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***mtu* NautIQ Co-Series**

Product presentation



A Rolls-Royce
solution

01

Automation strategy & background



Automation Portfolio Strategy & Ecosystem NautiQ

Automation Ecosystem

Servowatch
Marine Automation & Integrated Ship Solutions
A Larsen & Toubro Group Company

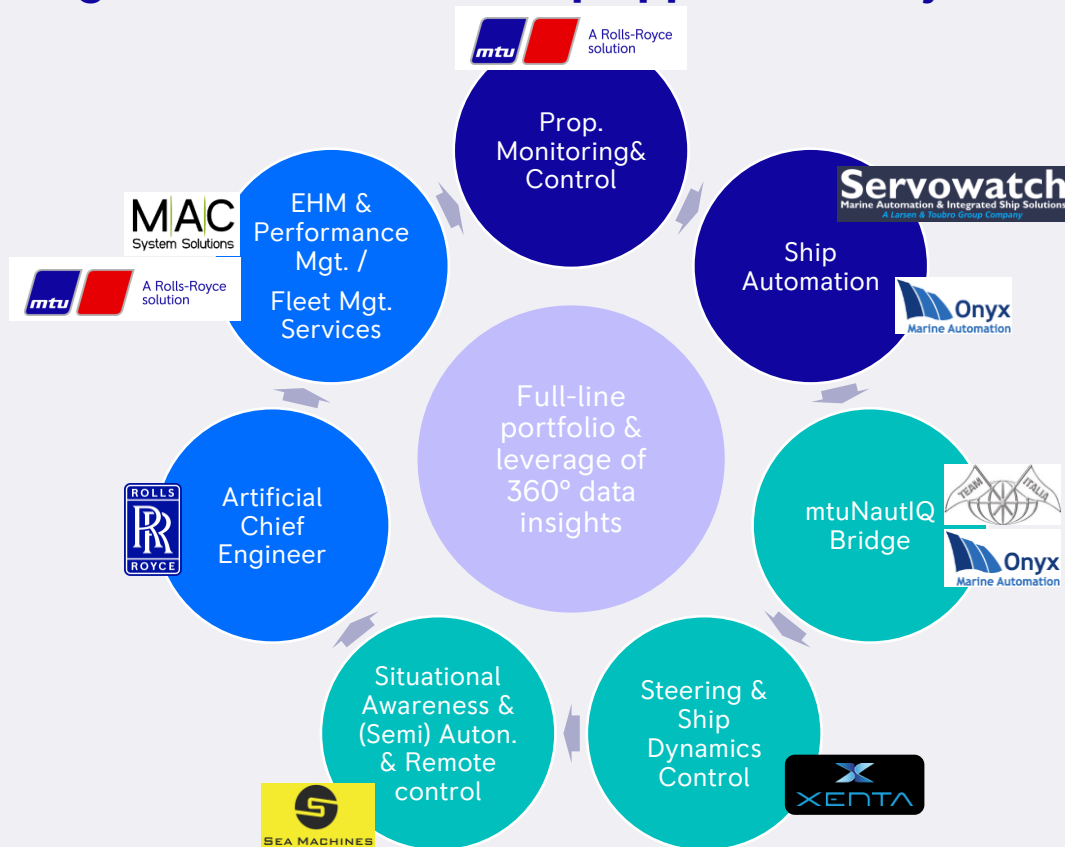


MAC
System Solutions
A Rolls-Royce solution



A Rolls-Royce
solution

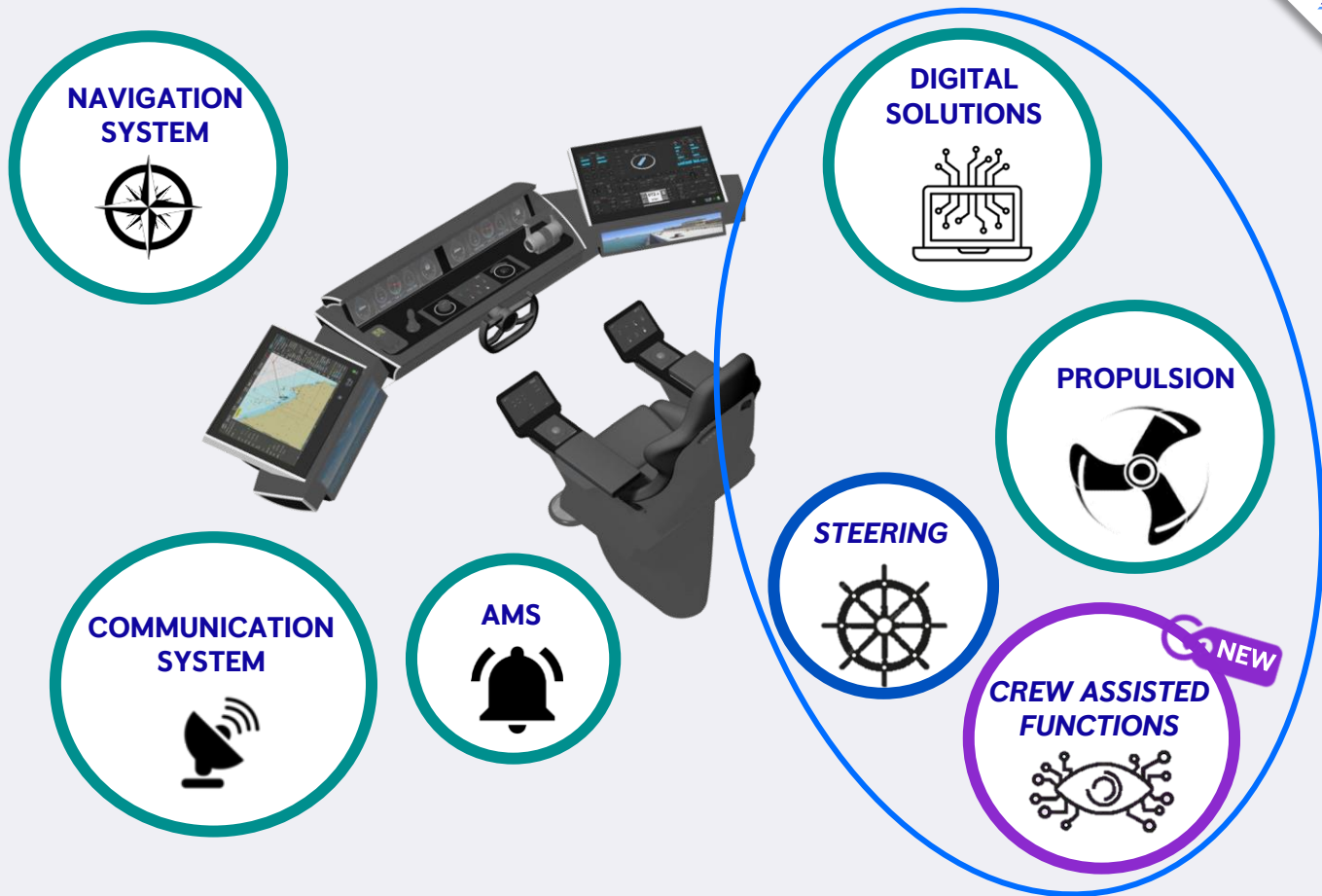
Become a Top 3 full-liner Automation solution provider & thought leader in smart ship applications by 2030

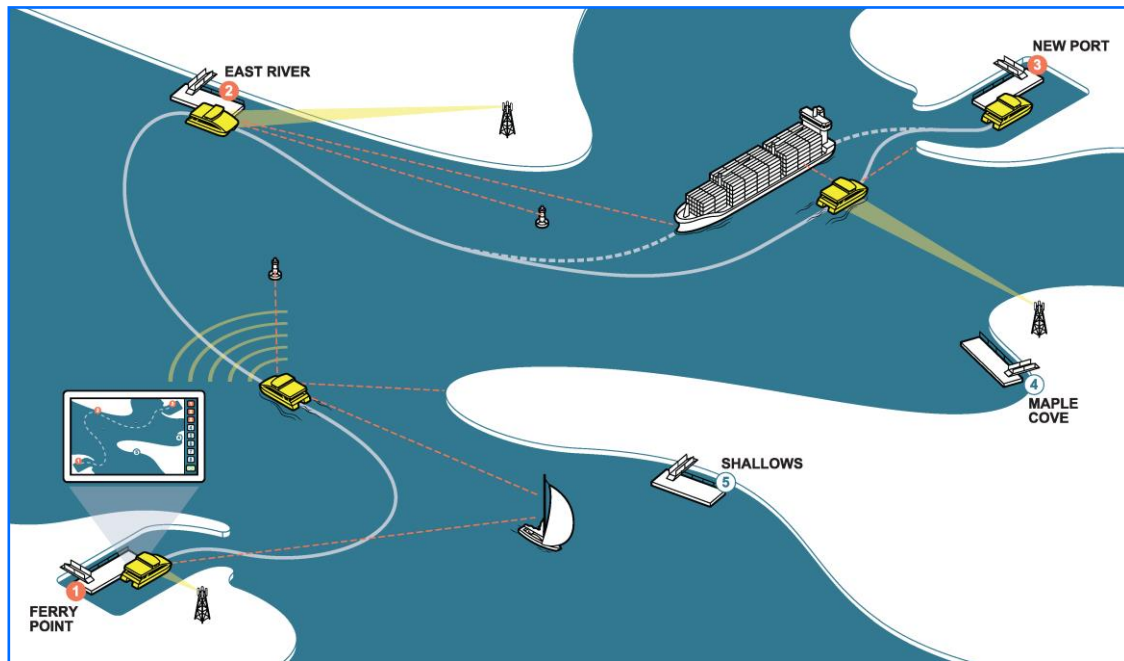


Future Vision: Areas of Integration

New offerings through
Propulsion System Integration
& Digital Solutions

Basis for future offerings such
as **Crew Assisted Function**
(Situation Awareness, Docking
Assistant, etc.)





Increased **safety**



Better **productivity**



Enhanced **situational awareness**



Sustainability



Reduced **OPEX**

Add value to commercial vessels and large displacement yachts by providing **autonomy** in **everyday operations**.



Autonomous does **not** necessarily mean unmanned! → enabling **better human decision making** through data driven autonomy

02

Sea Machines company & product overview

TECH FOR THE MODERN MARINER

Empower your vessel operations by using autonomous technology to take care of the dull, dirty and dangerous work.



TRANSIT
AUTONOMY →



PATTERN
AUTONOMY →



COLLABORATIVE
AUTONOMY →



AI-POWERED
VESSEL VISION →



WIRELESS
REMOTE-HELM
CONTROL →



REMOTE COMMAND
& CONTROL →



COLLISION &
OBSTACLE
AVOIDANCE →



COLLISION
ALERTS



Why *mtu* NautIQ Co-products?

89.5% of all maritime occurrences (2014-2020) were related to **human action**. A total of **180** vessels were lost (Source: EMSA Annual Overview of Marine Casualties and Incidents 2021)

“Nellie Bly” was the **first** remotely commanded autonomous vessel to travel **>1.000 NM** around Denmark with **96.89%** in autonomy & **31** collision avoidance maneuvers conducted by a **CoOperate** system in Oct. 2021:

<https://sea-machines.com/the-machine-odyssey>



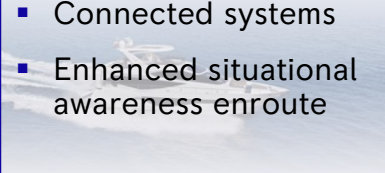
Customer benefits

- Increased **Automation**: Shifting effort from manual to intelligent systems
- Increased **Situational Awareness** of Operational Domain
- Increased **Alertness**: *mtu* NautIQ CoPilot system is “always on watch”
- Increased **Crew Safety**: Safe operations in hazardous environments
- Increased **Predictability** in Navigation Operations
- Digital **Connectivity**, Data & Remote **Visibility**
- Using and showing off the industry’s most **Advanced Technology**

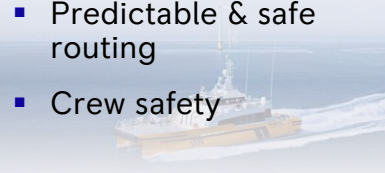
Tugs

- Increased visibility during tight maneuvers
 - Precision and overview during notching & pinning
- 

Yachts & Ferries

- Autonomous voyage
 - Crew assist
 - Connected systems
 - Enhanced situational awareness enroute
- 

CTVs

- Autonomous voyage
 - Pre-planned missions
 - Predictable & safe routing
 - Crew safety
- 



NautIQ CoDirect

Wireless Remote Helm

Direct local steering & propulsion control

Engine telemetry

Payload interface

Auxiliary equipment

NautIQ CoOperate

Remote Autonomous Command

Command vessel from anywhere

Route/grid planning

Collaborative autonomy

Radar/AIS based obstacle detection & avoidance

NautIQ CoPilot

Onboard Pilot Assist

Enhanced intuitive autonomy

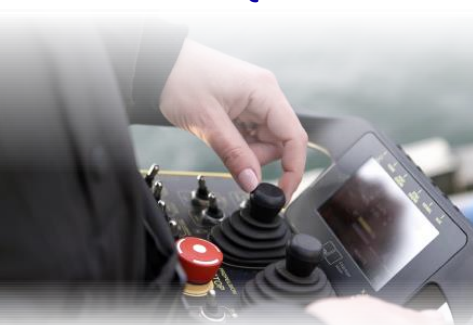
Dynamic path rerouting

AI-based object identification & tracking

Voice command

It's expected to integrate these products into the wider **mtu** portfolio in the future (i.e. NautIQ BVNG)

mtu NautIQ CoDirect



Wireless Remote Helm

Direct local steering & propulsion control

Engine telemetry

Payload interface

Auxiliary equipment

mtu NautIQ CoDirect features & specifications



Scope of supply

- **CoDirect** Beltpack (remote helm controller)
- **CoDirect** enclosure

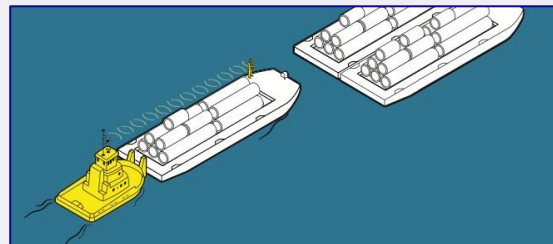


Use cases

- **Tugboats** (better visibility & precision)
- **Pushboats** (thruster control outside the wheelhouse)
- **Tenders** (control from Yacht)
- **Response vessels** (risk reduction for crews)
- **Target boats**
- **Offshore** (cargo/positioning ops)
- **Daughter Craft** ("LARS"*)

*"LARS" = Launch And Retrieval procedure (manual)

Benefits



Improved **safety** by situational awareness

Unrestricted **line-of-sight**

Minimized operational **risks**

Reduced risk of incidents due to **miscommunication**

mtu NautIQ CoOperate features & specifications

mtu NautIQ CoOperate



Remote Autonomous Command

Command vessel from anywhere

Route/grid planning

Collaborative autonomy (with additional beacon)

Radar/AIS based obstacle detection & avoidance

Scope of supply

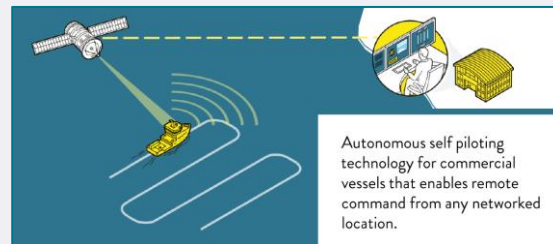
- **CoOperate** Laptop
- **CoOperate** enclosure
- Beltpack (optional)



Use cases

- **Patrol vessels** (pre-planned paths)
- **Hydrographic survey** (pre-planned grids/patterns)
- **Tugboats** (crew safety)
- **Pilot boats** (precise following & SA*)
- **SAR** (search patterns & crew safety)
- **Guard and Standby** (crew safety)
- **Aquaculture** (pre-planned grids)
- **Ferries** (autonomous routes)

Benefits



Reduction of fatigue-related errors & **precision** improvement

Crew & cargo **safety** in hazardous environments

Better **fuel efficiency** through route **predictability** & autonomy

Increased **productivity** by collaborative autonomy

mtu NautIQ CoPilot



Onboard Pilot Assist

Enhanced intuitive autonomy

Dynamic path rerouting

AI-based object identification & tracking

mtu NautIQ CoPilot features & specifications

Scope of supply

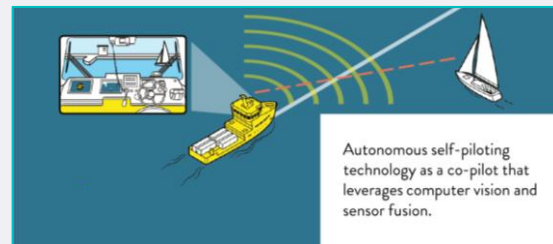
- **CoPilot** enclosure
- **CoPilot** video processing unit
- **CoPilot** camera
- MFD/flat panel (optional)



Use cases

- **Yacht** (guided transit, crew support)
- **Ferries** (pilot assist/SA)
- **Survey vessels** (pre-planned grids/patterns, vision based data)
- **Pilot boats** (transit/station keeping)
- **Patrol vessels** (crew support)
- **Tugboats** (mob/demob)
- **SAR** (search patterns & crew safety)
- **Guard and Standby** (crew safety)

Benefits



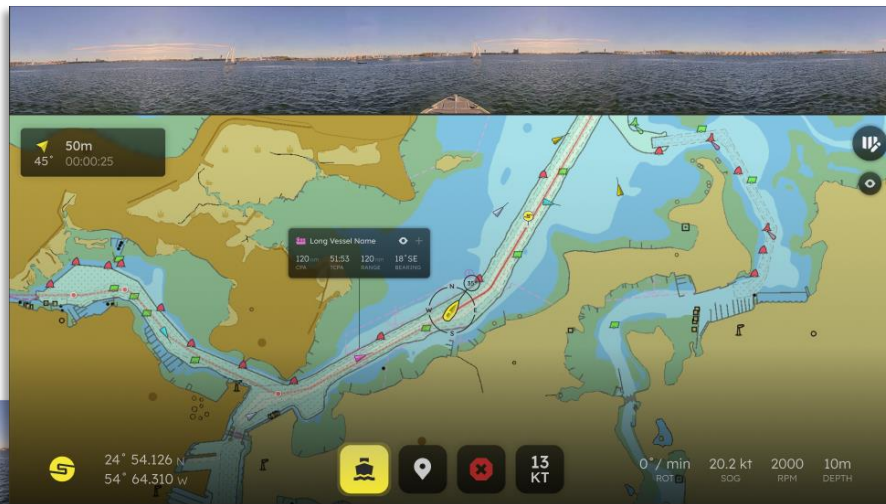
Enhanced **situational awareness** through sensor fusion & visual AI

Navigation assistance **or** full autonomous command (3 modes)

Reduced crew **fatigue** by being freed from routine tasks

Voice command

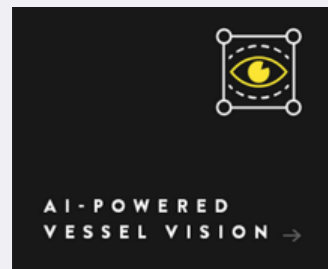
NautIQ CoPilot User Interface (preliminary)



Modes of Operation - 1

Guided Mode – visual indication and audible alert of collision or obstacle ahead

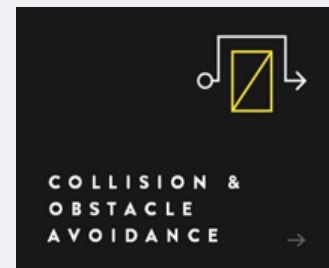
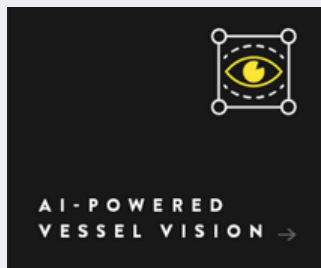
- Manual control by onboard human operator
- No active control by autonomy system
- Displays targets from ARPA, AIS and computer vision on chart/video feed
- Displays low depth warnings based on chart data



Modes of Operation - 2

Guard Mode - visual indication and audible alert of collision or obstacle ahead, giving operators signal to act

- Manual control by onboard human operator of either throttle or steering
 - Autonomy system in command of other control
- Establish guard radius (say 500/1000/2000m)
 - As target nears radius, system will warn user to avoid
 - If target enters inside radius (and user has not disabled guard mode for that target), the system will take full control and execute a collision avoidance maneuver
 - After maneuver has been completed, system will hand back control to the user as previously configured
- Guard against charted obstructions / shallow areas / running aground



Modes of Operation - 3

Autonomy Mode – man in the loop autonomy onboard

- Full autonomous control of steering and throttle
- Vessel follows pre-planned voyage of waypoints sequentially based on pre-determined attributes like speed, collision avoidance, XTE, planned pause, etc.



AI-POWERED
VESSEL VISION →



COLLISION &
OBSTACLE
AVOIDANCE →



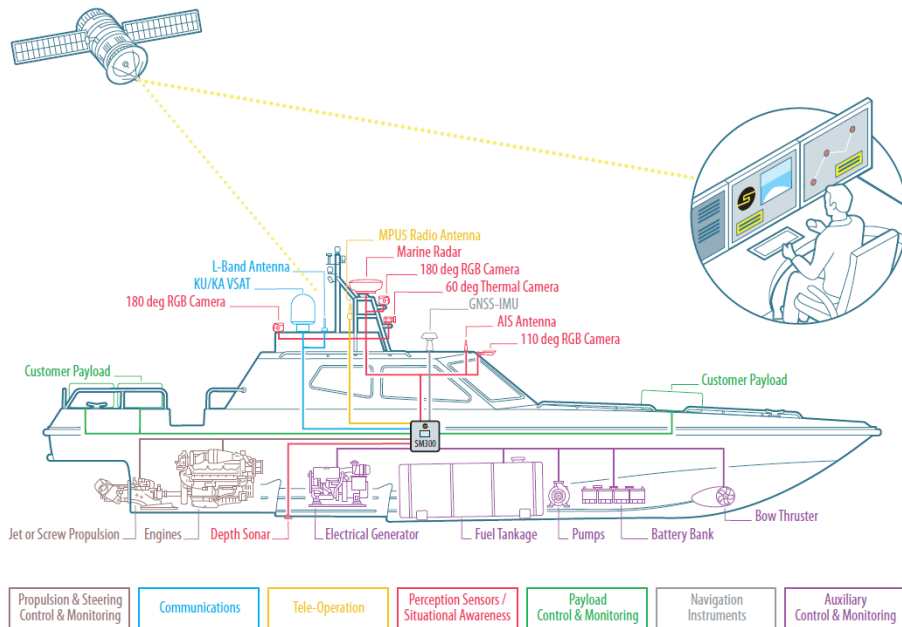
TRANSIT
AUTONOMY →



COLLABORATIVE
AUTONOMY →



PATTERN
AUTONOMY →



System	Device/ Sensor Types	Signal Types
Navigation	GNSS - IMU	NMEA 0183, NMEA 2000
Perception	Speed log Anemometer Autopilot Gyro/Magnetic compass Echosounder AIS Radar ECDIS Conning Display Camera(s)	RS422 - NMEA 0183 serial protocol NMEA 2000 Analog type: 0-10V, 4-20mA current loop Other custom serial protocols Ethernet TCP/IP
Situational Awareness		
Propulsion	Propulsion control & monitoring Throttle position RPM Gear Temperature Oil Pressure	Analog type: 0-10V, 4-20mA current loop Digital Type: CANbus, NMEA 2000, J1939 RS422 - NMEA 0183 serial protocol
Steering	Steering control & monitoring Rudder angle	Analog Type: 0-10V, 4-20mA current loop Digital Type: CANbus, NMEA 2000, J1939 RS422 - NMEA 0183 serial protocol Discrete Relay
Payload and Auxiliary Control and Monitoring	Pressure Temperature/Humidity Voltage, Current Fuel/liquid levels Wind speed/direction Flow rate Fuel burn Engine diagnostics Pump and Payload	Analog Type: 0-10V, 4-20mA current loop Other analog protocols Discrete Status Signals Modbus TCP Other custom signal types



Questions?