

Sea Machines Robotics Applying Technology TODAY

Don Black
VP Sales & Marketing
dblack@sea-machines.com



SEA MACHINES



Agenda

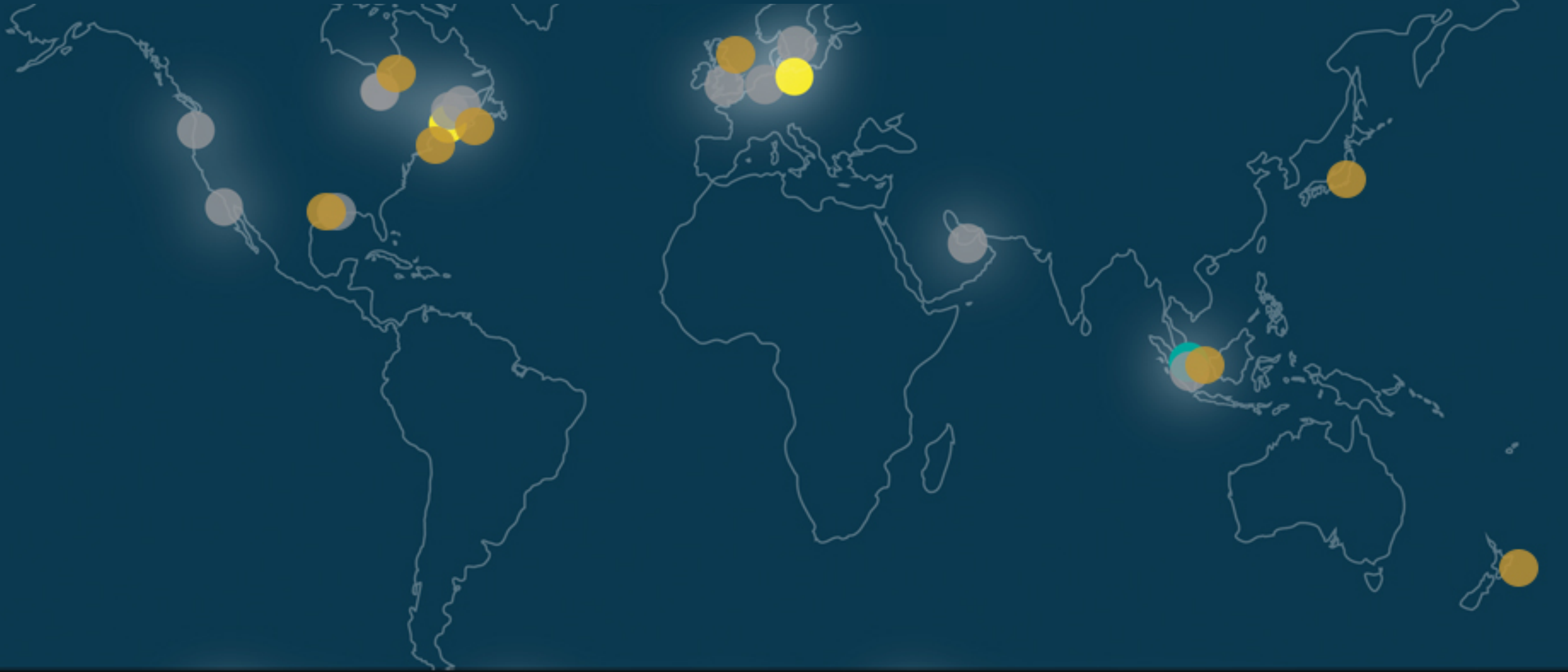
- Intro to Sea Machines
- Our “Customer Obsession”
- Where are we (the market) going?
- Situational Awareness – Advanced Pilot Assist

This is us.

- Founded in 2015
- Located in Boston and Hamburg
- Crew of approx.. 30+ and growing
- Mariners, autonomy ML/AI perception experts
- Leader in testing-validation in the marine domain
- Products on market for retrofit or new build
- Core Markets: Commercial Workboat & Shipping



Global Locations and Distributors



Our Customer Obsession : “Borne out of a vision to improve Safety & Efficiency”



Highly Manual



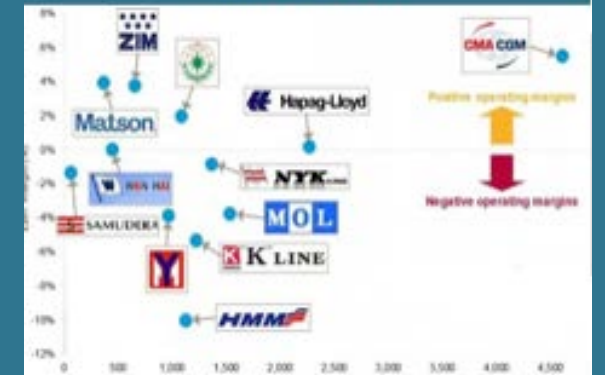
Hazardous Duty



Too Many Accidents

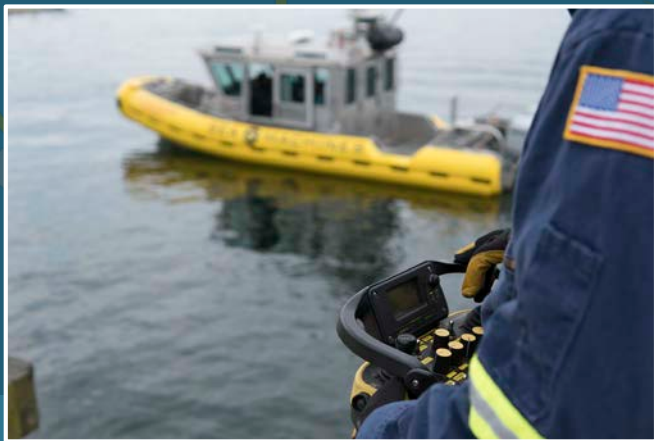


Slim Margins



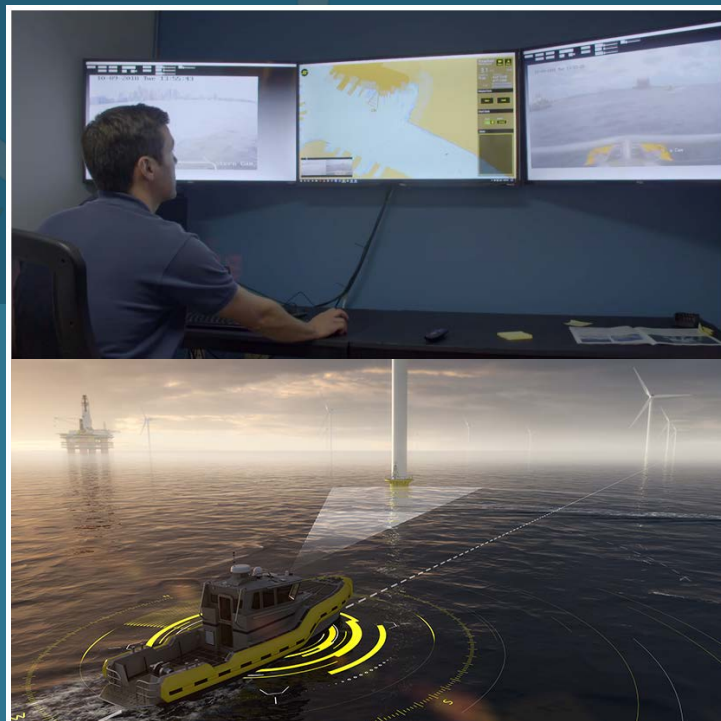
Where are we at right now?

SM200



Wireless remote helm control of vessel and payload up to 2 km range

SM300



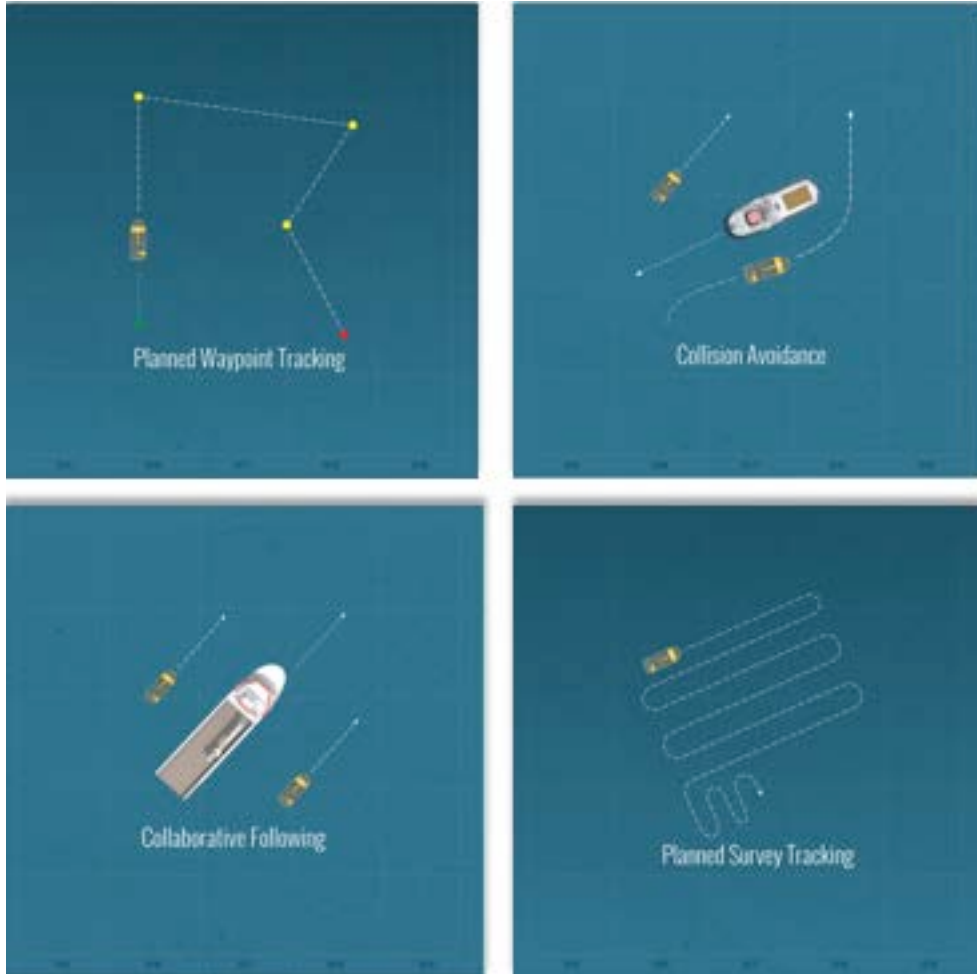
Industrial grade man-in-loop autonomous control for workboats

SMXXX



Advanced Situational Awareness

Where are we at right now? Use-case to Solution



- Level 3 Autonomy incorporates
 - o Planned waypoint tracking
 - o Survey grids
 - o Collision avoidance
 - o Collaborative following
- Uses sensors existing today on most commercial vessels - DGPS, ENC, AIS, ARPA RADAR
- Deployable to a wide range of vessel types

With Autonomous Operations in our sights, we are employing an iterative roadmap based on sensor fusion and perception as its precursor

Where is the market going: THE MAKINGS OF THE FUTURE SHIP

DIGITAL

EMISSION-NEUTRAL

ELECTRIC
PROPULSION



SEA MACHINES

Where is the market going: Owner/operator Investment fatigue?

DIGITAL

DATA-DRIVEN

EMISSION-NEUTRAL

REMOTELY
ACCESSIBLE

ELECTRIC
PROPULSION

AUTONOMOUS



SEA MACHINES



What moves the modern operator?

Faster

Better

Cheaper

Safer

Where are we going?

Industry demands ROI delivered by advanced tech:

- Reduce accidents
- Reduce transit risk
- Increase schedule performance
- Data driven verification

The path to autonomy is via sensor fusion & perception tech

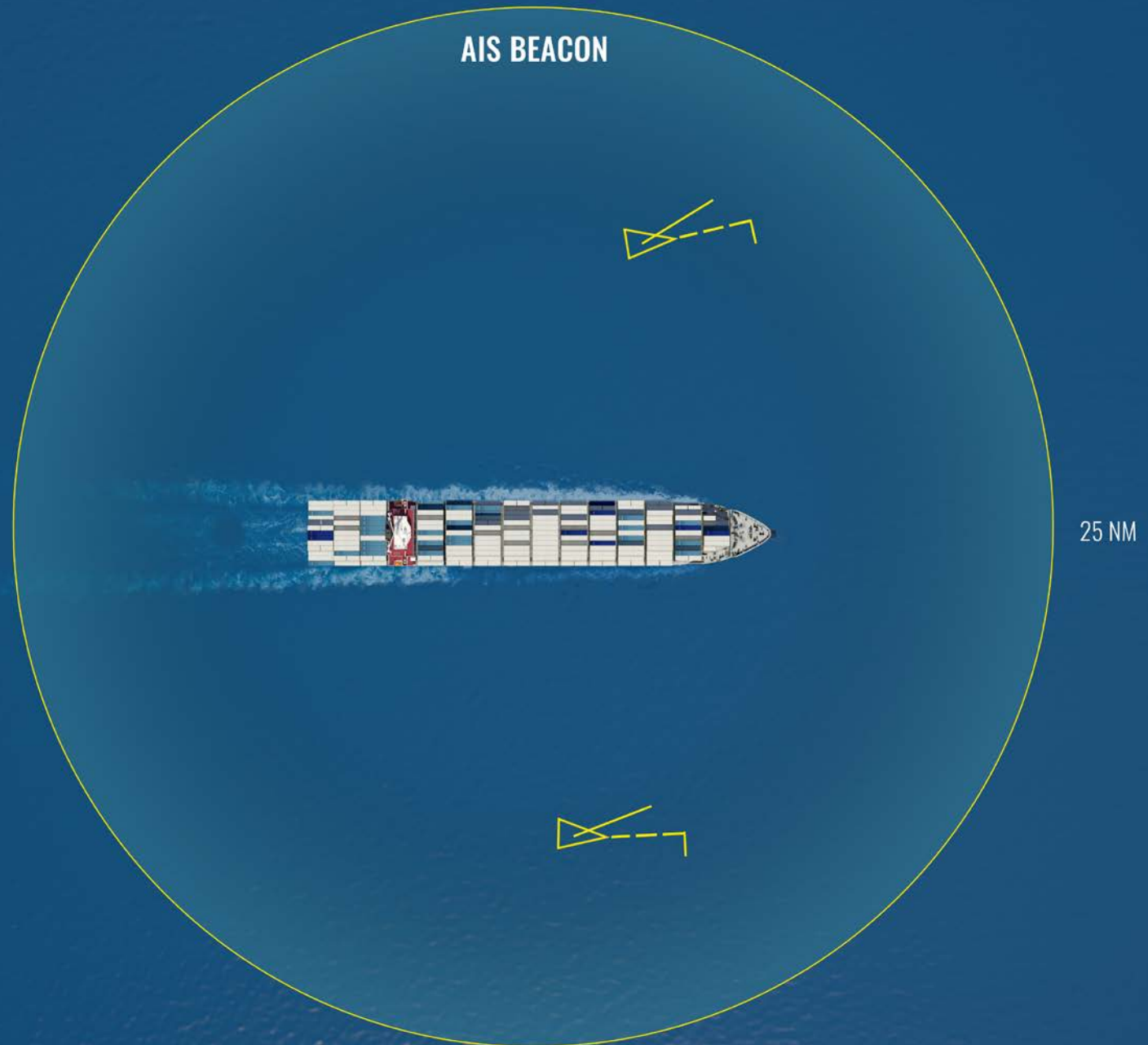


SEA MACHINES

SITUATIONAL AWARENESS TODAY

AIS BEACON

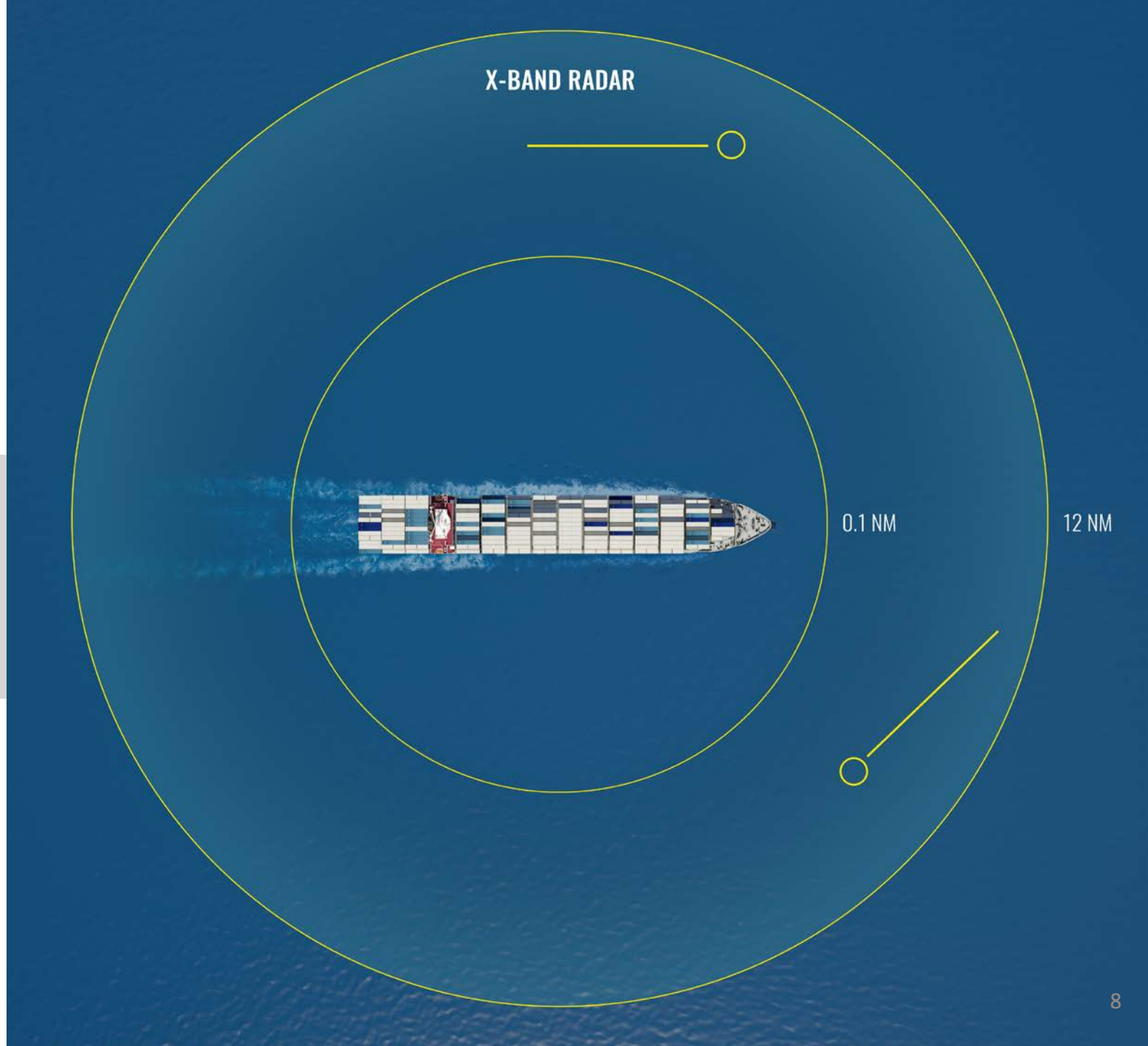
- Unreliable information
- Latency of 2-12 seconds
- Not carried by small vessels



SITUATIONAL AWARENESS TODAY

X-BAND RADAR

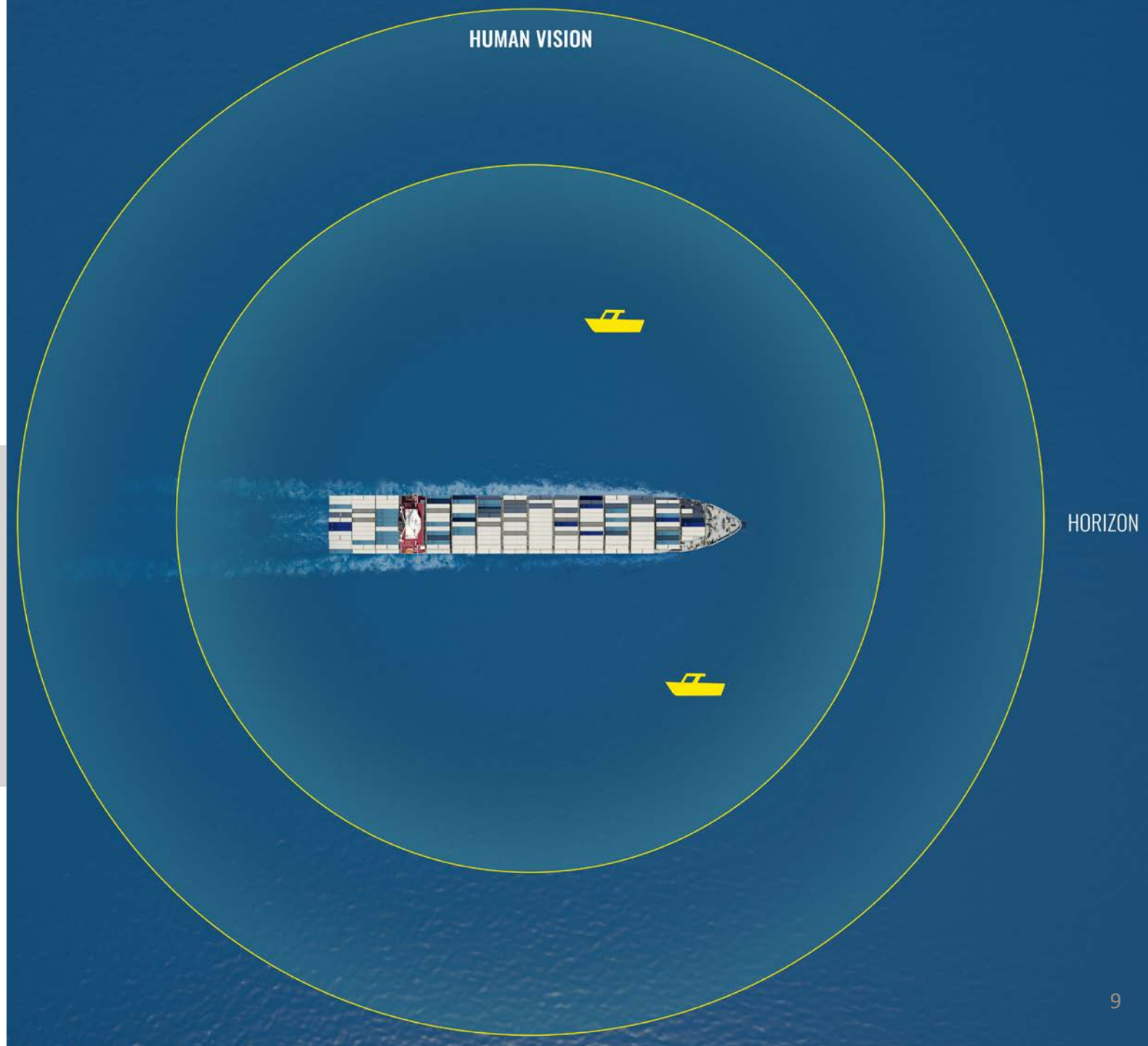
- Auto target acquisition is not reliable
- Highly susceptible to clutter
- No classification of targets



SITUATIONAL AWARENESS TODAY

HUMAN VISION

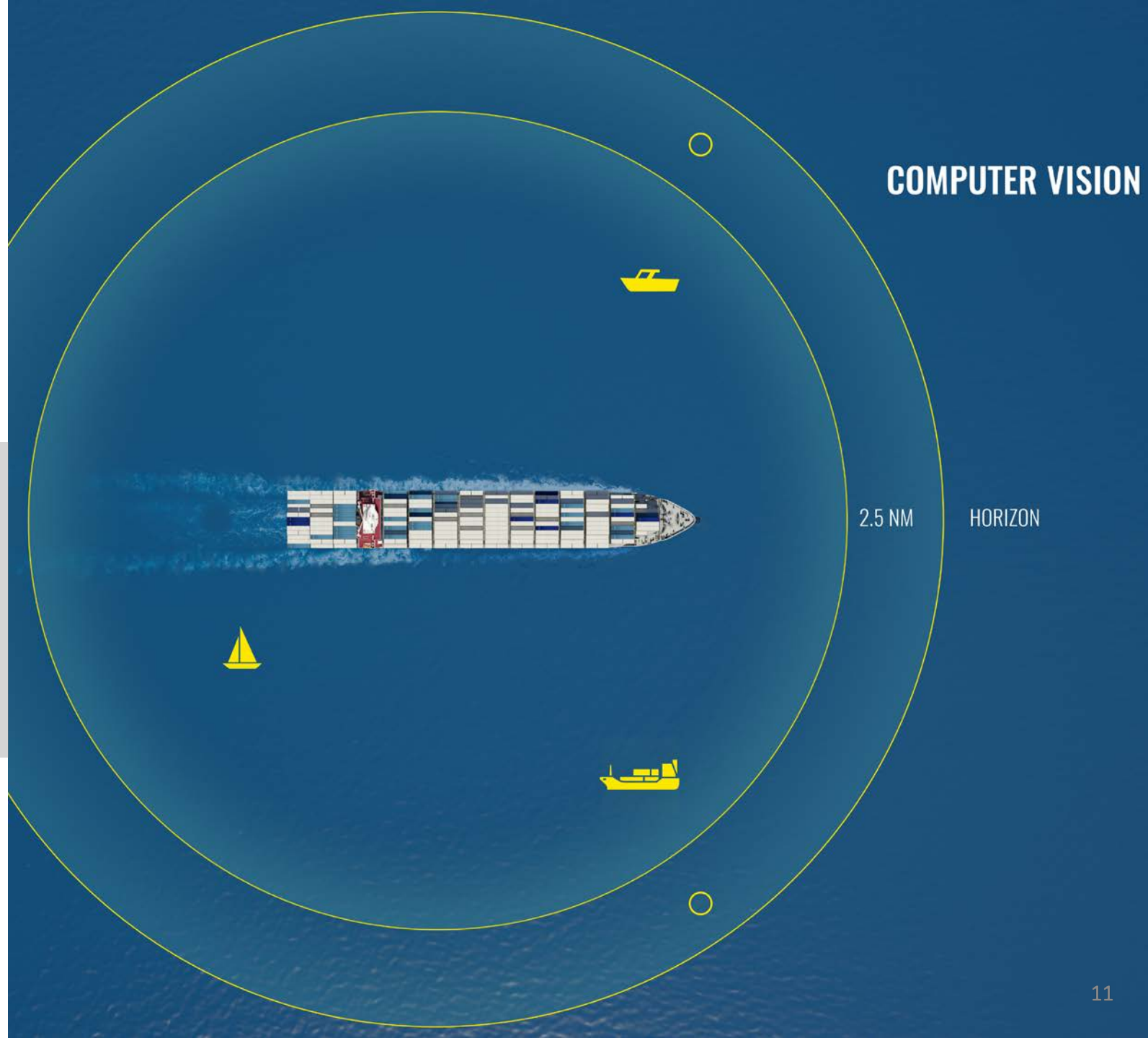
- Quality varies from person to person
- 114 deg field of view (horizontal)
- 7 deg field of focus (horizontal)
- Simultaneous target tracking limit is 3 to 4



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





Computer Vision

- Detects maritime targets in real-time RGB/IR camera imagery
- Deep Neural Net based detection and classification algorithms
- Below is early modelling work with target discrimination algorithms working with video



RESULTS

Computer Vision

Improved Perception

Sensor Fusion

Enhanced Situational Awareness

Performance

Superior Safety, Higher Productivity, Better Operating Results



SEA MACHINES

Challenges

- Undefined regulatory guidelines for classification definition and certification
- Owner investment fatigue
- Conducting iterative development on a working vessel
- Timely collection of more and varied training data
- Cost of COTS industrial-grade perception sensors
- Creating technology that delivers real value NOW

Thank you



Don Black
VP Sales & Marketing
dblack@sea-machines.com

AUTONOMY SYSTEM ARCHITECTURE

WIRELESS COMMS



REMOTE
COMMAND
STATIONS

GPS

RADAR

STEERING CONTROL

SEA
MACHINES
SM300

ENGINE/TRANSMISSION
MANAGEMENT

User Interface

Comms Equipment

Autonomy
Engine

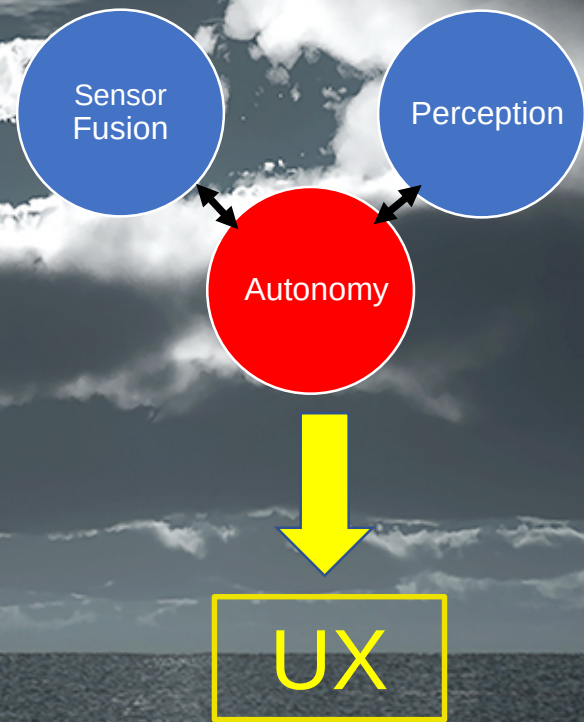
Vessel Controller

Vessel Equipment



SEA MACHINES

AUTONOMY SYSTEM ARCHITECTURE



WIRELESS COMMS



REMOTE
COMMAND
STATIONS

GPS

RADAR

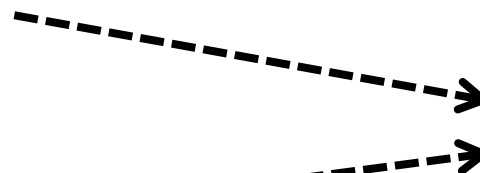
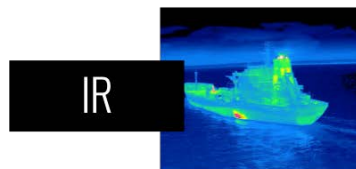
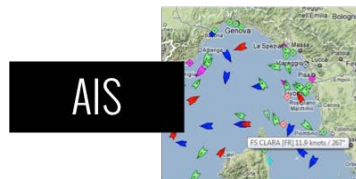
STEERING CONTROL

SEA
MACHINES
SM300

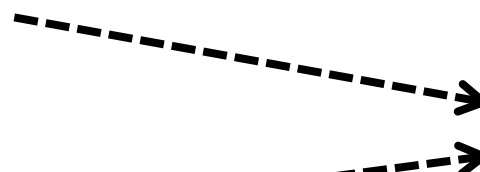
ENGINE/TRANSMISSION
MANAGEMENT



SM300 V1.1



Target Data



**Remote Operator
Information**



Target Data (V1.2)