3 — 2025 FINO 2

German Law: At the corner positions of the wind farms sonar transponder ***must*** be installed (applies to all man-made underwater constructions).

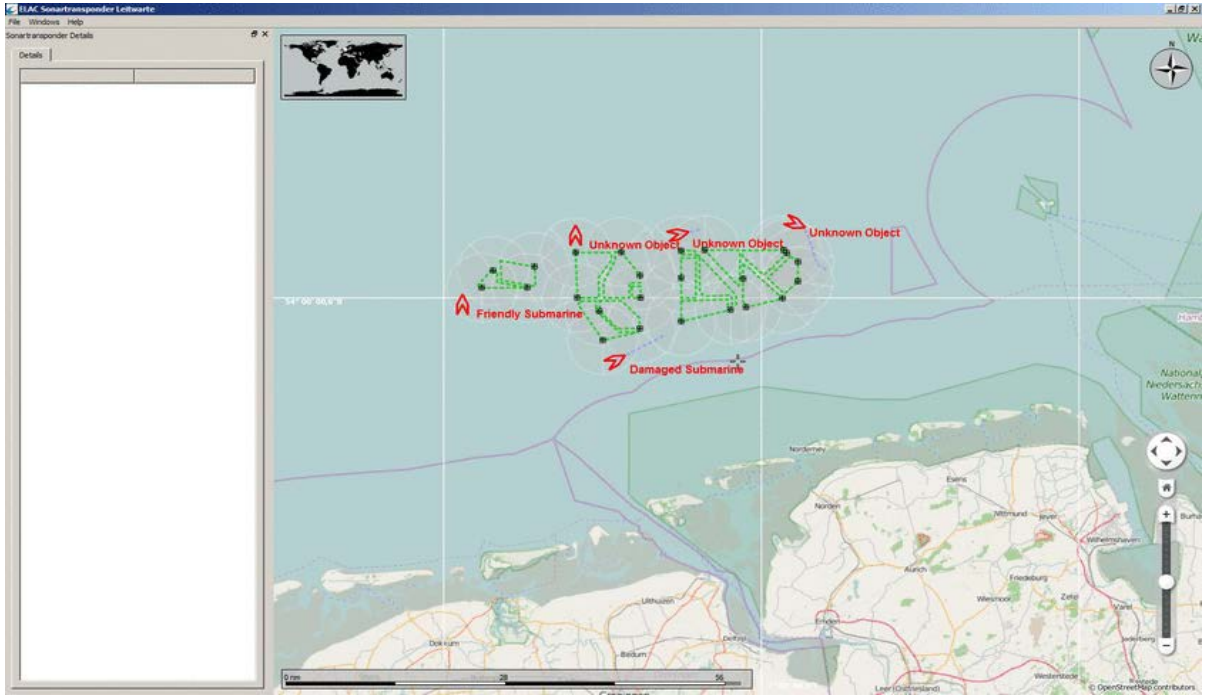
2015 ~ 60 SONAR transponders
2020 ~ 95 SONAR transponders



DATA FUSION & ANOMALY DETECTION

After coarse DETECTION with DAS:

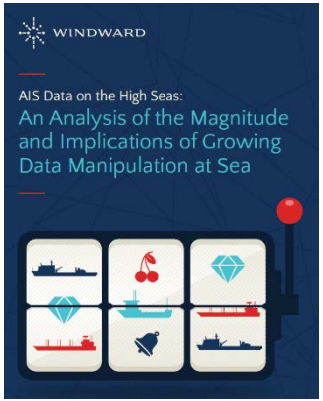
→ Activation of SONAR-transponder MULTI-STATIC for 10 minutes



Top Five AIS Manipulation Practices

New research by Windward identifies the top AIS manipulation tactics:

- *Identity Fraud*
- *Obscuring Destinations*
- *'Going Dark'*
- *GPS Manipulation*
- *AIS Spoofing*



http://www.windward.eu/wp-content/uploads/2015/02/AIS-Data-on-the-High-Seas-Executive-Summary-Windward-October-20-2014.pdf

Finland detects satellite navigation jamming and spoofing in Baltic Sea

Reuters

By **Anne Kauranen**

October 31, 2024 3:49 PM GMT+1 · Updated 3 months ago

Summary

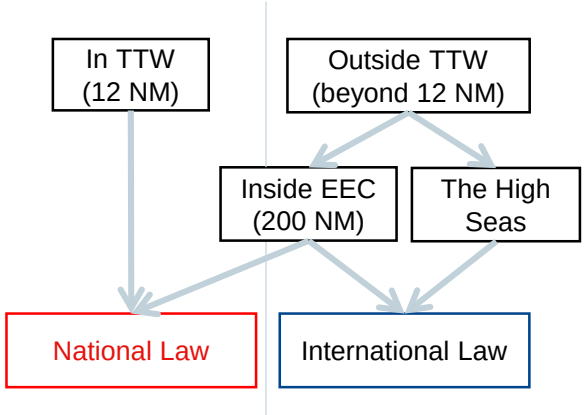
- Finland has detected increased GNSS jamming since April
- Location spoofing aims to evade sanctions on Russia, says coast guard
- Lack of navigation and ageing Russian fleet risks oil spill

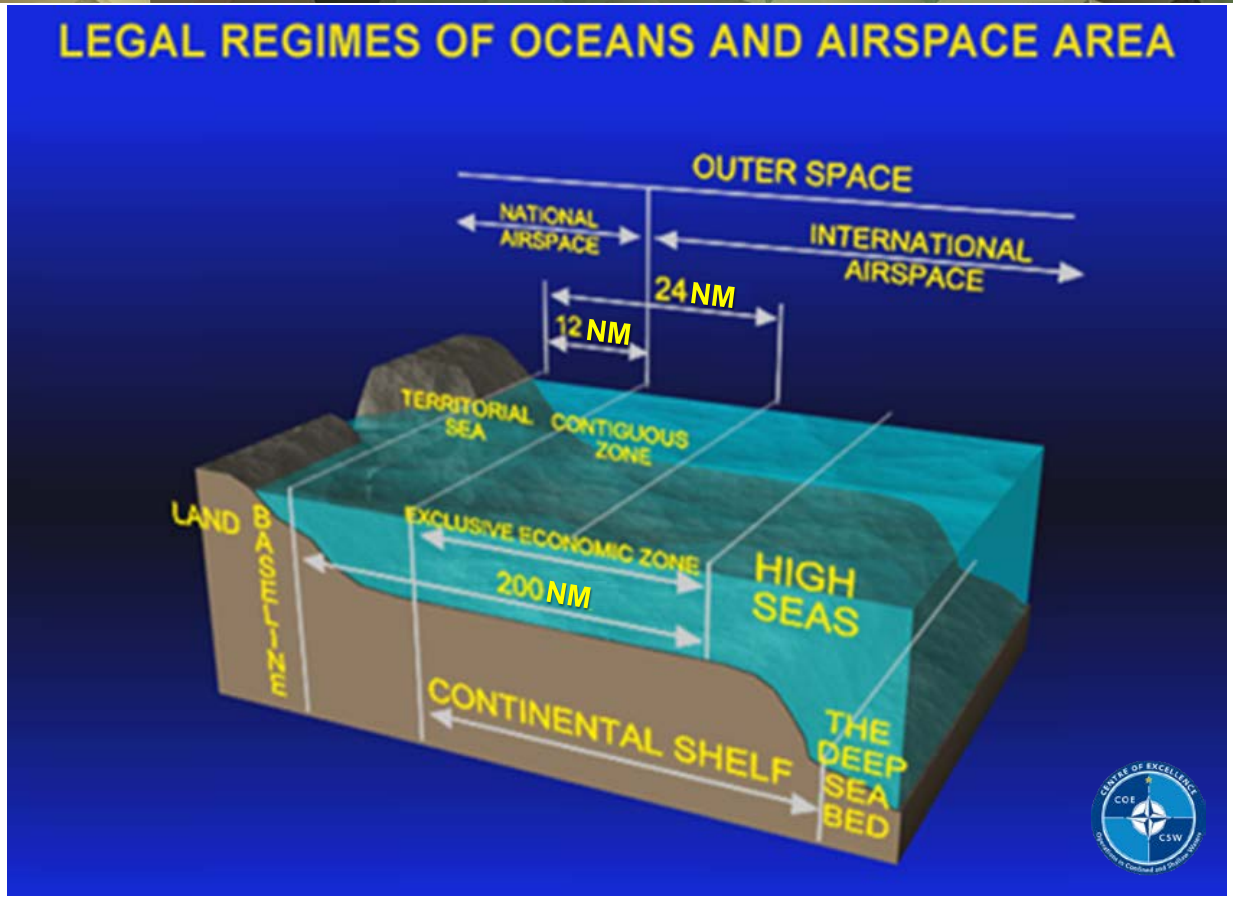
HELSINKI, Oct 31 (Reuters) - Finland's Coast Guard said it has detected constant disturbances to satellite navigation signals in the Baltic Sea since April and in recent weeks has seen tankers spoofing their location data to cover up visits to Russia.

CHALLENGE: INTERNATIONAL LAW AND ORDER

With technolgy there are no problems with implementation, the organizational and legal problems must be clarified ***politically***!

We have to distinguish:





OUTSIDE TTW (BEYOND 12 NM)

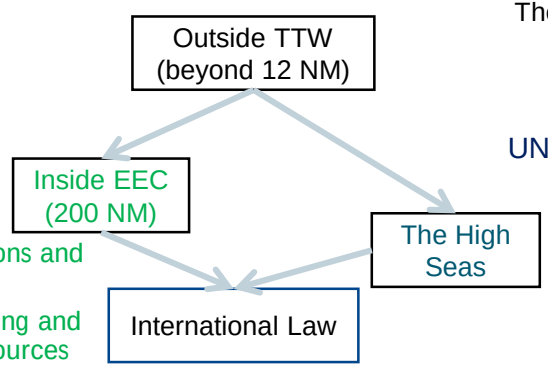
INSIDE The EEZ:

Beyond TTW (more than 12NM),
in general max. 200 NM

UNCLOS (Law of the Sea Convention)

Art. 56 lit. 1 (a)(i): In the exclusive economic zone, the coastal State has jurisdiction … with regard to the establishment and use of artificial islands, installations and structures;

Art 56, 60: sovereign rights … for the purpose of exploring and exploiting, conserving and managing the natural resources



EEZ: *The Area* (the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction

Art. 145: Ensure effective protection for the marine environment.

Art. 147 such installations shall be used exclusively for **peaceful** purposes;

Art. 60 (4) The coastal State may … establish reasonable safety zones around such artificial islands, installations and structures.

Art. 60 (5) Such zones shall be designed to ensure that they are reasonably related to the nature and function of the artificial islands, installations or structures, and shall not exceed a distance of 500 metres around them.

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The High Sea:

- Beyond TTW (more than 12 NM) and
- Outside EEZ (in general max. 200 NM)

UNCLOS (Law of the Sea Convention):

- Art. 87 (1)(d) [Freedom of the high seas]… comprises, inter alia, freedom to construct artificial islands and other installations permitted under international law, subject to Part VI [Continental Shelf]:
- Art. 77 (1) The coastal State exercises over the continental shelf sovereign rights for the purpose of exploring it and exploiting its natural resources.

High Sea: The Area (the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction)

Art. 147 Installations used for carrying out activities in the Area shall be subject to the following conditions: (2)(d) such installations shall be used exclusively for ***peaceful*** purposes;

Cable Convention from 1884
also Russia and Germany!

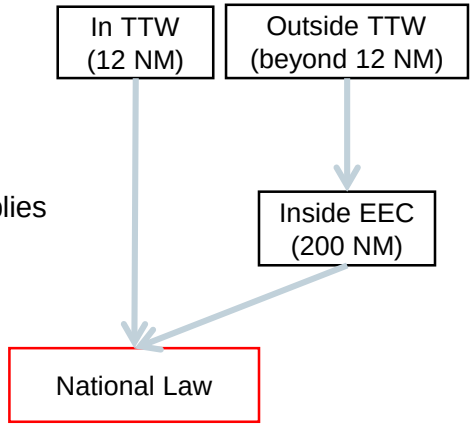
NATIONAL LAW – MANY QUESTIONS

The Territorial Waters

Within 12 NM from the coast (baseline)

– Sovereign state has full jurisdiction
– Problems are national problems, national law applies
- National responsibility:
  - Federal law?
  - Law of federal states or municipality law?
- National procedures:
  - What authority?
  - From easy allowance to complex planning.

- EU law (supranational), e.g. protection of marine environment.
- Data law
  - Data as a national secret?
  - Data protection law: Data gathering purposes are different than the data is been used for later on.
  - Data gathering by whom (Navy v. Intelligence services).



- Who is nationally responsible for managing the EEZ?
- Are military purposes (v. exploring and exploiting) covered by this responsibility?
- What are the national procedures?

– What is the legal status of these installations under national law?
– How can these installations be protected?
– Are there **private** law issues?

– Vorratsdatenspeicherung (retention of data), each nation own (VerkDSpG), Fingerprinting von Fahrzeugen

UNKNOWN SITUATION, MANY QUESTION MARKS

CONCLUSION

- Enhancing MSA with new Sonar multi static concepts — no technical problems
- Data fusion & anomaly detection using Transponders and DAS — no technical problems
  - use DAS for coarse detections,
  - activate after detection confirmation in case of anomaly the SONAR ping via transponders
  - multi static processing with all transponders in the neighborhood
  - hydro acoustical fine detection using trilateration
- Challenge: International Law and Order — no solution for different laws
- Navies definition without fixed infrastructure, we need change in consciousness, also including stationary infrastructure.

Mobile components: German Navy protects the territorial waters and sea lanes of Germany and its allies

The German Navy - Facts and Figures, 12. Edition

This encompasses maritime surveillance, mine countermeasures and anti-submarine warfare, protection against sea-based terrorist threats, maritime search and rescue as well as maritime environmental monitoring.

In total, about ~62 commissioned ships, including submarines and auxiliary ships plus 50 aircrafts (https://www.bundeswehr.de/en/organization/navy)