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# MARITIME AUTONOMOUS NAVIGATION TECHNOLOGY @ FRAUNHOFER CML

Prof. Dr.-Ing. Carlos Jahn

2017/03/21 – BUVUS @ CeBIT, Hannover

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# Agenda

- 1 Fraunhofer CML
- 2 Autonomous ship development projects
- 3 Outlook

# Agenda

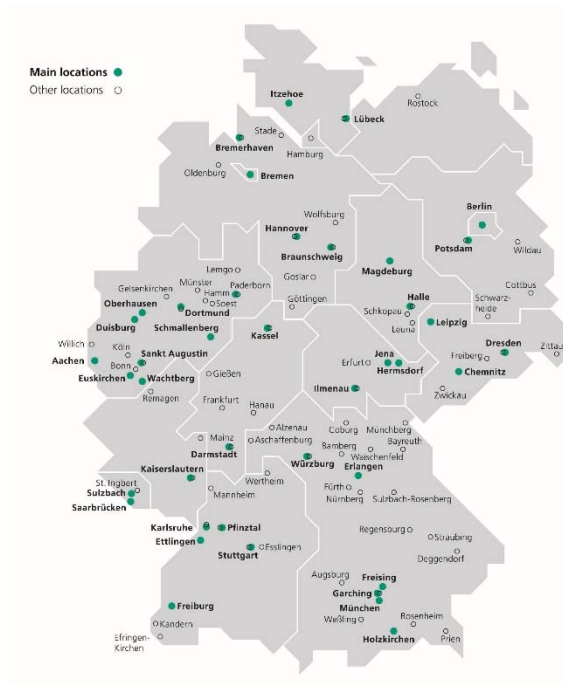
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# The Fraunhofer-Gesellschaft at a Glance

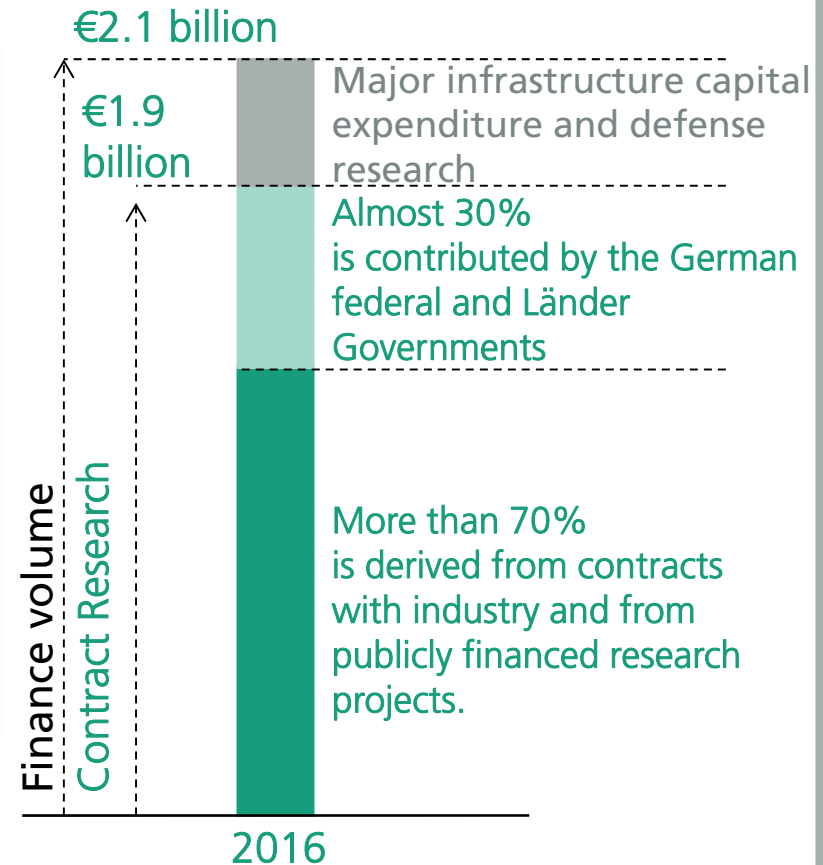
The Fraunhofer-Gesellschaft undertakes applied research of direct utility to private and public enterprise and of wide benefit to society.

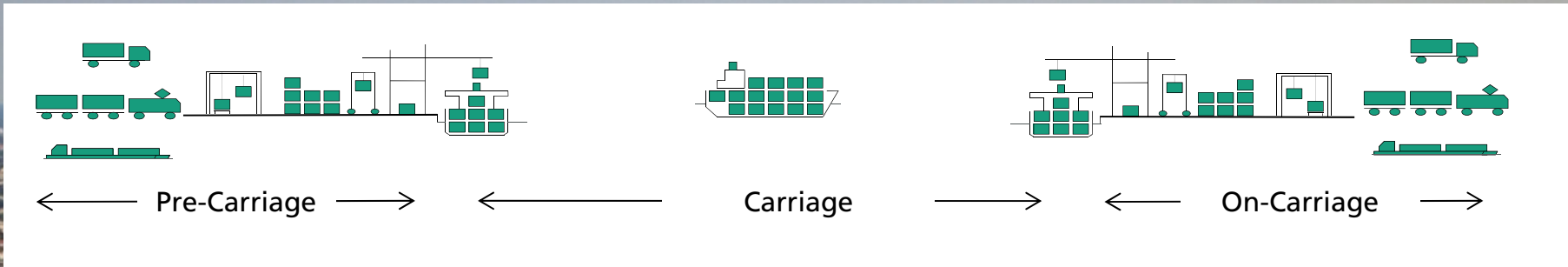


24,500 staff

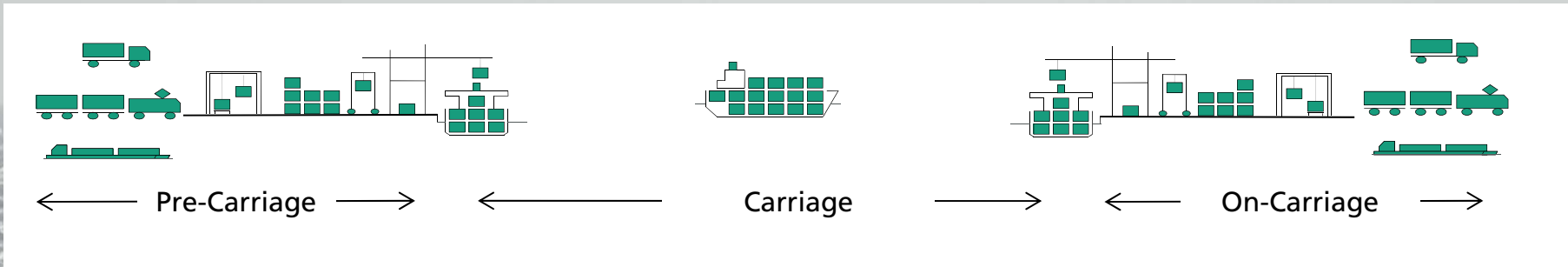



69 institutes and research units









## Port and Terminal Development

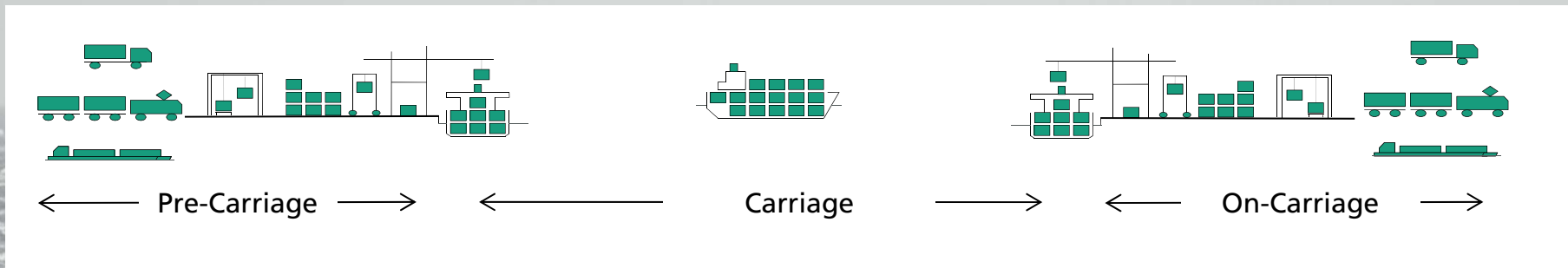


## Ship and Information Management



## Sea Traffic and Nautical Solutions





## Sea Traffic and Nautical Solutions

### Focus

- Develop innovative nautical technologies and processes
- Analyse, evaluate and optimize ship safety and efficiency

### Tools (e.g.)

- Ship technology test-bed framework
- Ship handling simulator bridges connected to EMSN (European Maritime Simulator Network)
- Maritime traffic analyses and risk assessment system



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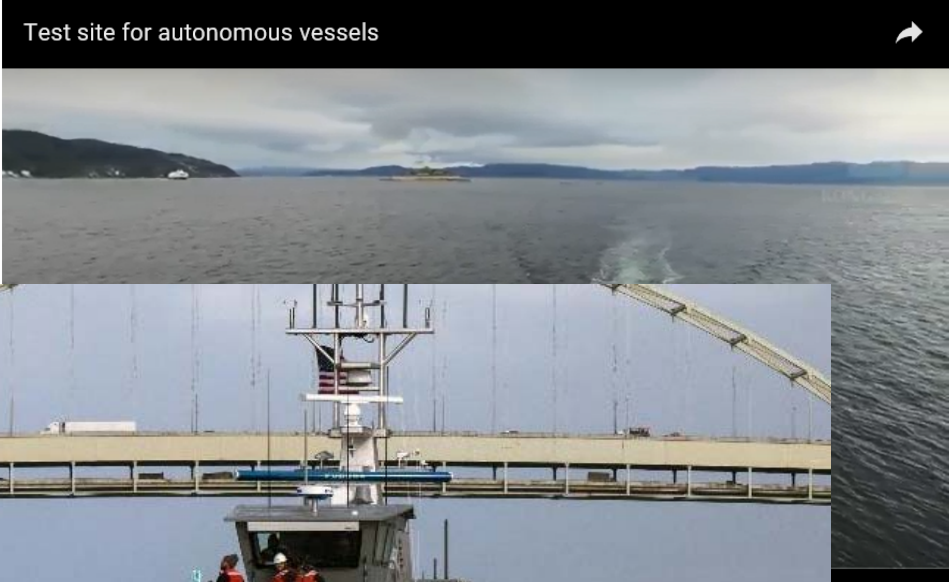


# Autonomous Ships: Models and Prototypes

Im Video: Autonome Schiffe im Maßstab 1:20

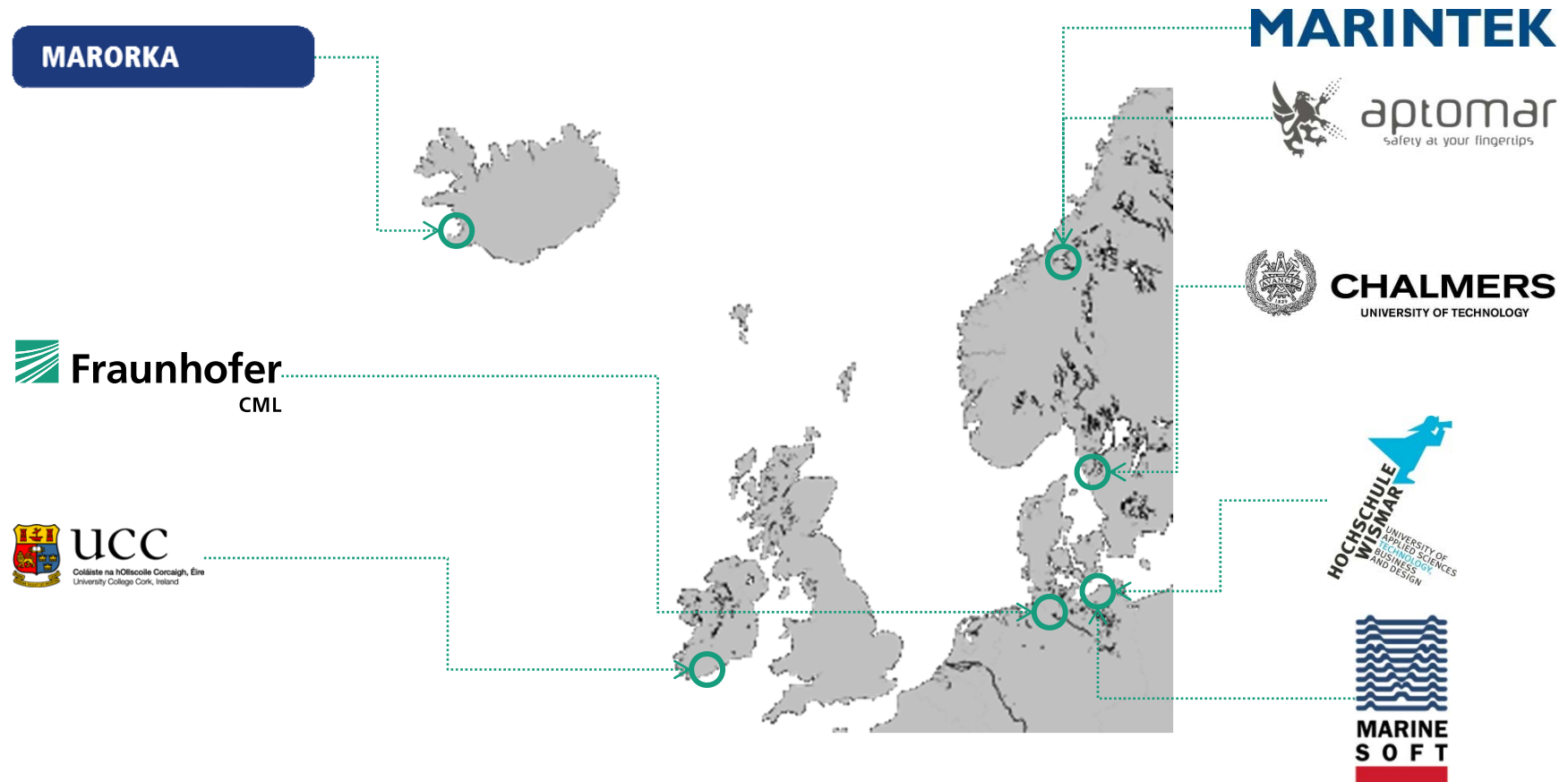


Trondheimfjord, Norway



# Autonomous ship development project MUNIN\* (EU)

- Develop a concept for an unmanned merchant vessel and prototypes for basic systems
- Validate concept in a simulator set-up



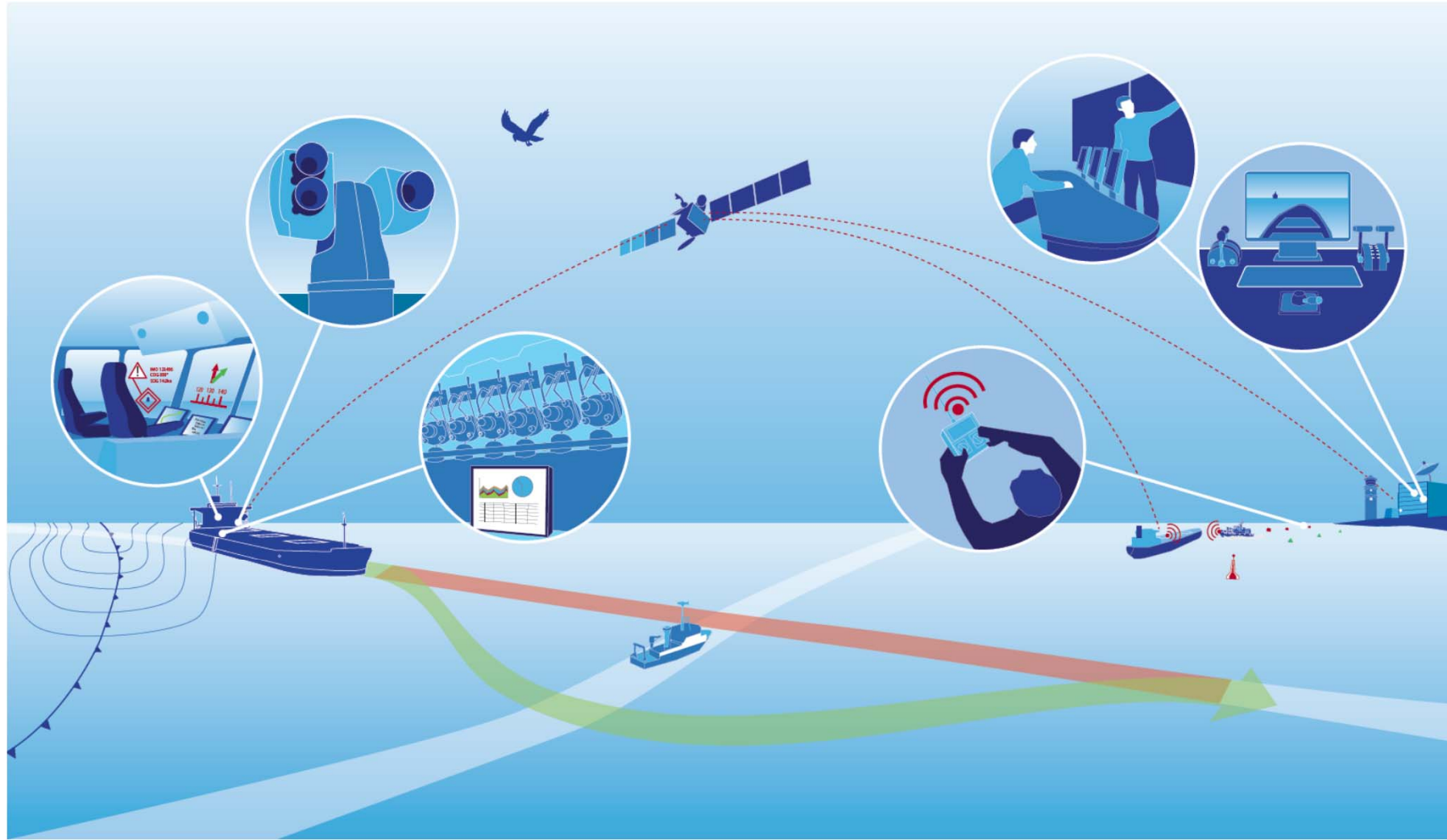
\* Maritime Unmanned Navigation through Intelligence in Networks

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# EU-Project MUNIN (2012-2015)

Vision of an autonomous deep-sea voyage



# Sensors and autonomous navigation

## From concept ...



### Advanced Sensors System

#### Electronic lookout

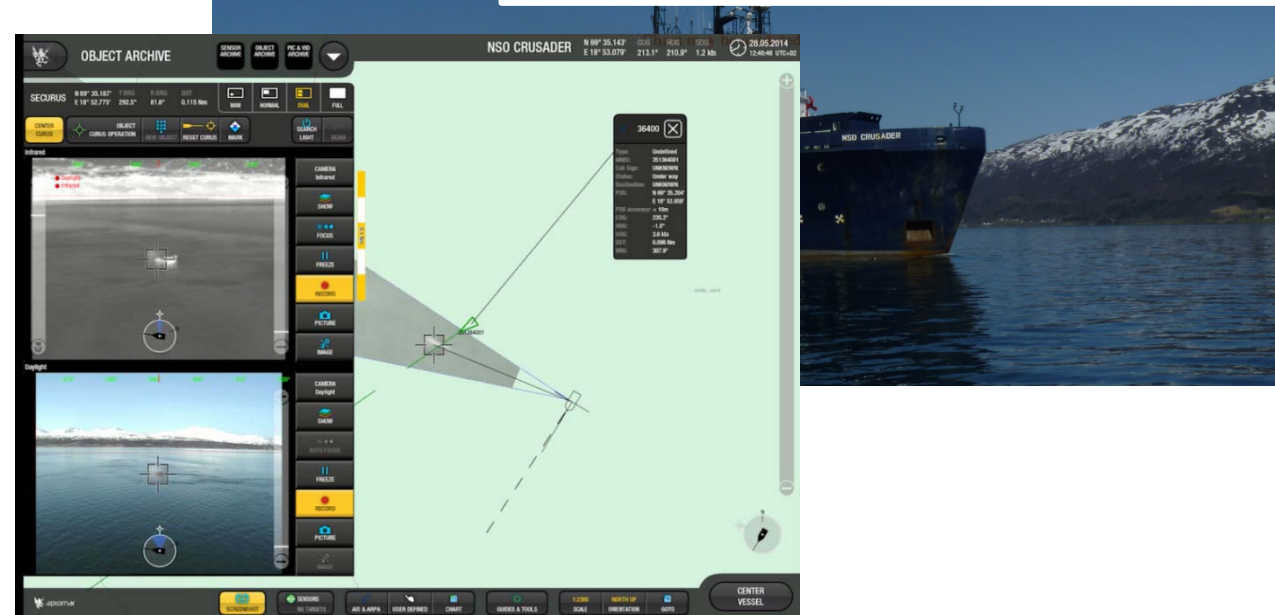
- Detect small objects
- Detect weather phenomena



# Advanced Sensor Module

## Electronic Lookout

- Detect small objects
- Detect weather phenomena



# Sensors and autonomous navigation

## From concept ...



### Advanced Sensors System

Electronic lookout

- Detect small objects
- Detect weather phenomena



### Autonomous Navigation System

Op. decision-making

- Avoid collisions
- Ensure stability in harsh weather

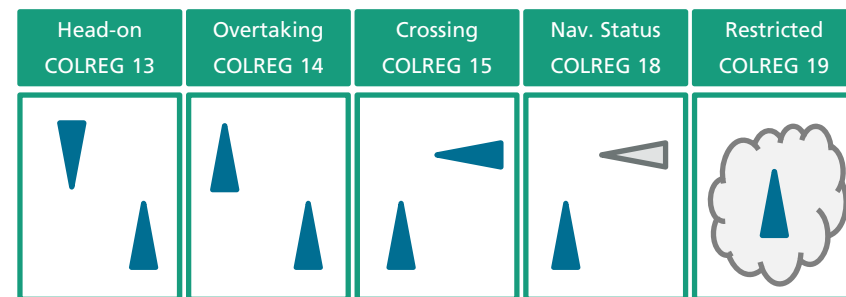
# Autonomous ship development projects

## Deep-Sea Navigation System: Collision avoidance handling



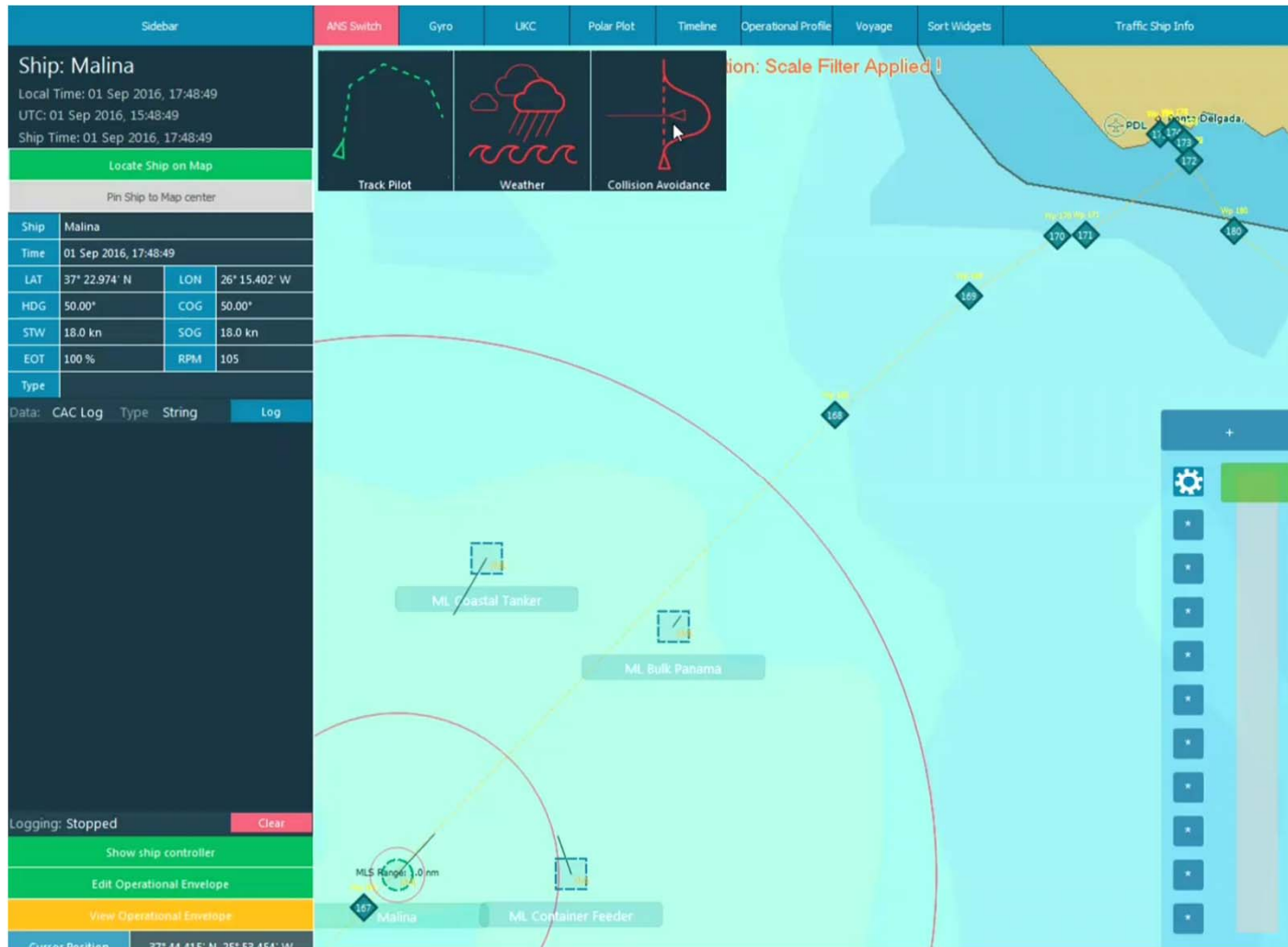
### Collision avoidance

- Prevent close ship to ship encounters
  - COLREG-compliance required
- Evade other obstacles on the ship's track
  - Not covered by COLREG



# Autonomous ship development projects

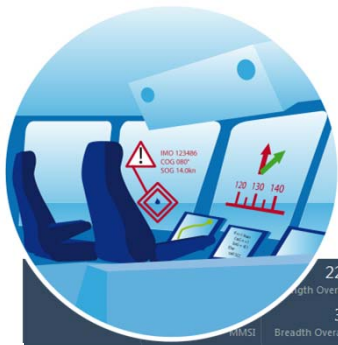
## Deep-Sea Navigation System: Collision avoidance handling





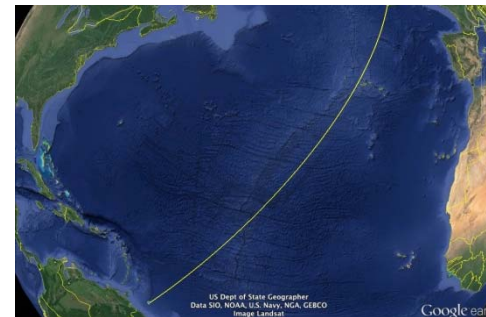
# Autonomous ship development projects

## Deep-Sea Navigation System: Harsh weather handling



### Weather routing

- Determine optimal route and service speed profile
  - Routeing restrictions, fuel efficiency and safety included
- Avoid unfavorable weather conditions
  - Ship responses optimised



# Sensors and autonomous navigation

## From concept ...



### Advanced Sensors System

Electronic lookout

- Detect small objects
- Detect weather phenomena



### Autonomous Navigation System

Op. decision-making

- Avoid collisions
- Ensure stability in harsh weather



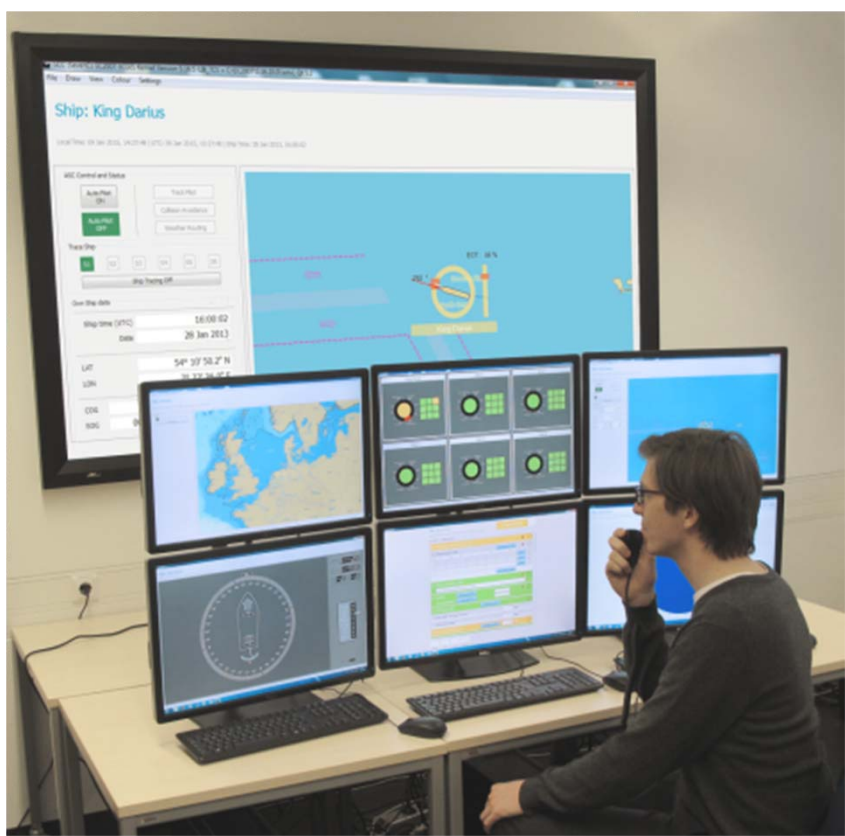
### Shore Control Centre

Human element

- Monitor voyage and vessel
- Problem-solving

# Shore Control Center

Monitor voyage and vessel  
Problem solving



# Sensors and autonomous navigation

## From concept ...



### Advanced Sensors System

Electronic lookout

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### Shore Control Centre

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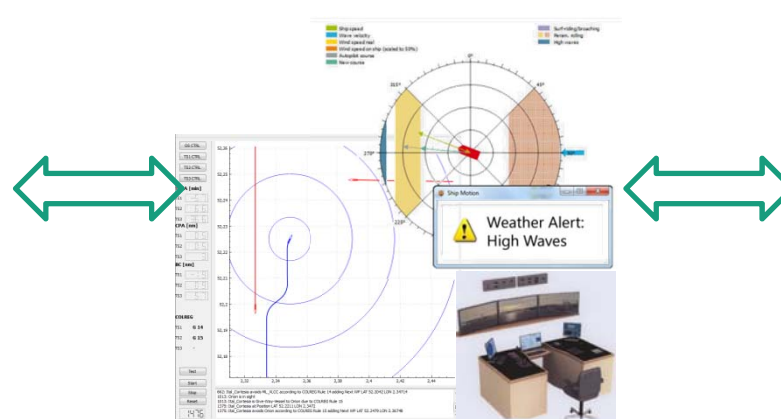
# Sensors and autonomous navigation ... to prototype implementation



## Advanced Sensors System

Electronic lookout

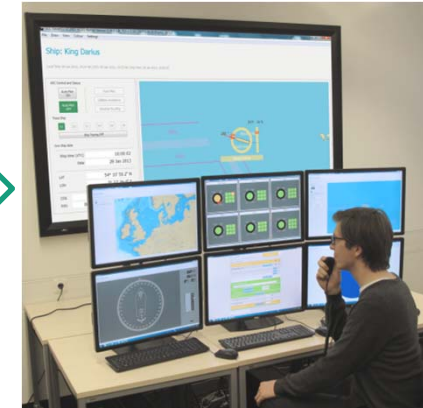
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## Autonomous Navigation System

Op. decision-making

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## Shore Control Centre

Human element

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# Autonomous ship development projects

## DSME\*: Follow-up project



Shore Control Centre



Autonomous Navigation System

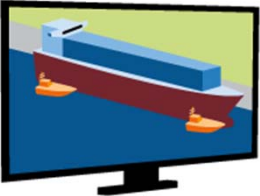
\* Daewoo Shipbuilding and Marine Engineering

# Autonomous ship development projects

## Test-bed: Ship handling simulators



**Stealth View**



Function:  
Free vision perspective



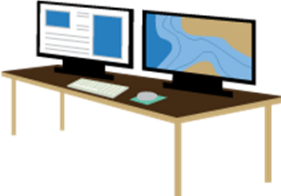
**Ship Handling Simulator**



Function:  
Real-time and interfaceable  
ship handling simulation



**Data Base Generating  
Station**



Function:  
Modelling of ship hydro-  
dynamics, ENC's and 3D objects

**Virtual Ship Handling  
Simulator**



Function:  
Multi-ship simulation

Exclusively used for research and development projects

# Autonomous ship development projects

## Test-bed: SMARTFRAME

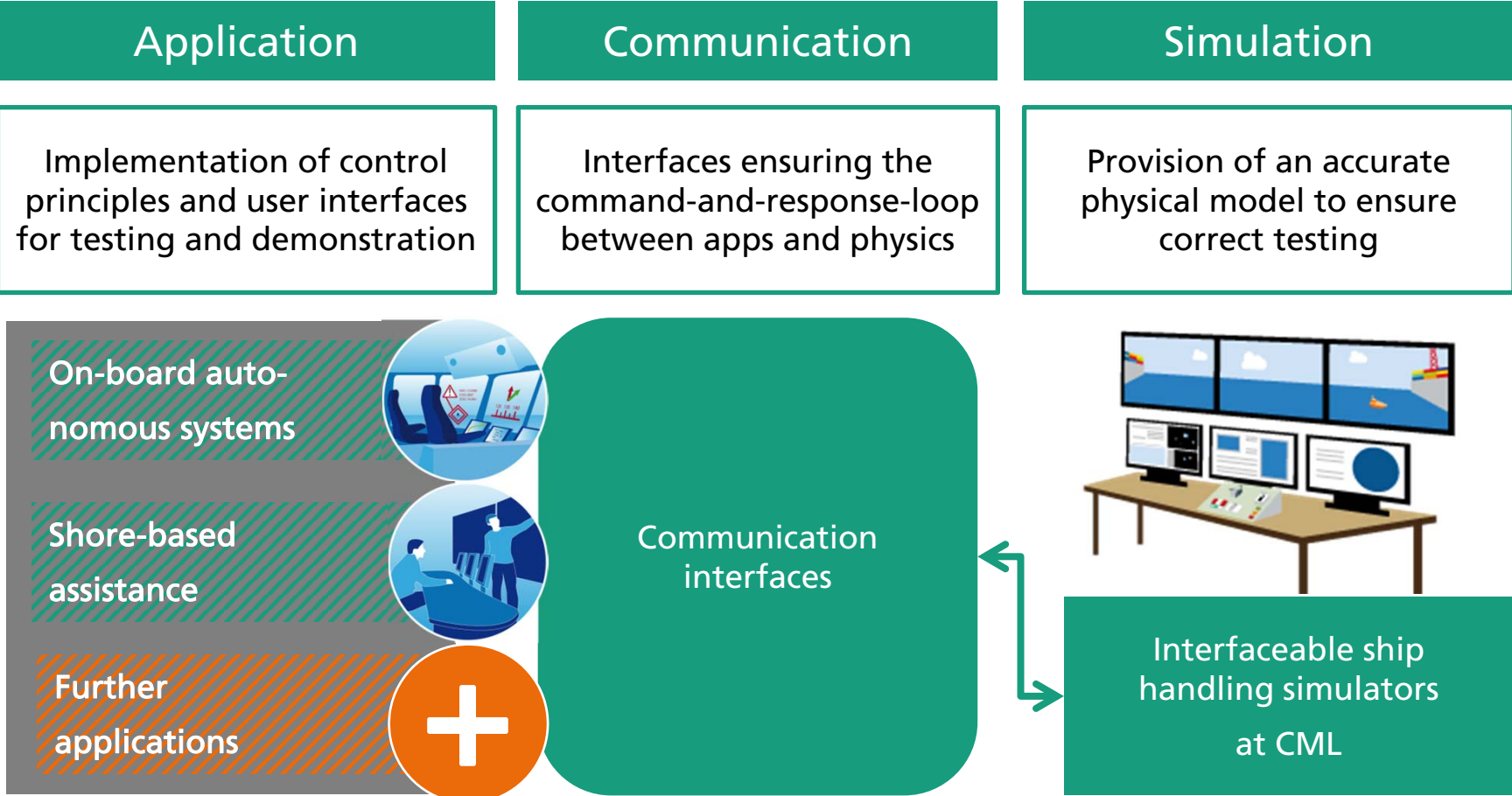


- Data exchange network → Real-time, Remotely accessible
- Link various modules → Software, Hardware, Simulators
- Scalable setup → Integration of new solutions, Reuse common functionalities



# Autonomous ship development projects

## Test-bed: Full-scale set up





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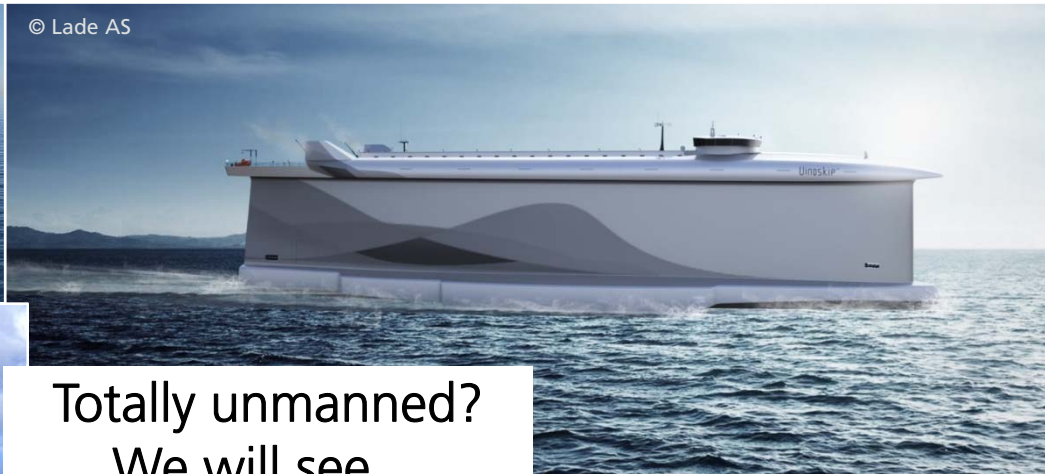
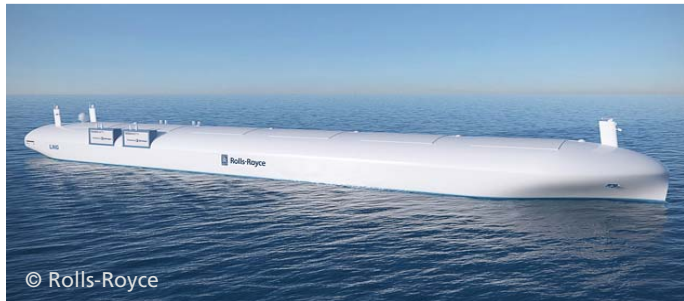
# Outlook

Intermediate steps expected e.g. autonomy-assisted manned ships and shore-based navigational assistance



# Outlook

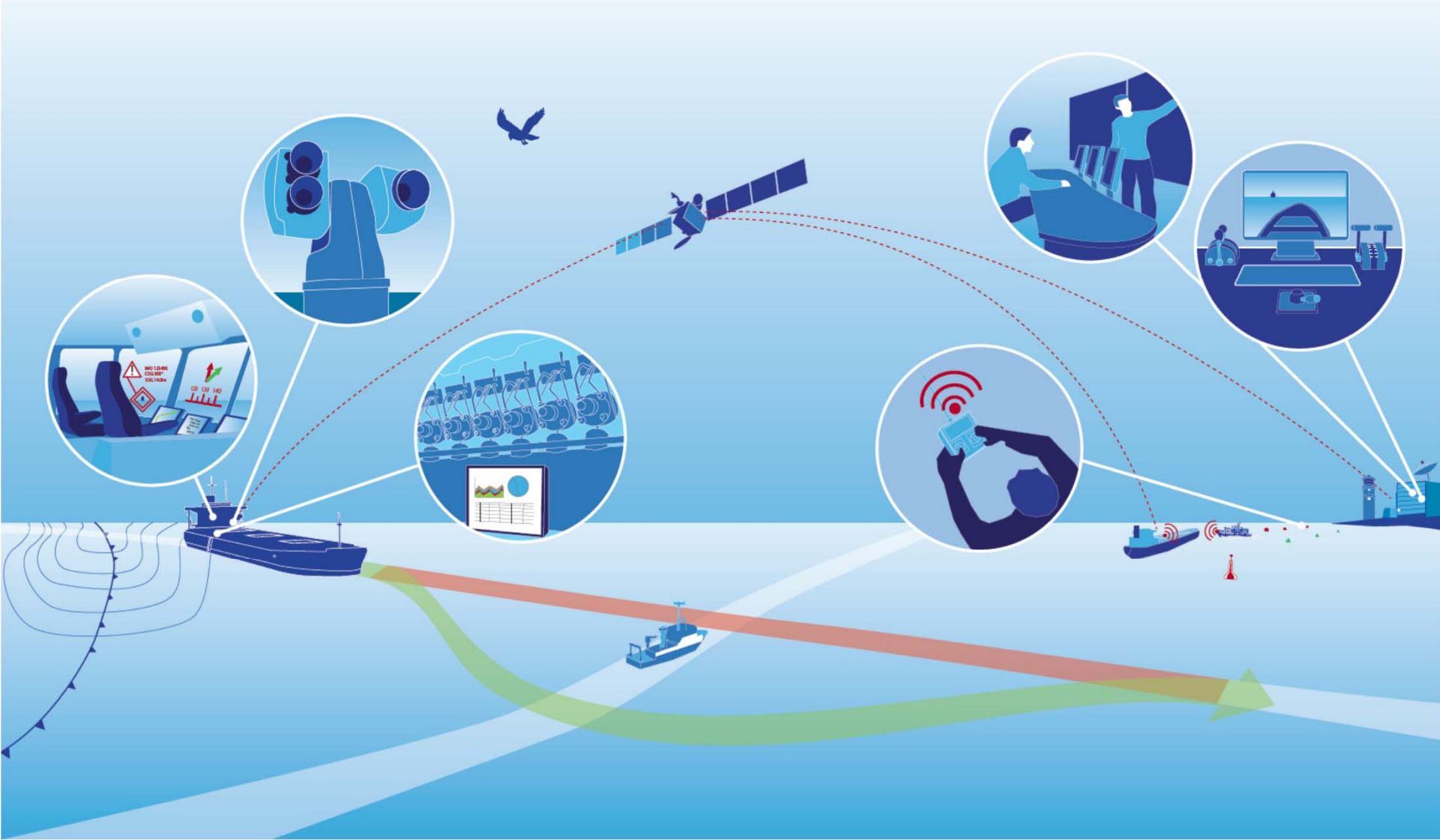
What will the future of shipping look like - tomorrow



Totally unmanned?  
We will see...



THANK YOU VERY MUCH FOR YOUR ATTENTION!



# Contact

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