

AUTONOMOUS COMMAND & CONTROL FOR VESSELS



SEA MACHINES

**Achieving Critical
MASS
July 22, 2019**

BUILDING THE FUTURE OF OCEAN MOBILITY



- Crew of 33 in Boston and Hamburg
- Mariners, autonomy scientists, engineers and experts in MLAI
- Product-minded; we build commercial systems
- World leader in testing & validation in the marine domain
- Two products on market
- Backed by U.S. venture capital
- Practical technology, from development to deployment

A SIGNIFICANT & ACTIVE DOMAIN

Purposes

- Transports 90% of global trade by volume
- Provides 30% of the world's hydrocarbons
- 20Gw of offshore wind power and growing
- Primary food source for over 1 billion people
- Key recreational sector
- The frontier to support expansion of society

Magnitude

- 20 Million vessels operating globally
- \$1 Trillion spent annually on operations
- 5% of world GDP

INDUSTRIAL ERA TECHNOLOGY OPERATING IN THE DIGITAL AGE

Consequences

- Restrained capability
- Delays
- Accidents
- Too much effort per \$ earned



SEA MACHINES

WHAT MOVES THE MODERN OPERATOR?

BETTER

FASTER

CHEAPER

The 21st century maritime industry demands performance improvements as delivered by advanced operational technologies

- Enhanced situational awareness
- Predictable control
- Productive and efficient data-driven conveyance

THE MAKINGS OF THE FUTURE SHIP

DIGITAL

EMISSION-NEUTRAL

NETWORKED

ELECTRIC PROPULSION

DATA-DRIVEN

REMOTELY ACCESSIBLE

AUTONOMOUS



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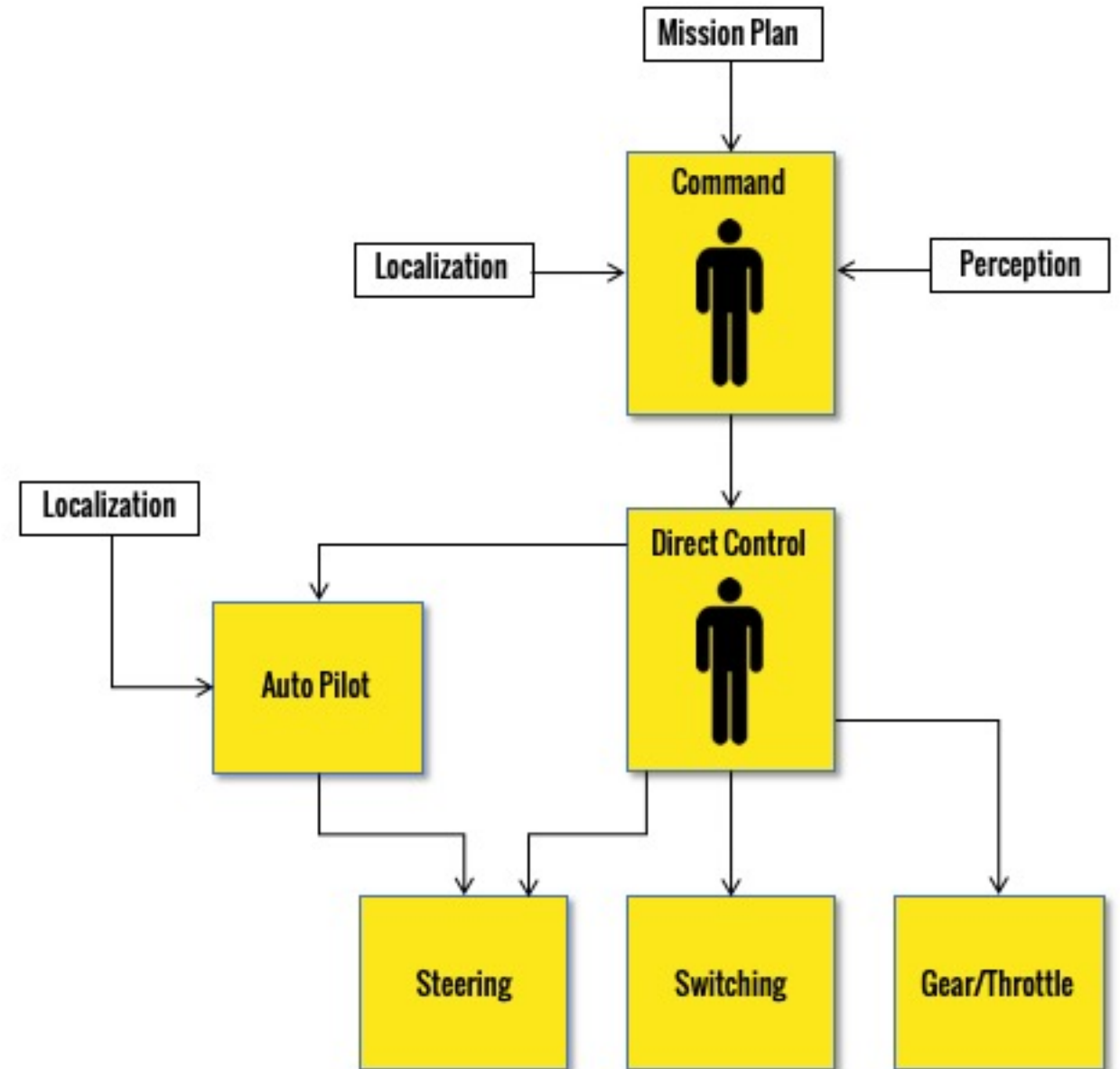
AUTONOMOUS

REMOTELY ACCESSIBLE

CONVENTIONAL VESSEL OPERATIONS

Human:

- Command
- Mission plan
- Mission execution
- Localization
- Perception
- Control



AUTONOMOUS VESSEL OPERATIONS

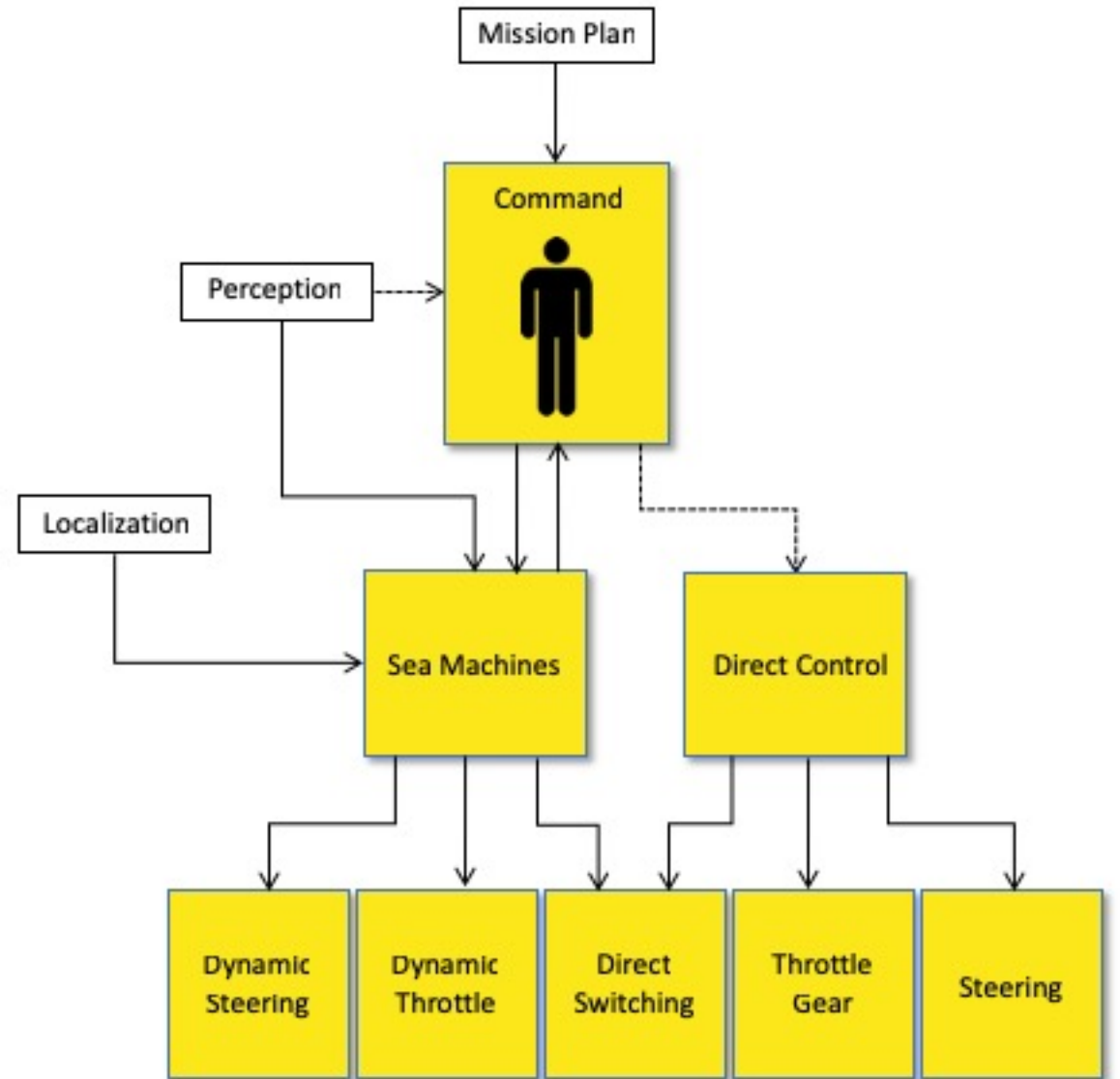
Human:

- Command
- Mission plan



Sea Machines:

- Mission execution
- Localization
- Perception
- Control



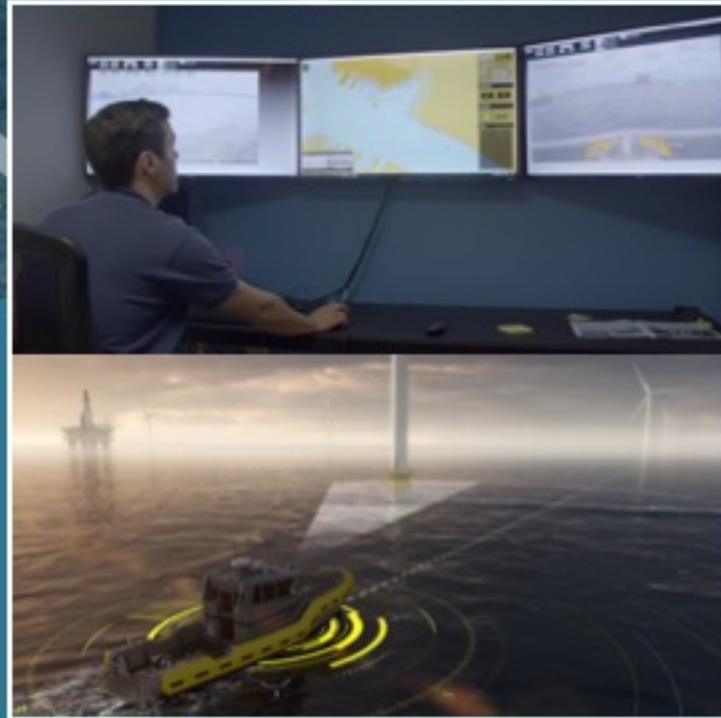
OUR PRODUCTS

SM200



Direct wireless control of vessel and payloads via personal backpack with 1-2 km range

SM300



Industrial grade man-in-the-loop autonomous control for workboats and utility craft

SMXXX



To be announced

SM200 WIRELESS REMOTE CONTROL



- **System Capability & Features**

- Propulsion & Steering: Engine start, stop, throttle, gear
- Payloads: pumps, winches, davit, sensors
- Telematics / Remote Monitoring

- **Expands Control Zone / Improves Situational Awareness**

- Outside of Wheelhouse - on Deck or Bridge wing
- Off vessel - from shore, land, or other vessel

- **Enables Capability in High-Risk Operations**

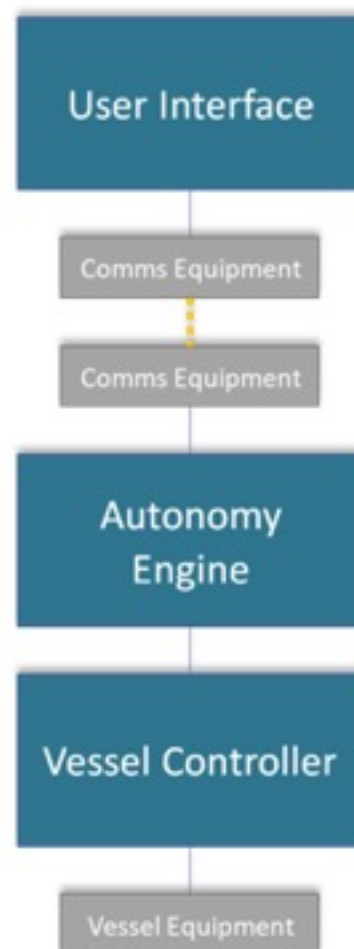
- **Applications**

- Tugs: Barge Handling & Fleeting
- Aquaculture
- Fireboats
- Spill Response
- Interceptors

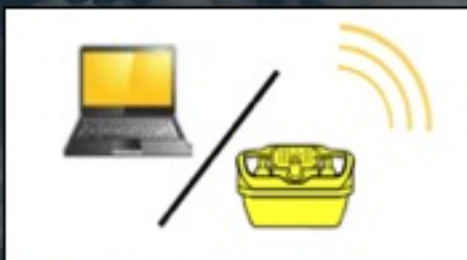


SM300 AUTONOMOUS COMMAND & CONTROL

- **Edge System with Remote C2**
- **Autonomous Missions**
 - Waypoint
 - Grid Survey or Search
 - Multi-Vessel Collaboration
- **Localization & Perception**
 - GNSS Compass & INS
 - AIS
 - Marine Radar
 - HD Video
- **Command via:**
 - Local on Vessel (Crew Support)
 - Remotely from Mothership or Shore



AUTONOMY SYSTEM ARCHITECTURE



COMMAND STATIONS

WIRELESS COMMS

GPS

RADAR

THERMAL CAMERA

STEERING CONTROL

SEA MACHINES SM300

ENGINE/TRANSMISSION MANAGEMENT

User Interface

Comms Equipment

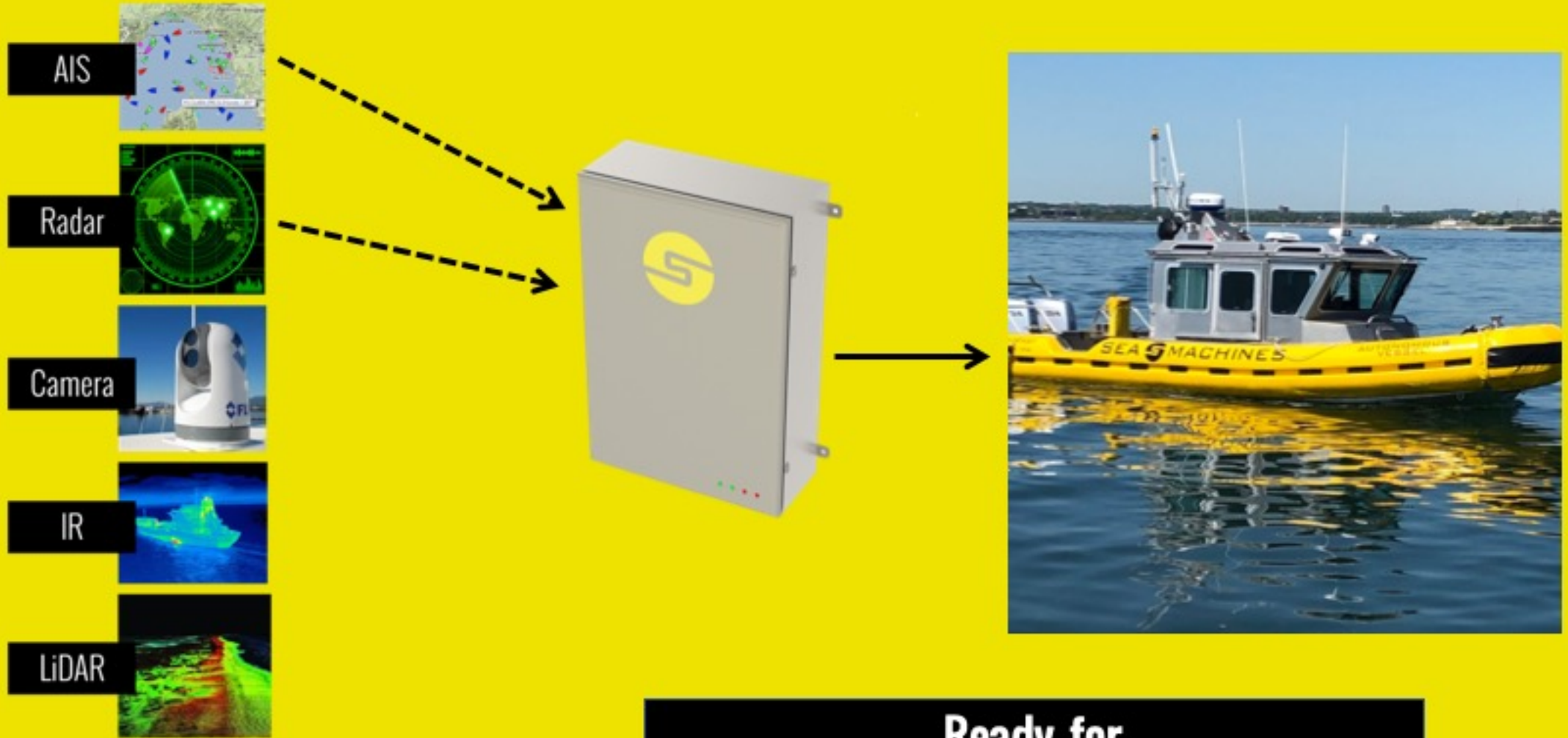
Comms Equipment

Autonomy Engine

Vessel Controller

Vessel Equipment

DYNAMIC MULTI-MODAL PERCEPTION

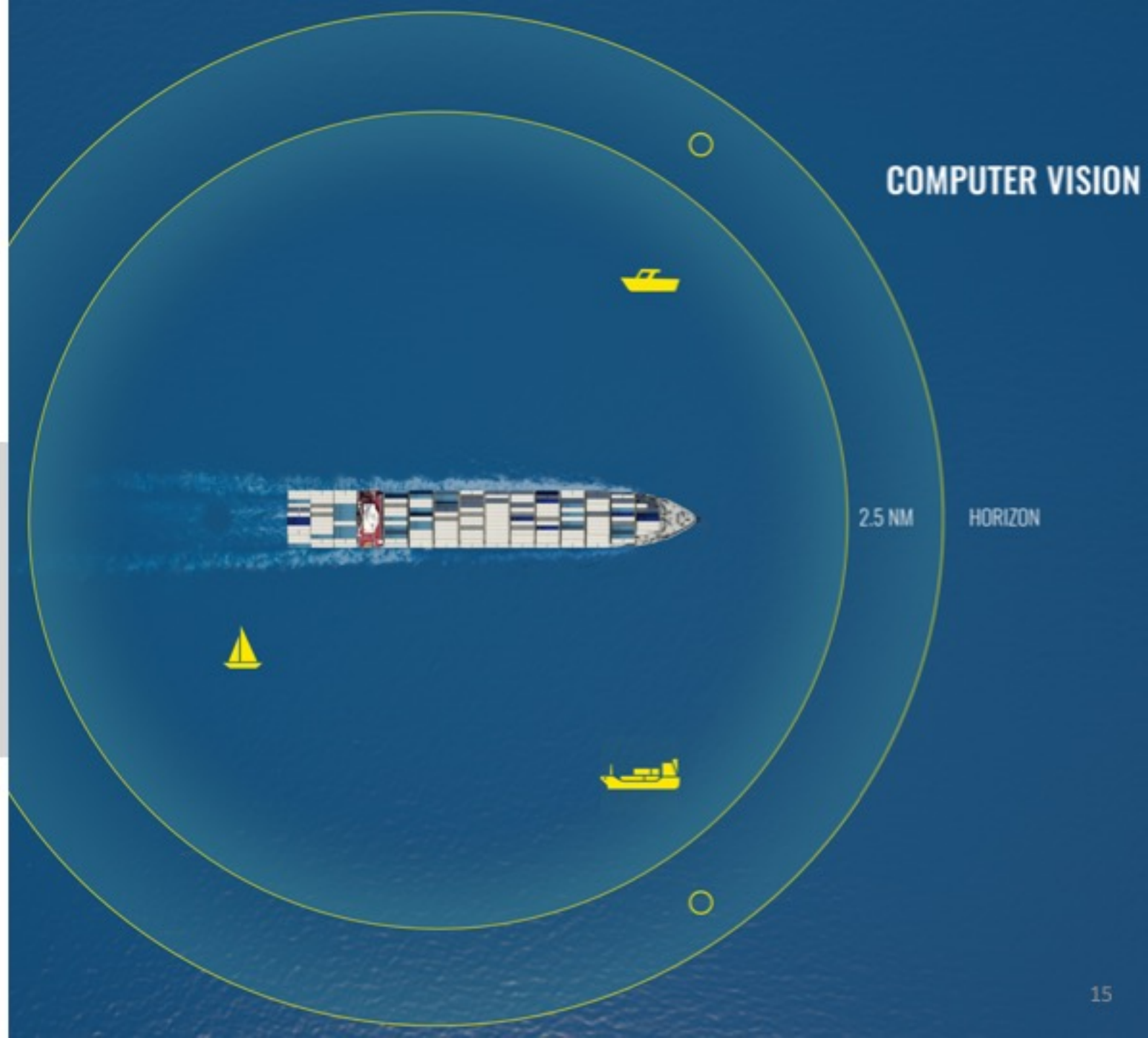


**Ready for
Controlled or Semi-Controlled Domains**

REAL-TIME COMPUTER VISION

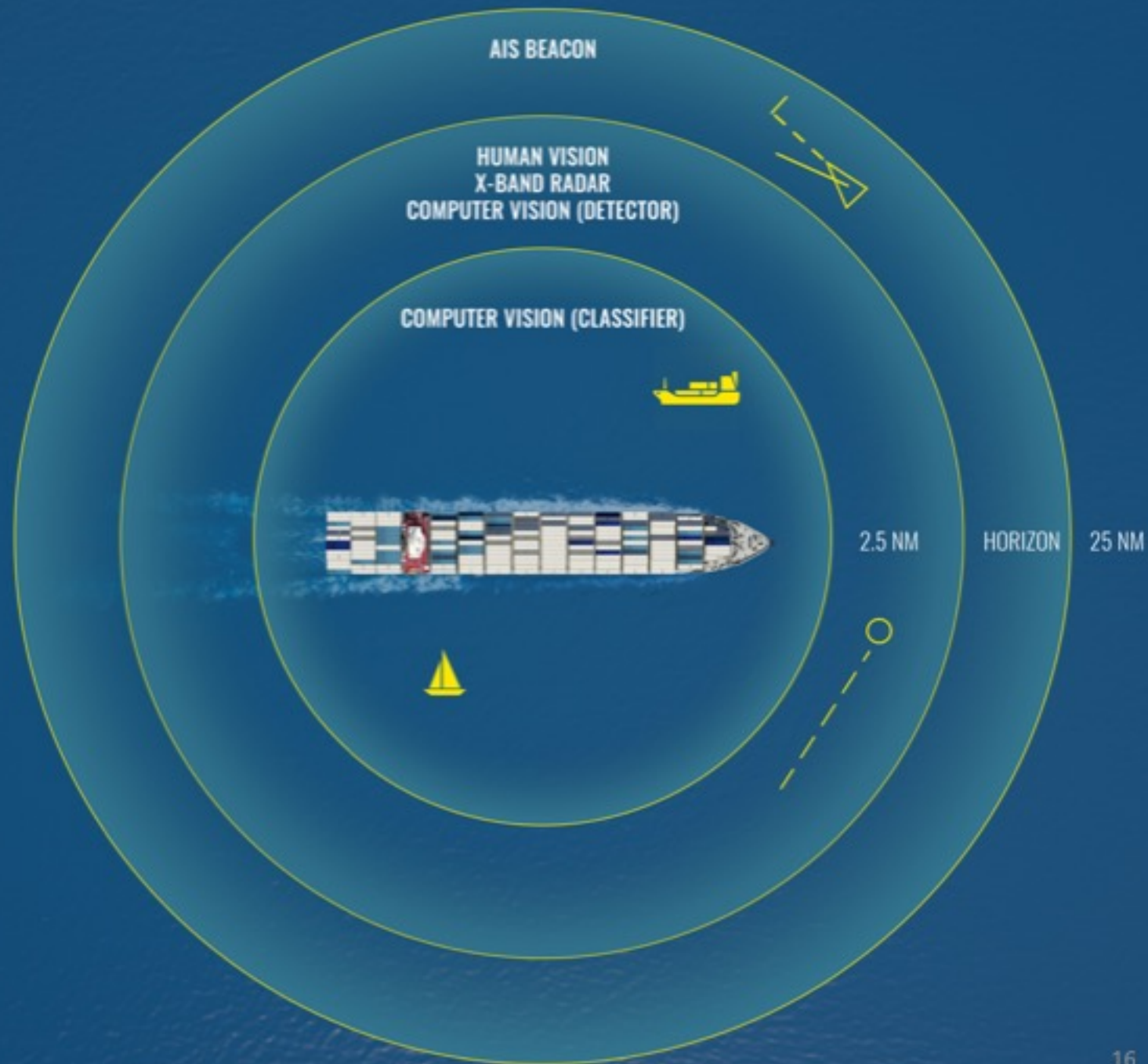
RGB & Thermal Panorama

- 360 deg HD stitched panorama
- Recognition of 7m vessel at 3500m range
- System latency of less than 2 sec



ENHANCED SITUATIONAL AWARENESS

- Sensor fusion improves domain awareness
- Comprehensive perception improves operational performance



ENHANCED SITUATIONAL AWARENESS

Maersk's Goals:

- Reduce accidents
- Reduce transit risk
- Increase schedule performance
- Translate info into digital data
- XXXXXXXX
- XXXXXXXX



MAERSK

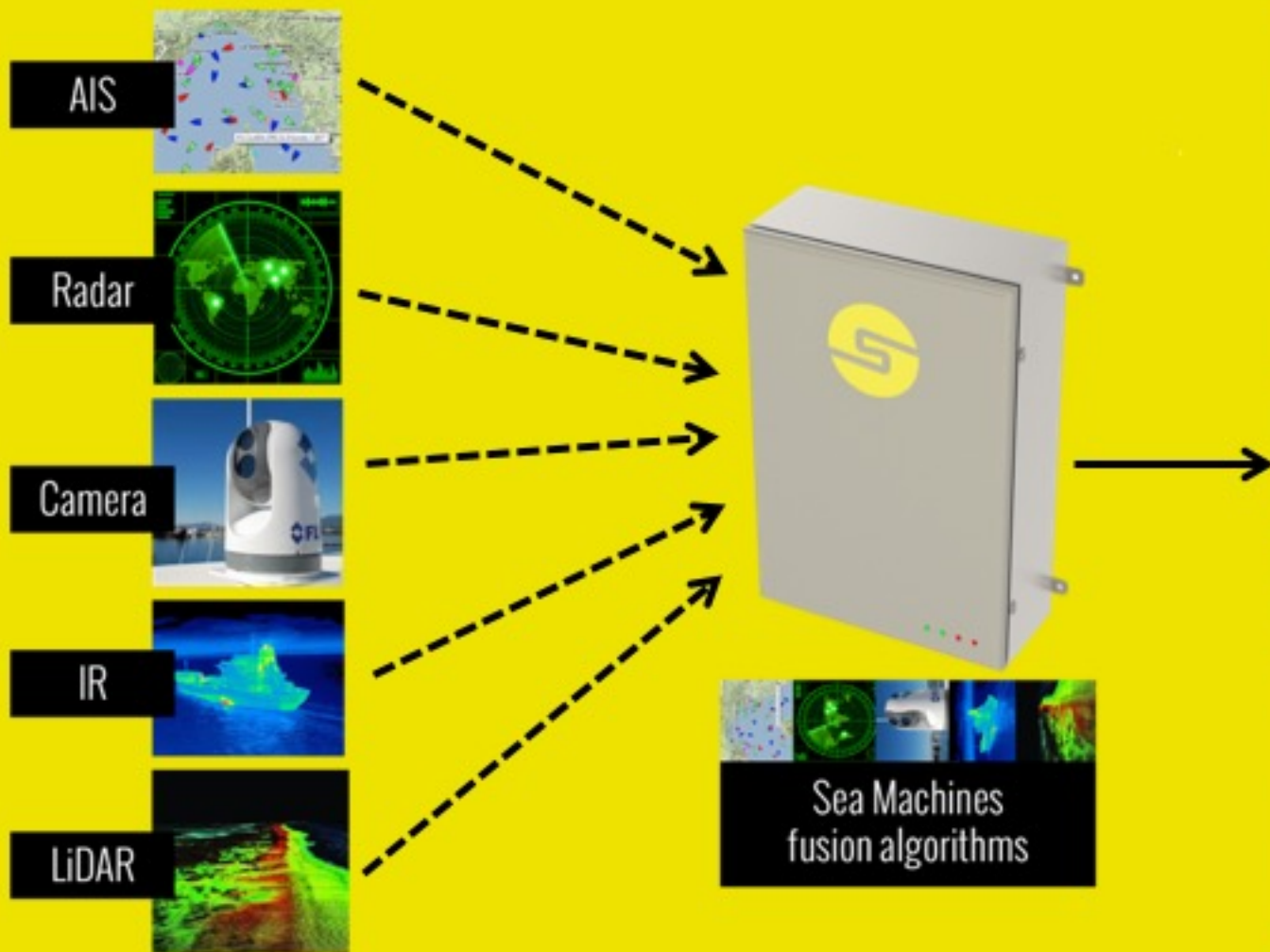


SEA MACHINES

PROOF OF CONCEPT



MULTI-MODAL SITUATIONAL AWARENESS



ESTABLISHING THE MARKET

Direct Remote Control (2018 as SM200)

Autonomous Command Level 3 (2018 as SM300)

Advanced Situation Awareness for Ships (2020 as SMXXX)

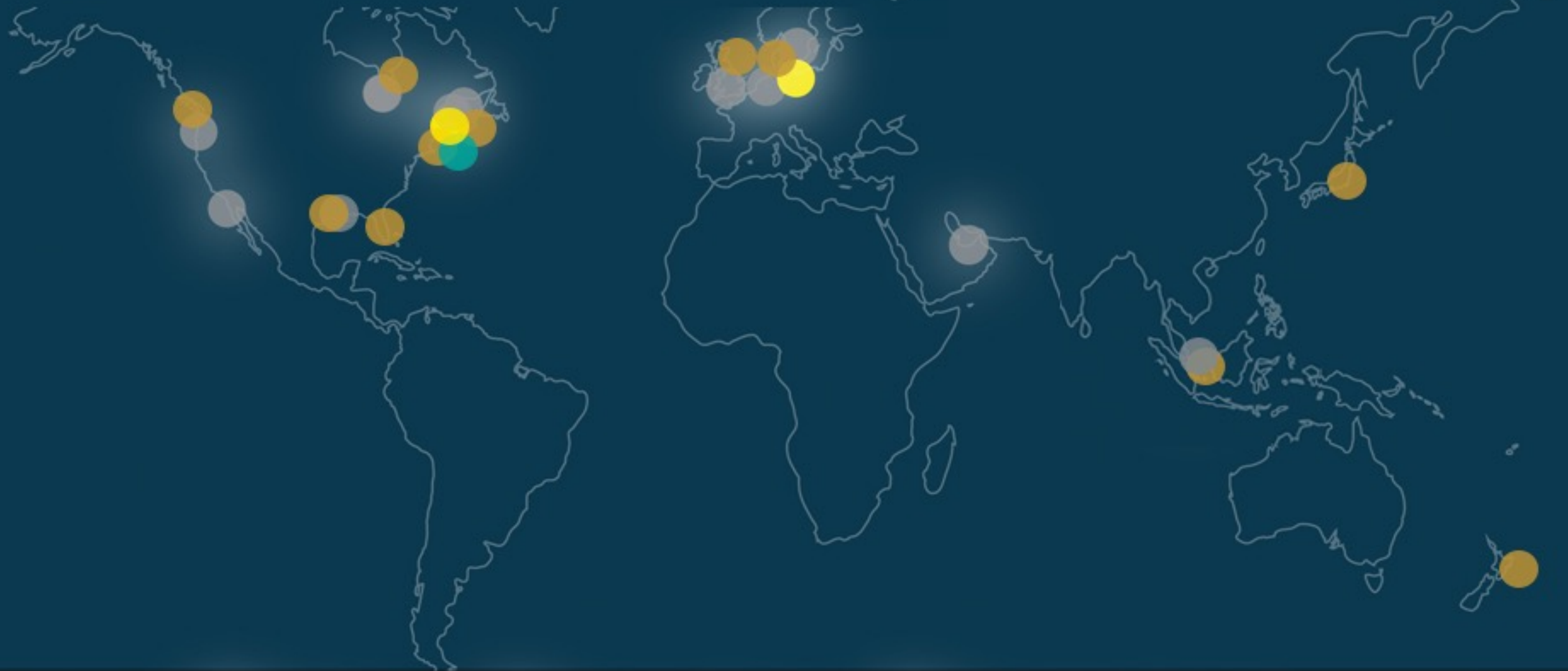
Advanced Pilot Assistance System (TBA)

Autonomous Command Level 4 (TBA)

RULES & REGULATORS



SEA MACHINES PRESENCE



-  OFFICES
-  TEST FLEETS
-  PRODUCT DEPLOYMENTS
-  DEALERS

LEADING A NEW ERA OF AUTONOMOUS MARINE VESSELS



