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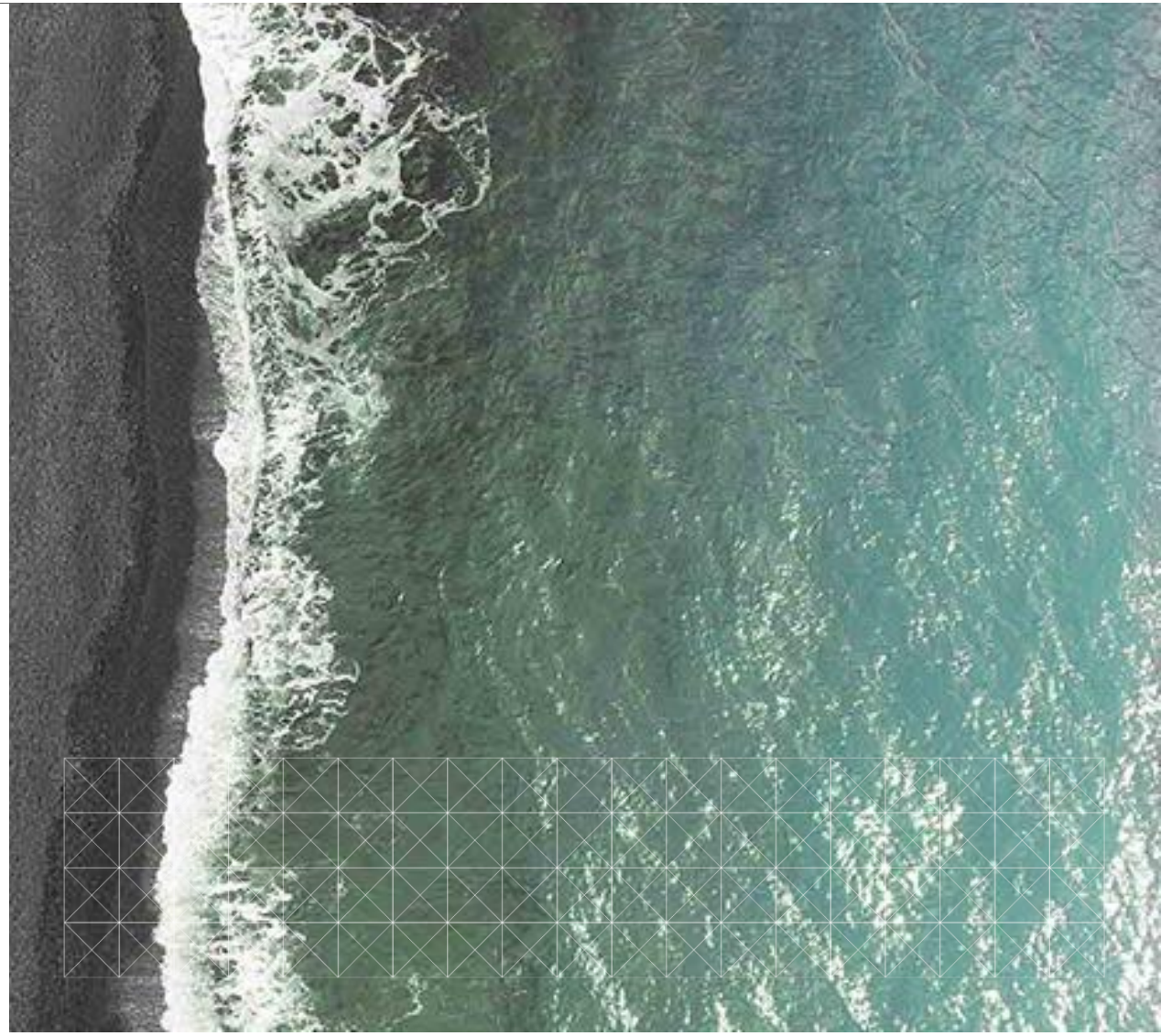
DYNAMIC POSITIONING CONFERENCE

Who moved my DP

October 15, 2019

Vivek Barve



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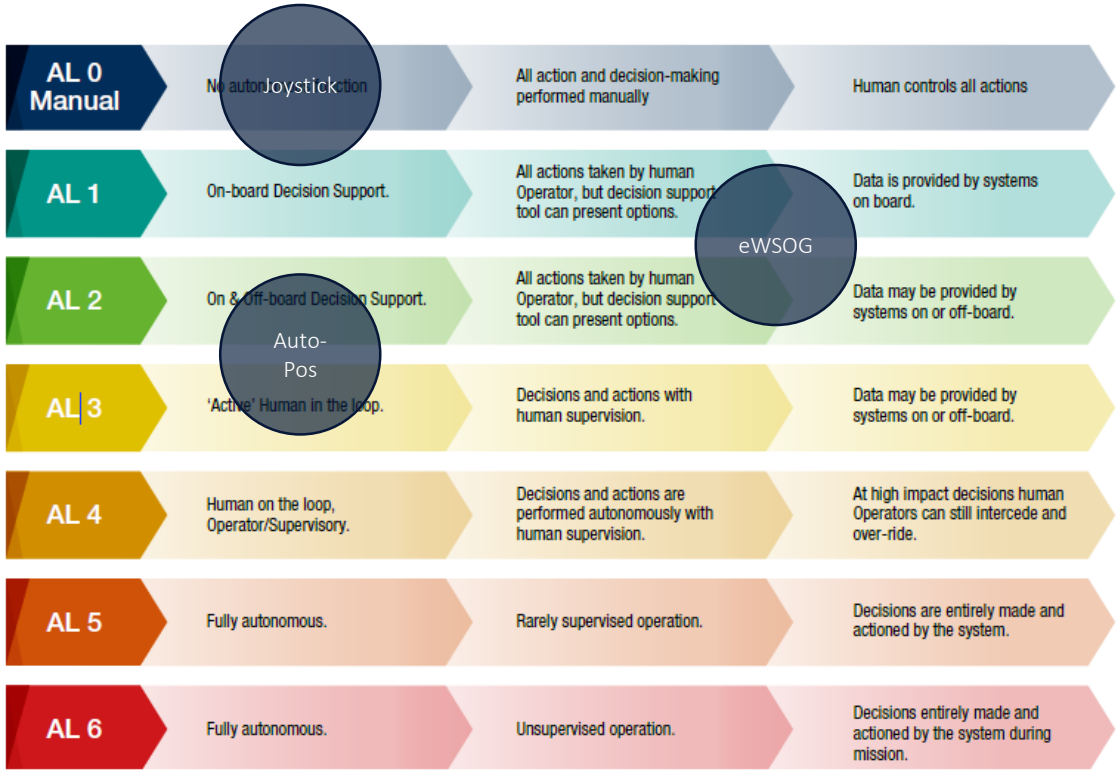
Introduction

Definitions

- Capacity of a system to self-govern under significant uncertainties without intervention
- Multiple definitions for Levels of Autonomy
  - Automated functions and self-governance
  - Manning level
- Lloyds Register and Norwegian Forum for Autonomous Ships
- System Autonomy is a function of sub-system autonomy



Hamburg School of Business Administration. (2018). *Seafarers and digital disruption*.

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Automation vs Autonomy vs Manning

- Automated Systems
  - control structured and repetitive processes
  - respond with pre-programmed actions
  - respond only within system parameters
  - cannot handle unforeseen situations
- Autonomous Systems
  - solve problems on the fly
  - make decision based on conditions
  - adapt to conditions
  - respond to unforeseen or abnormal situations
- Manning
  - depends on the operation
  - shore-side control centers required
  - sub-system with limited automation

- Capacity to self-govern
- Level of Human Intervention
- Manning requirements for the Operation

Automatic bridge – Operator assistance

Operational autonomy levels	Manning levels		
	Manned bridge	Unmanned bridge – crew on board	Unmanned bridge – no crew on board
Decision support	Direct control No autonomy	Remote control	Remote control
Automatic	Automatic bridge	Automatic ship	Automatic ship
Constrained autonomous	-	Constrained autonomous	Constrained autonomous
Fully autonomous	-	-	Fully autonomous

©NFAS, *NFAS Definitions for Autonomous Merchant Ships*

Remote control

Operational autonomy levels	Manning levels		
	Manned bridge	Unmanned bridge – crew on board	Unmanned bridge – no crew on board
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Constrained autonomous	-	Constrained autonomous	Constrained autonomous
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Remote firefighting

Fully autonomous

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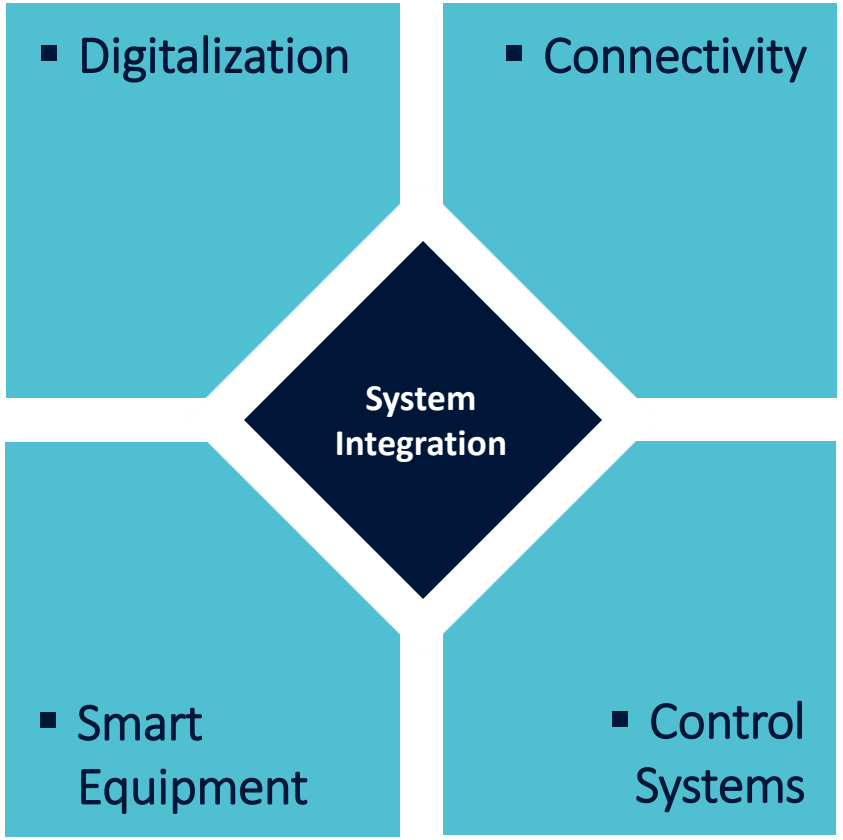
©NFAS

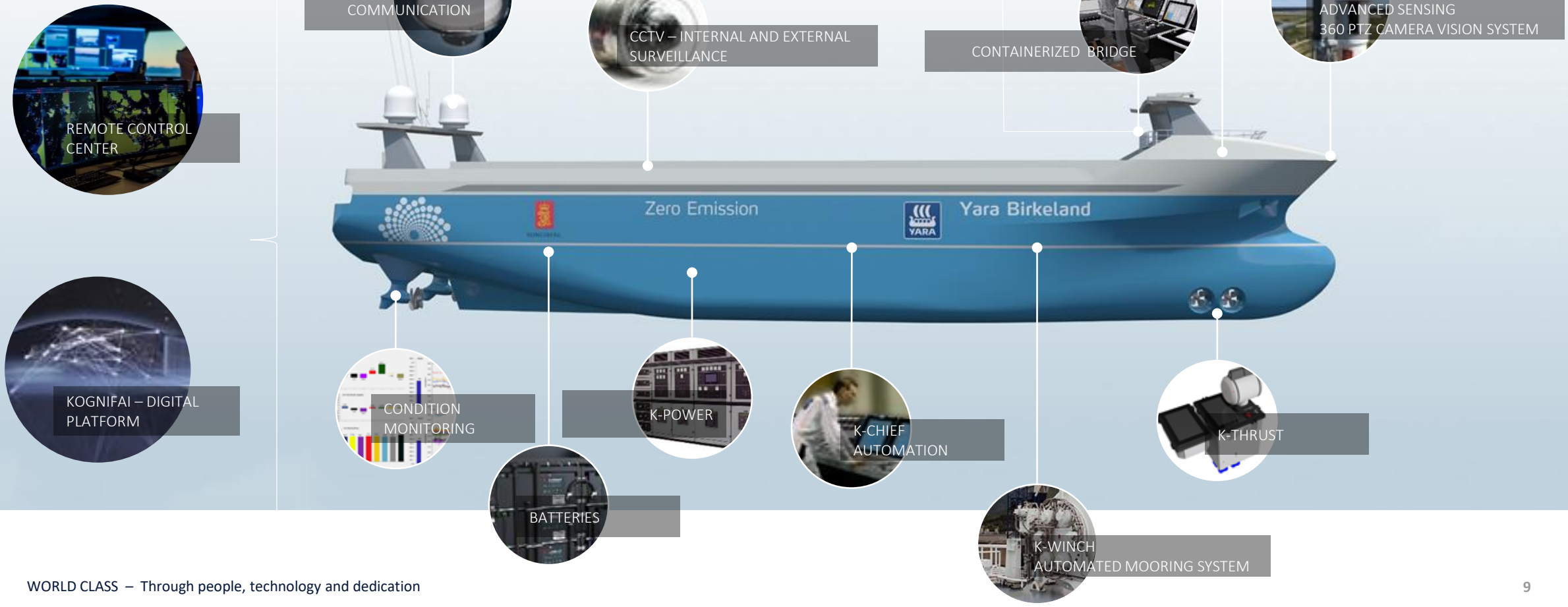
Sea-bed exploration (USV with AUV)

Enablers

- Digitalization
  - Create value by leveraging digital technologies
- Connectivity
  - Increased connectivity
  - Bandwidth and Latency improvements
- Smart Equipment and Data
  - Equipment capable of self-regulation
  - Data generation and reporting
  - Low-level monitoring
- Control Systems
  - Most system's automated or available to automation
  - Increased integration
  - Common data platform



System Integration



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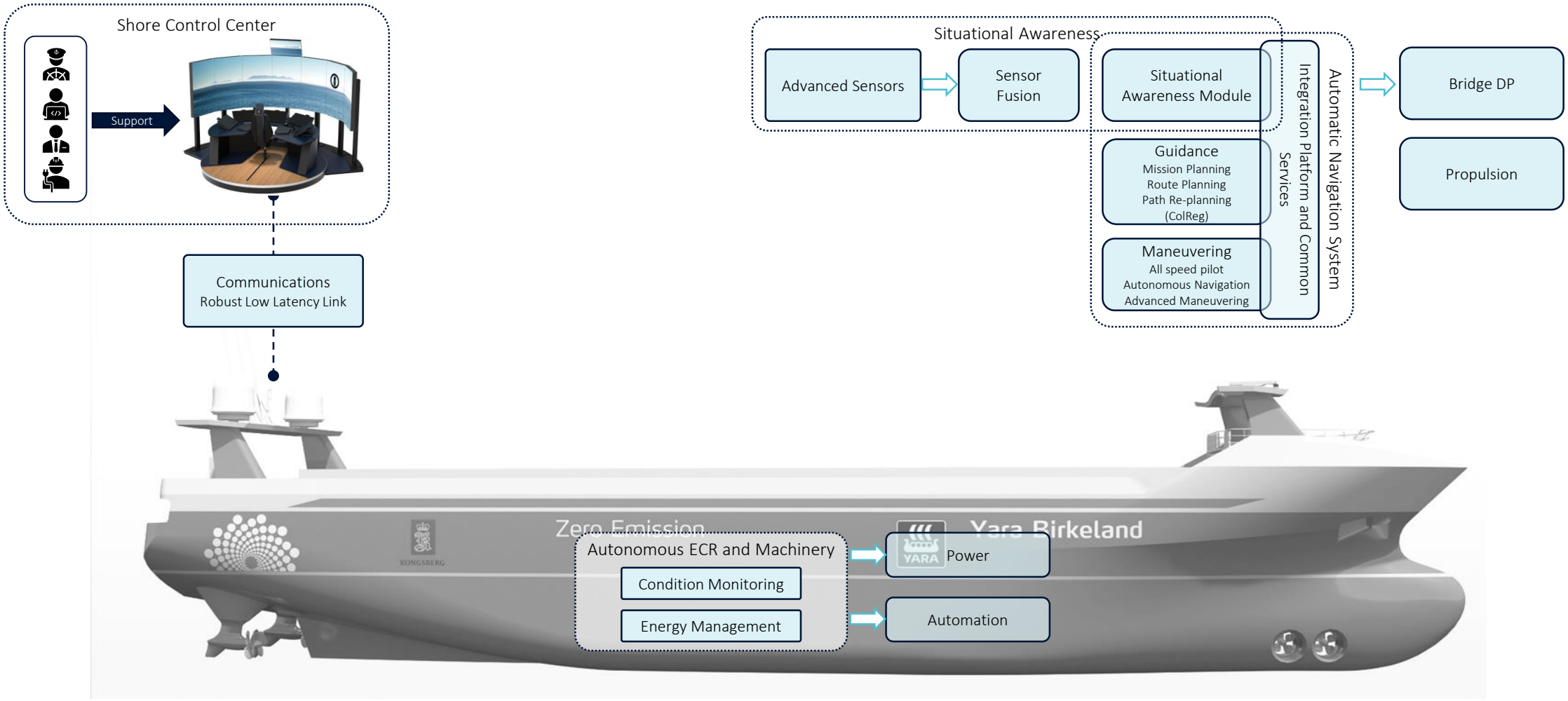
Autonomy

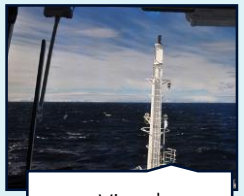
Key Functions

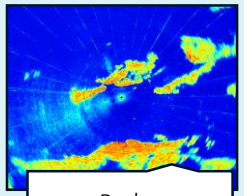


Situational Awareness

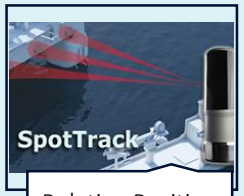
Sensor Fusion

Advanced Sensors with Sensor Fusion

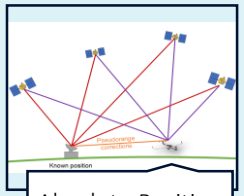

Visual

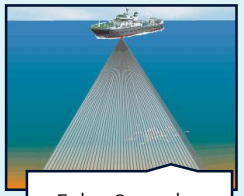

Radar

Motion



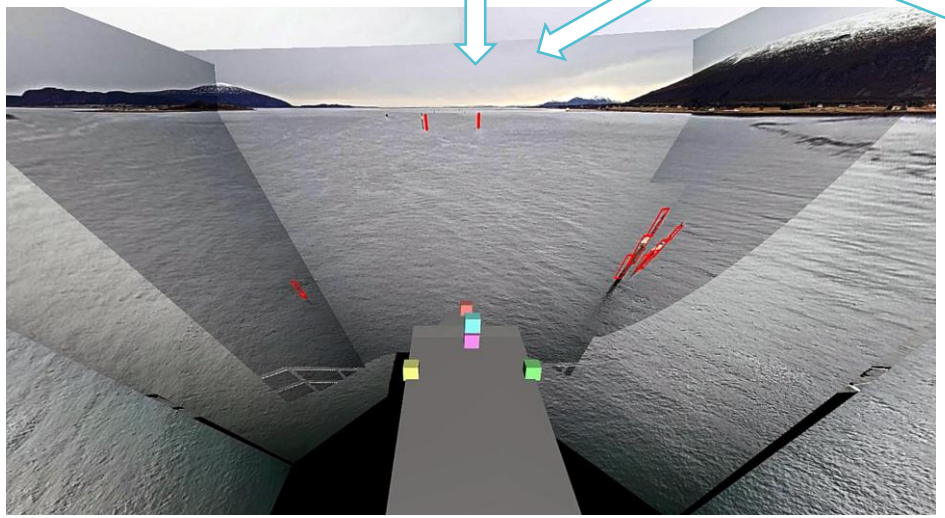
Relative Position


Absolute Position


Echo Sounder

External

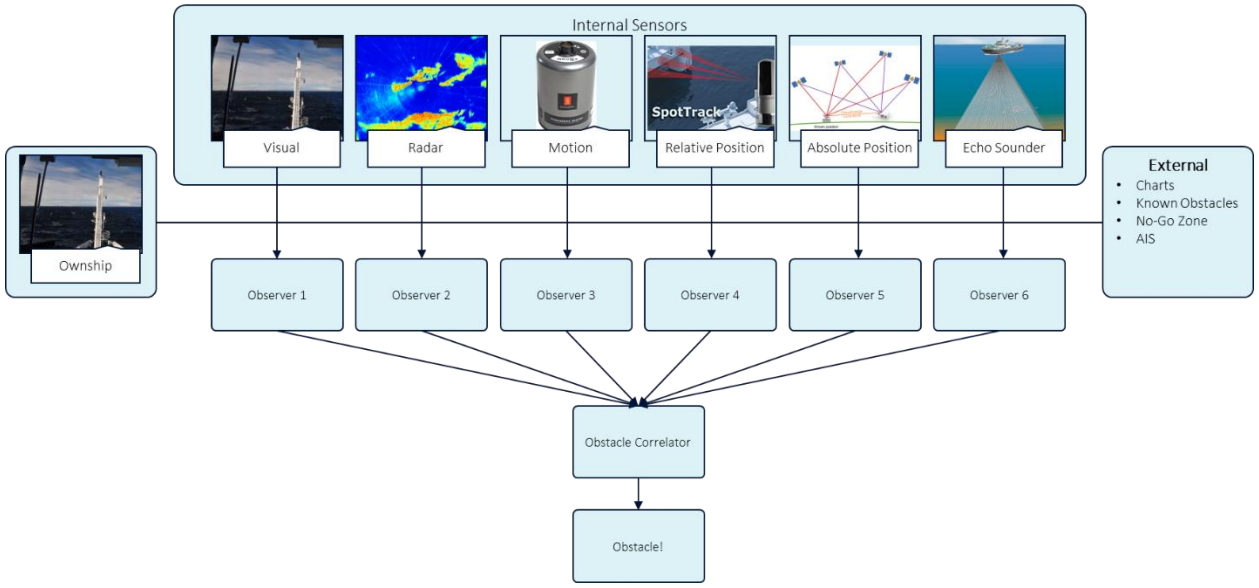
- Charts
- Known Obstacles
- No-Go Zone
- AIS



www.fraps.com

Obstacle Detection System

- Observer for each sensor compared against OwnShip
  - Absolute position of Obstacle from local observer
  - Obstacle quality KPI
- Multiple observed obstacles correlated
  - Redundancy in obstacle detection
  - Comparing against repository of existing obstacles
  - Duplicate consolidation
- Obstacle disposed based on conditions
  - Reduced chance of new obstacle being reported as known
- Obstacle Quality
  - Sensor capability
  - Loss of Sensor or Network
  - Raise “uncertain quality” flags



THE FUTURE OF SENSOR FUSION

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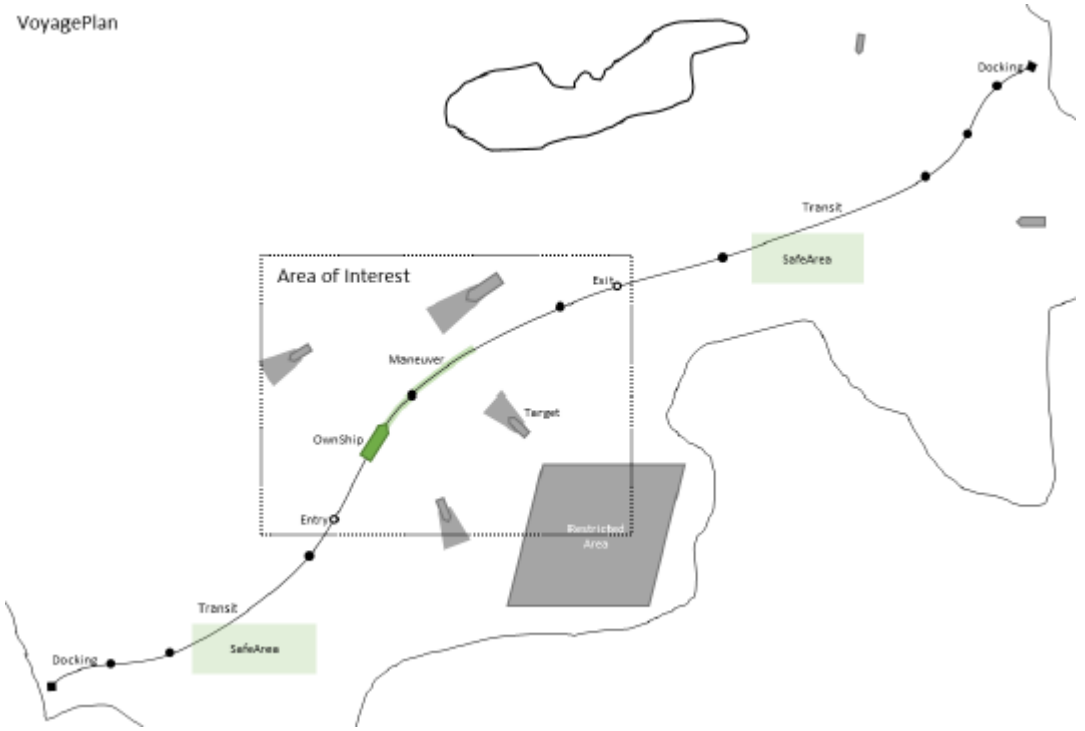
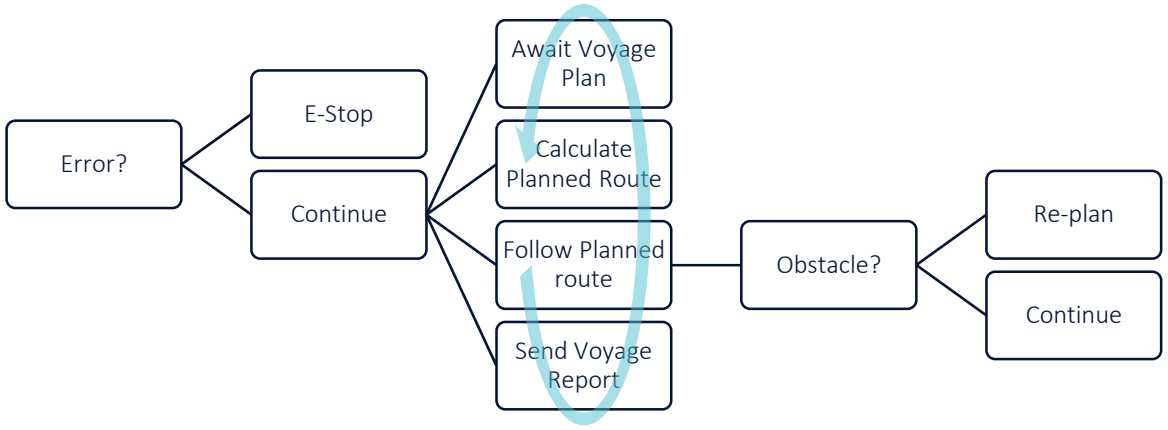
Obstacle Avoidance System

- Analyzing and selecting routes based on obstacles
- Re-routing based on obstacle information
  - Existing route
  - Optimization to avoid obstacle
- Area of Interest:
  - Sliding window captures obstacles
  - Route re-planning based on Entry and Exit points
- Route analyzer
  - Calculates optimum route at all times
  - Least-cost method to minimize deviations
- Account for projected trajectories of obstacles
  - Avoid unnecessary route re-planning



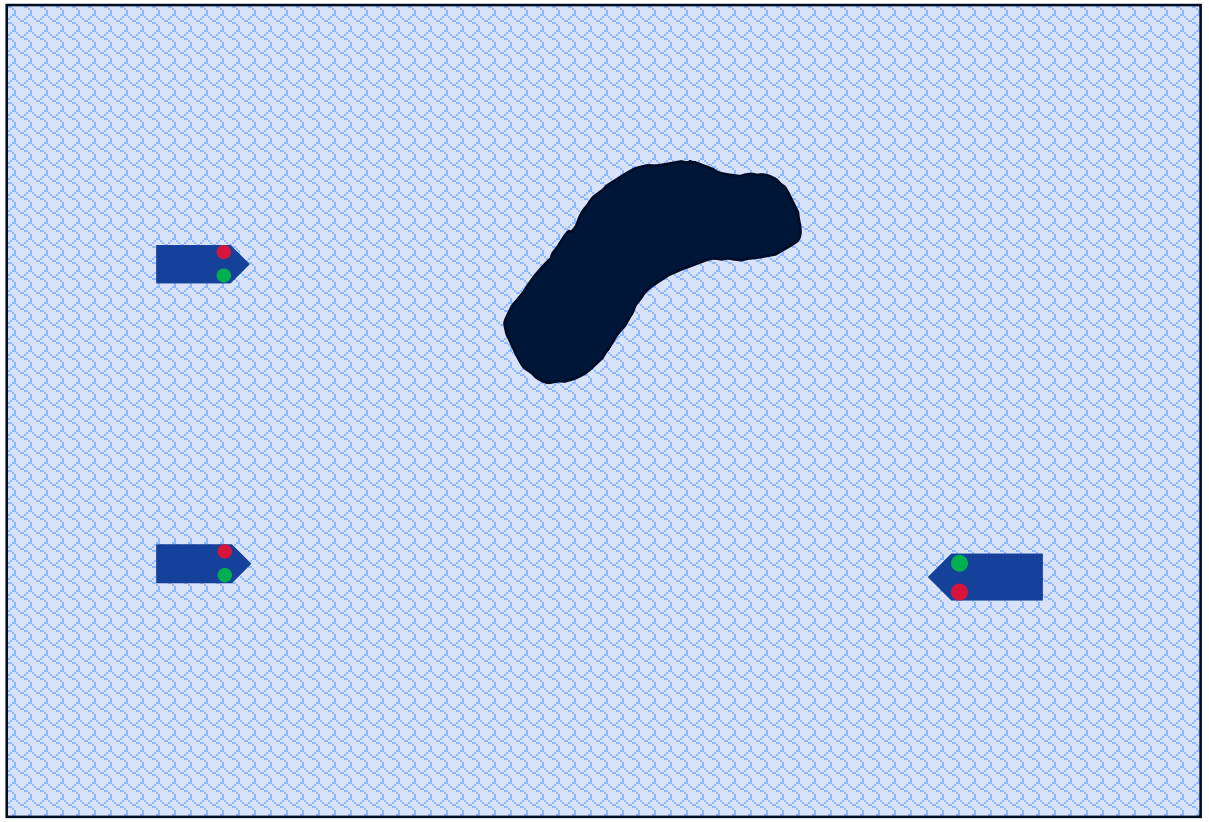
Voyage Control System

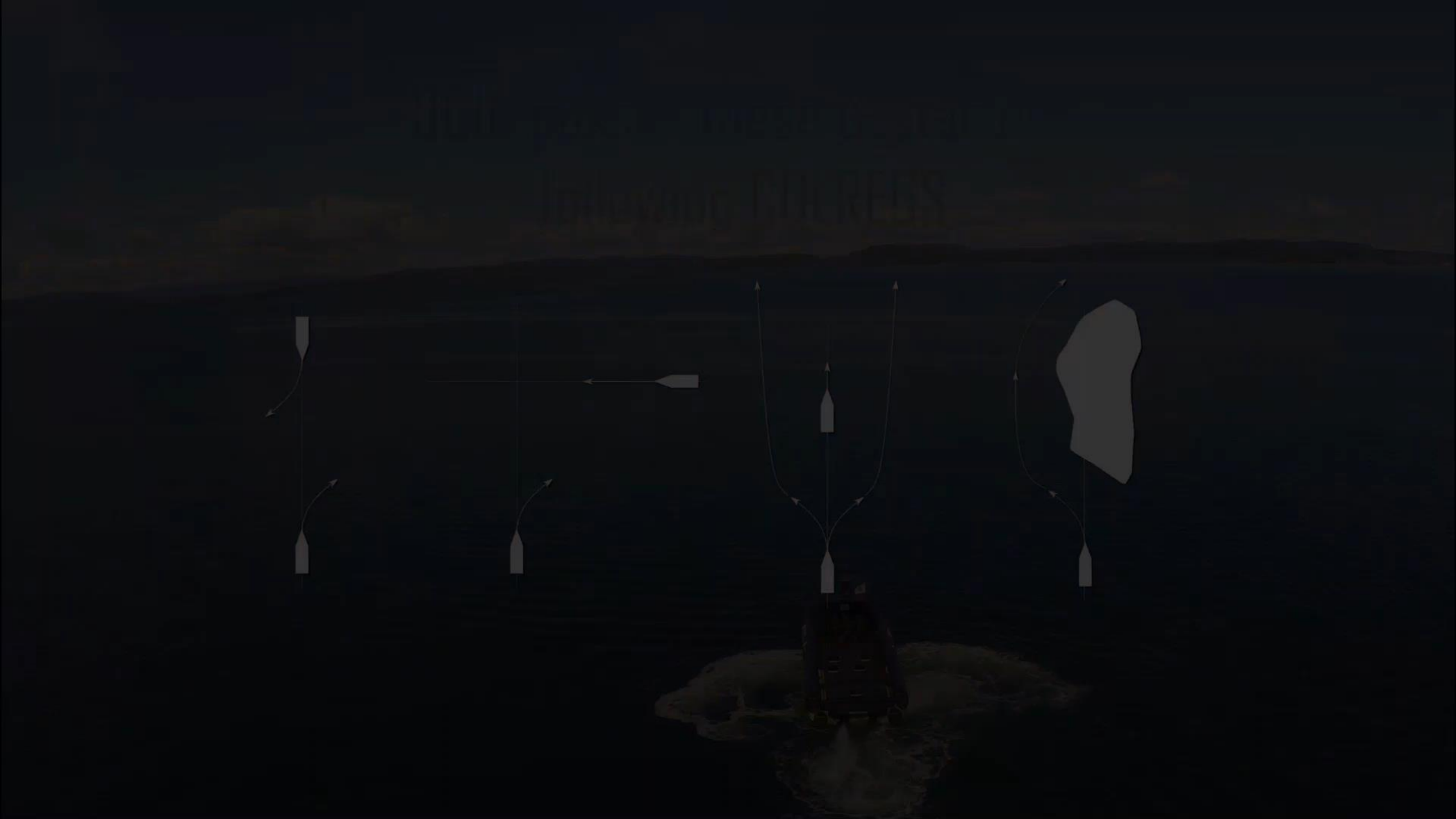
- Responsible for overall execution
  - Planned route
  - Alerts
  - Vessel capabilities
  - Operational constraints
- Decision engine and behavior-tree
  - Standard Operating Procedures
  - Regulations



Guidance and Collision Aviodance

- Planning and re-planning in real-time
- Navigational safety to Obstacle avoidance
- Collision avoidance
  - ColReg
  - Predicted and projected trajectories



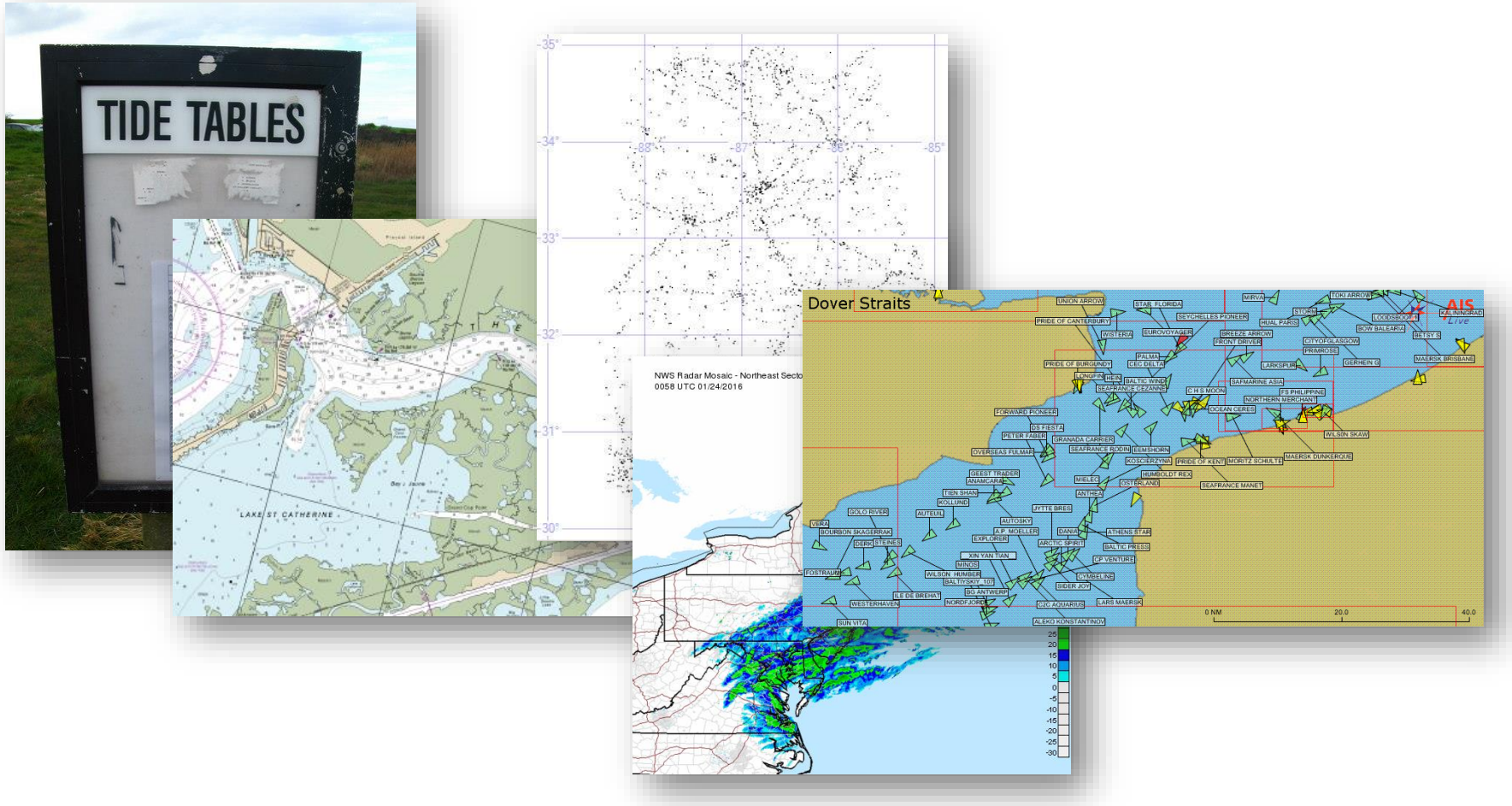


Internal Systems

- Grounding avoidance
  - Avoid obstacles below the waterline
  - Sensor fusion: Charts, Tide Tables, Echo Sounders
- Energy Control System
  - Maintain required power
  - Condition-based decision making
  - Batteries to reduce environmental impact
- Ownship
  - Speed and Position
  - Relative obstacles
- Vessel Capabilities
  - Online and real-time capability analysis
  - Power, Machinery, Ballast and other sub-systems

External Systems

- Data Sources
  - Tide Tables
  - Charts
  - Known Obstacle Databases
  - Weather Forecasts
  - Vessel Traffic Service



Lisa Jarvis / *Tide Tables* / CC BY-SA 2.0

Shore Control Center

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DP Operations

First Remote DP Application

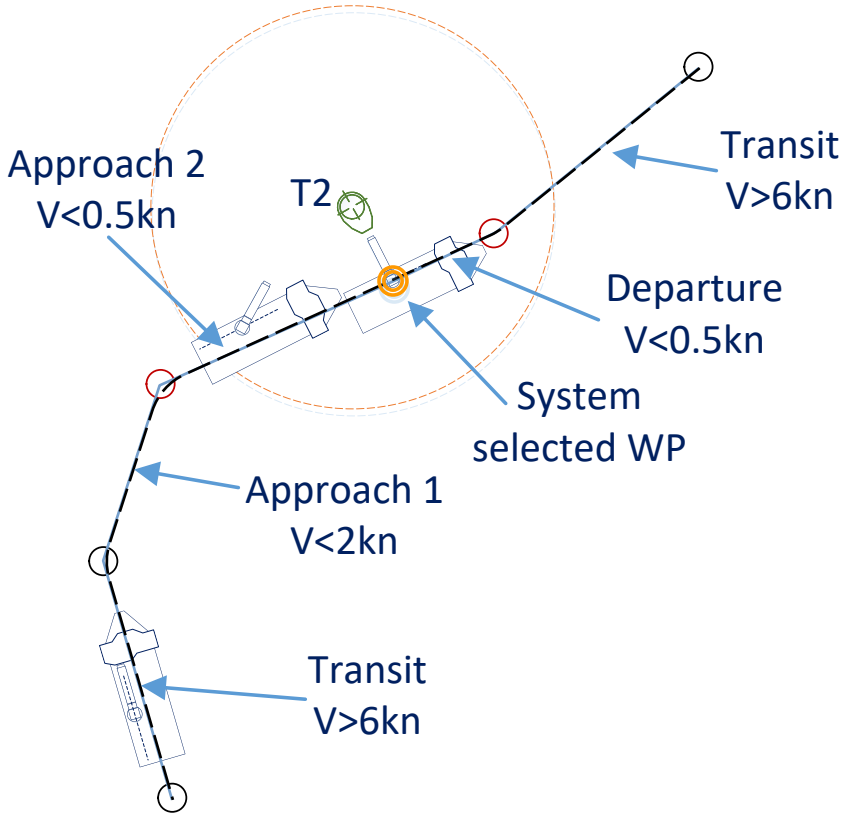
Sea Launch Odyssey and Commander

Sea Launch Commander located 5 km away from Sea Launch Odyssey during launch. Remote controlled operations sequence, including DP (SDP)

First launch in March 1999. 36 launches completed.

Wind Farm Support

Combining Low-speed and High-speed application



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Conclusion

Conclusion

Our DP will move our DP

- New operations and Business Models
- Autonomy and Sustainability
- Remove people from harm's way
- Journey to "Maritime 4.0"

2019 United Nations Sustainable Development Goals

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Thanks

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