Autonomous navigation

A-NAVIGATION

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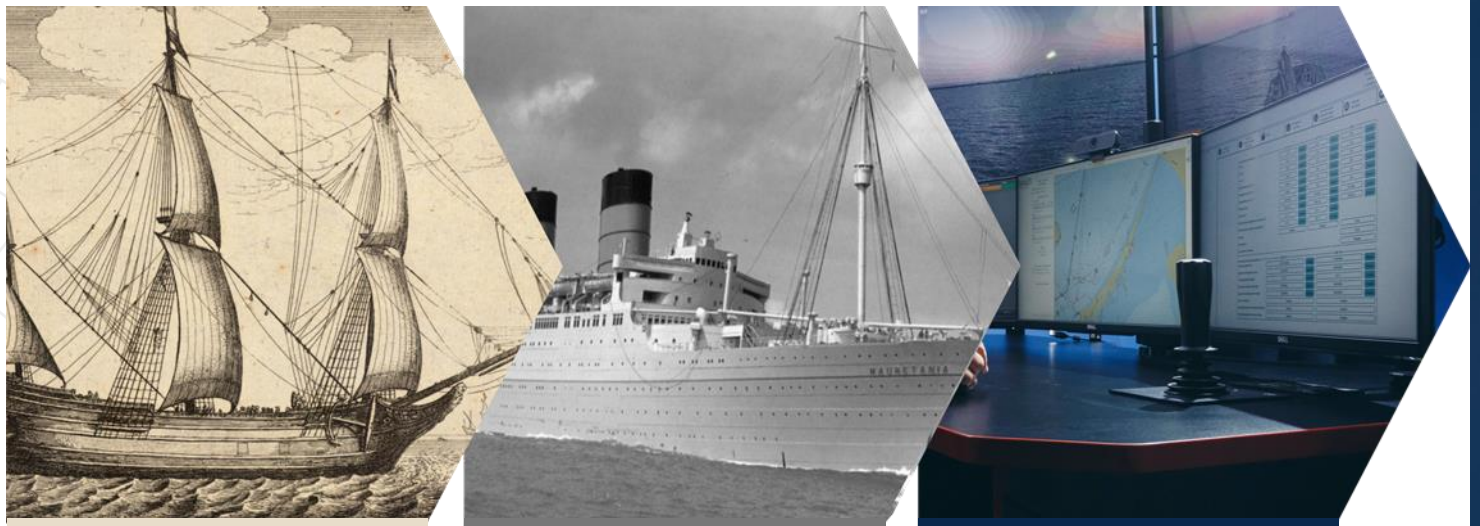
Maritime technology revolutions change the global landscape



15th-18th cent.
New maritime technologies opened the Age of Discovery and provided dominance of European civilization in the world.

19th-20th cent.
Modern merchant ships dropped the shipping costs and opened age of the global economy. About 90% of all goods are transported by seas.

21st cent.
Autonomous (remotely and automatically controlled) vessels, will dramatically change the industry model itself and the global logistics.

In 2021, Russia the first in the world has begun the wide operation of autonomous ships by creating the necessary legal and technical conditions

- **Increasing the safety of navigation.** The human factor remains the main cause of incidents at sea. According to Allianz Global Corporate & Specialty AG, the cost of losses in shipping due to human errors in 2017 amounted to US$1.6 billion (Allianz Global Corporate & Specialty SE's "Safety and shipping review", 2018).
- **Reduction of onboard crew number.** The direct costs of shipping companies for the crew on board, including ensuring its life and safety, needs on board, are estimated as average 30-40% of ship operation costs.
- **Improving personnel policy**. In accordance with IMO analysis, there is 20% deficit of qualified officers of the global merchant fleet and this gap is growing due to hard conditions of work at sea.
- **Better transport safety control.** Permanent and real-time control allows to prevent and to react immediately on cases of illegal traffic, piracy, poaching and violations of environmental legislation

Our approach, technology and legislation

In 2019 the group of technology and shipping companies joined efforts to make possible wide practical operation of autonomous navigation in the maritime transport in the nearest future.

The strategic goal of the project is to develop and to implement technical and legal conditions for wide MASS trial operation by any shipping company starting from 2021.

Key challenges:

1. The systems shall be predictable and transparent for all participants

2. The solutions shall fit to the existing international regulation

3. The technologies shall be affordable for shipping companies

Mikhail Ulyanov by SCF Barents Sea (Arctic)

Pola Anfisa by Pola Group Azov and Black Seas

Rabochaya by Rosmorport Black Sea

Complete Functional Equivalence

Legislation for commercial operation of autonomous ships

Standard set of technical solutions allowing to upgrade any vessel to autonomous

Trial operation in real conditions on different types of ships in various regions

Wide operation of autonomous vessels under the Russian flag from 2021

SCF

Pola

sitronics KT

POLYTECH

ROSMORPORT

AME

RSCC

scanex

orange

Principle of Complete Functional Equivalence

The principle of CFE implies fulfillment in automatic and remote modes of those functions that are now prescribed to be performed by a human on board as per current international safety regulations: STCW, SOLAS, COLREGS.

This therefore guarantees that MASS, when interacting with other actors, will be guided by and perform well-known and mandatory for functions. This makes MASS operation predictable and understandable for everyone, removing fears of unpredictable AI systems. At the same time, it also allows for MASS operation to fit within the existing framework of international regulation as is, without requiring any immediate change pre-implementation.

As a ground we used a set of functions in line with the standards of competence of crew members set out in Chapter II of Part A of the **STCW Code**.

VOYAGE PLANNING	Taking into account any factor, including economic and logistic factors, weather conditions, etc. with possible use of decision support systems
ANALYSIS OF THE ENVIRONMENTAL SITUATION	Use of charts and navigation equipment information
	Vessel position determination and keeping the route
	Permanent observation of environment situation, identification of dangers
	Logging of the events and actions during the watch
SHIP MANOEUVRING	Steering the ship
	Controlling the engine
	Ship manoeuvring to keep the route, avoid collisions or other dangers
	Ship manoeuvring in extremely difficult conditions
TECHNICAL AND ENGINEERING CONTROL	Ship engine and technical systems control
	Checking the operation of navigation and signal lights
	Hull, ship rooms and cargo inspection
COMMUNICATION WITH OTHER ACTORS (remote control only)	Using the ship's messaging system
	Radio communication
	Ship loudspeaker use
	Using visual and sound signals
PERFORMANCE OF FUNCTIONS RELATED TO INTERACTION WITH HUMANS AND NON-AUTOMATED MEANS	Crew management and care for people on board
	Search and rescue operations
	Respond to emergencies
	Mooring operations (require additional systems)

Available in the complete automatic mode

Available with limitation (remote operator or additional systems)

Currently prescribed for human only

Submission to IMO MSC 103/5/12, 16 March 2021

Legal framework for a-Navigation

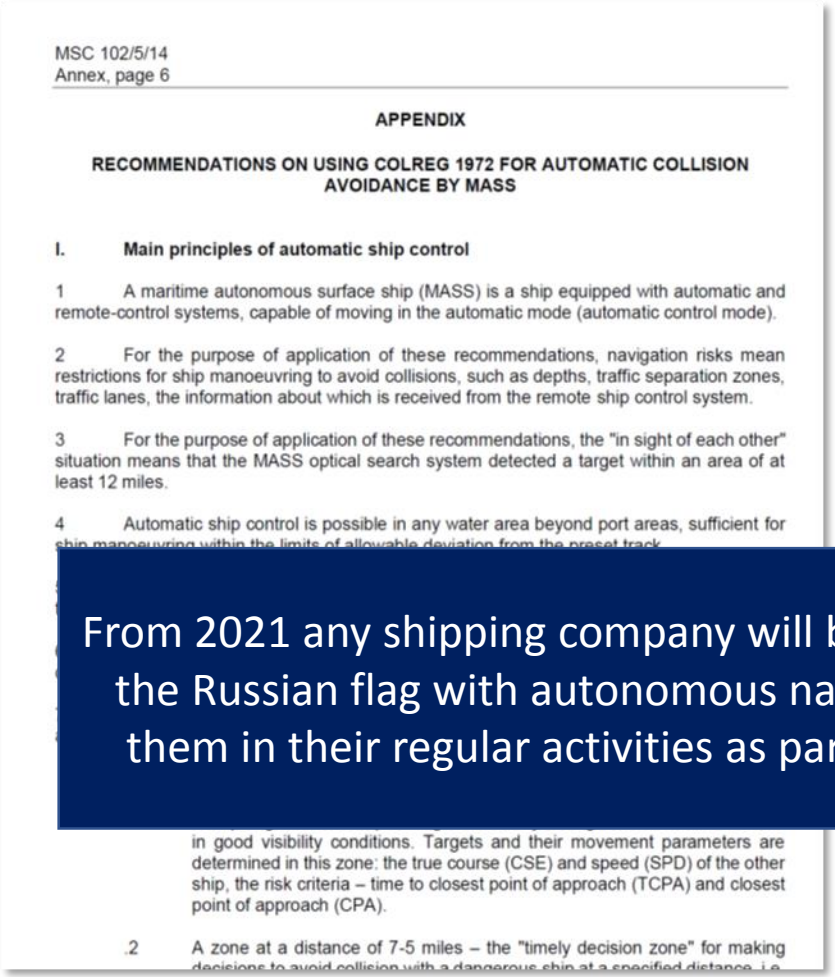
Based on the current international maritime law and results of the RSE provided by IMO Maritime Safety Committee and IMO Legal Committee the proper national MASS regulation has been developed in Russia.

In January 2021 Federal Agency for Maritime and River Transport has issued Guidelines for COLREG-72 application for MASS, interpreting the existing provisions of COLREG-72 in a determined way which allows to define the scenarios (algorithms) of MASS movements in a every given situation, as well as the limits for the use.

The proper interpretation of SOLAS provisions by the State Flag administration is provided in the Federal Law. Also in December 2020 the Government of Russia approved the national experiment on wide MASS trial operation based on Interim Guidelines for MASS trials adopted by the Circular MSC.1/Circ.1604.

MSC 102/5/14, 11 February 2020, MSC 103/5/7-8, 16 March 2021

COLREG



MSC 102/5/14
Annex, page 6

APPENDIX

RECOMMENDATIONS ON USING COLREG 1972 FOR AUTOMATIC COLLISION AVOIDANCE BY MASS

I. Main principles of automatic ship control

1 A maritime autonomous surface ship (MASS) is a ship equipped with automatic and remote-control systems, capable of moving in the automatic mode (automatic control mode).

2 For the purpose of application of these recommendations, navigation risks mean restrictions for ship manoeuvring to avoid collisions, such as depths, traffic separation zones, traffic lanes, the information about which is received from the remote ship control system.

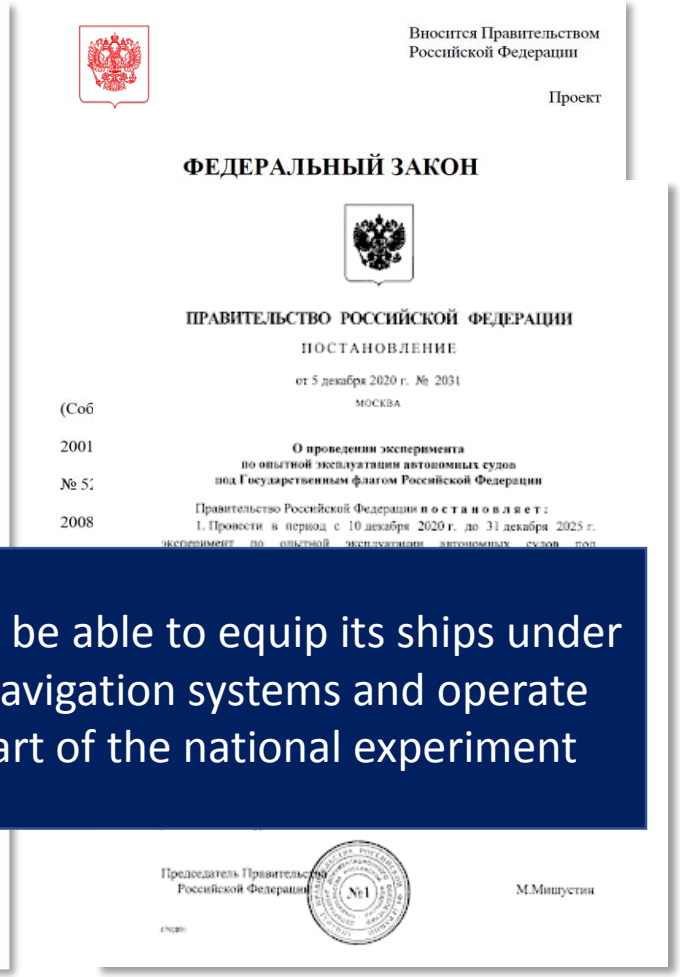
3 For the purpose of application of these recommendations, the "in sight of each other" situation means that the MASS optical search system detected a target within an area of at least 12 miles.

4 Automatic ship control is possible in any water area beyond port areas, sufficient for

in good visibility conditions. Targets and their movement parameters are determined in this zone: the true course (CSE) and speed (SPD) of the other ship, the risk criteria – time to closest point of approach (TCPA) and closest point of approach (CPA).

.2 A zone at a distance of 7-5 miles – the "timely decision zone" for making

SOLAS, IG for MASS Trials



Вносится Правительством Российской Федерации

Проект

ФЕДЕРАЛЬНЫЙ ЗАКОН

ПРАВИТЕЛЬСТВО РОССИЙСКОЙ ФЕДЕРАЦИИ

ПОСТАНОВЛЕНИЕ

от 5 декабря 2020 г. № 2031

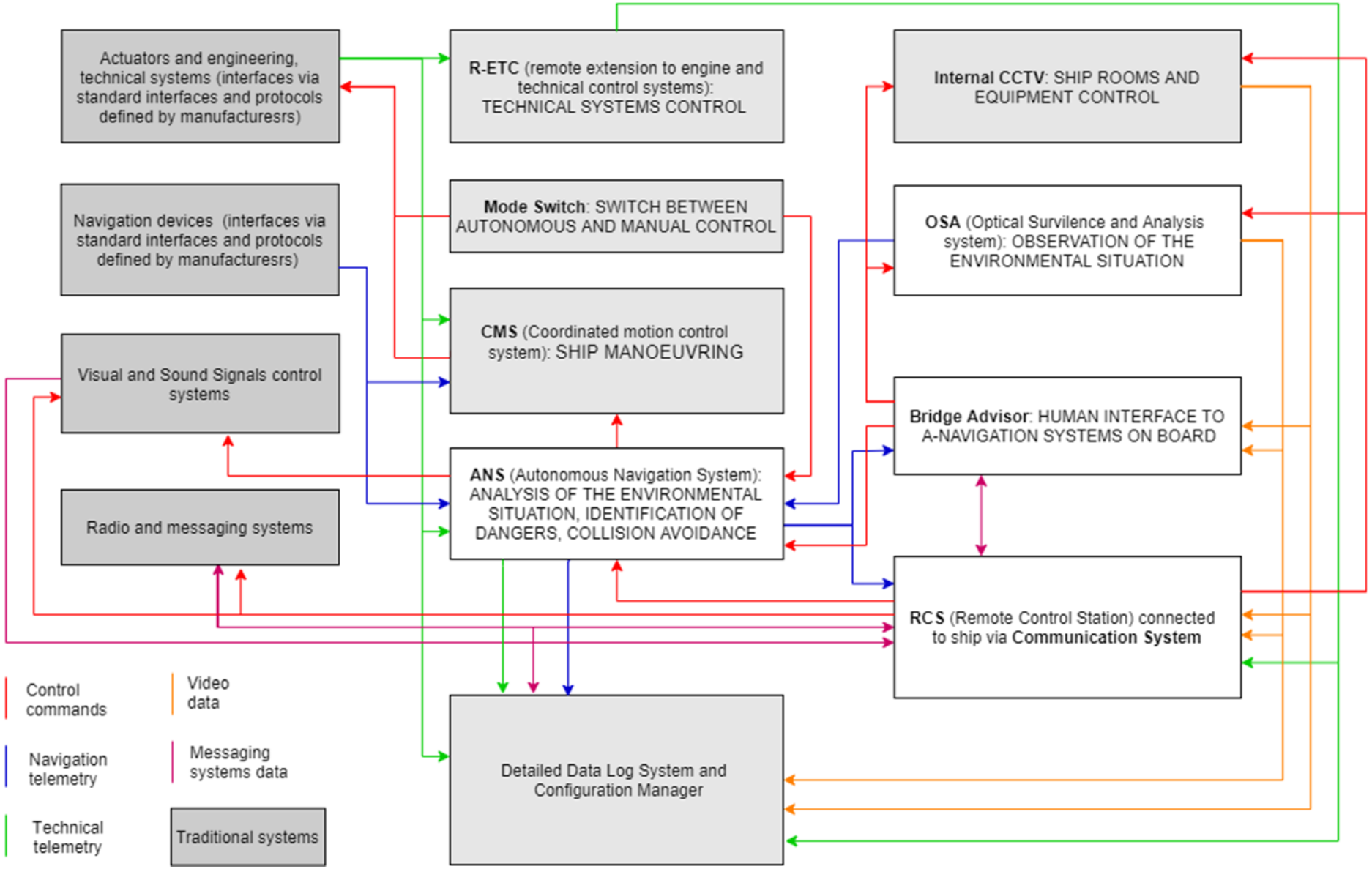
МОСКВА

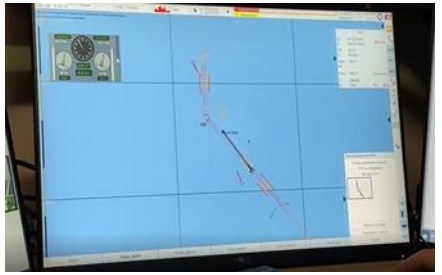
О проведении эксперимента по опытной эксплуатации автономных судов под Государственным флагом Российской Федерации

Председатель Правительства Российской Федерации М.Мишустин

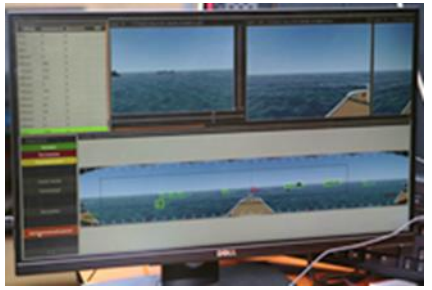
From 2021 any shipping company will be able to equip its ships under the Russian flag with autonomous navigation systems and operate them in their regular activities as part of the national experiment

System Architecture

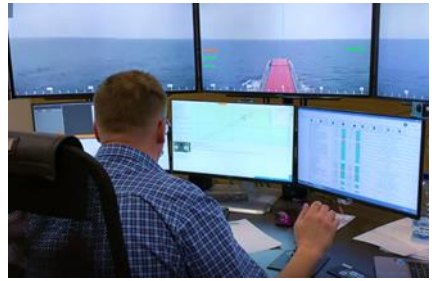




Autonomous Navigation System



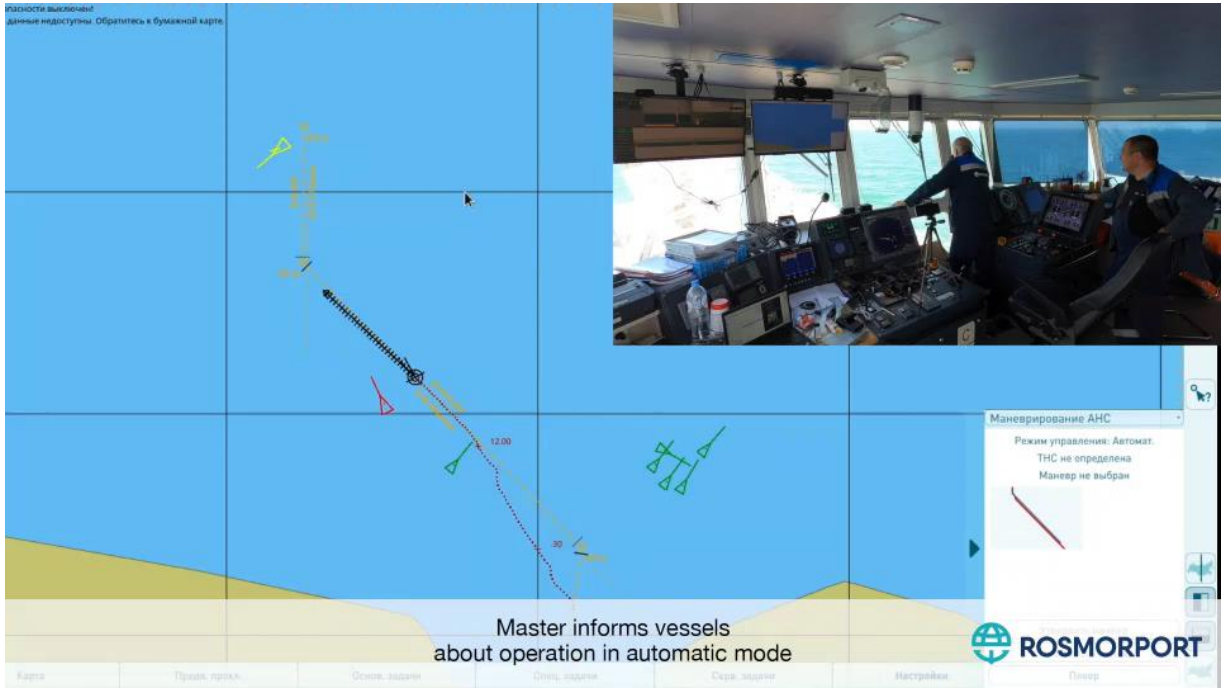
Optical Surveillance and Analysis System



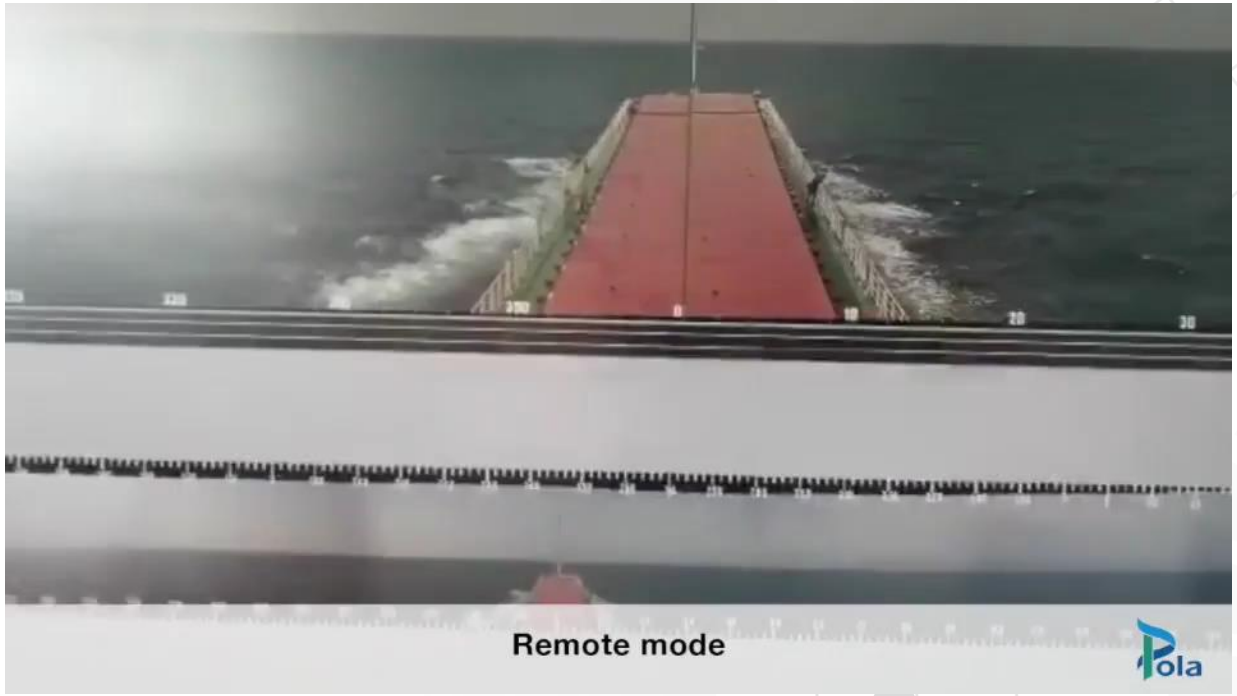
Remote Control Station

Examples of trial navigation

Example of trial operation in heavy traffic area onboard Rabochaya и Redut



Example of trial operation in high seas onboard Pola Anfisa

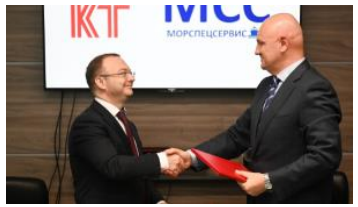


Symbiosis of ship control modes,

which could be combined on the same ship and during the same voyage: e.g., fully automatic navigation on a passage in the high seas (80-90% of the time); non-standard situations – by the remote operator; and only in some limited cases – like pilotage or emergency cases – we need human control onboard.

a-Navigation Trial Project Progress

March 2019 – August 2019	Development of methodology and solutions prototypes
July 2019 – February 2020	Risk assessment and draft legislation development
December 2019 – March 2020	Manufacturing of experimental equipment
May - September 2020	Installation on board four ships
June – August 2020	Preliminary tests of systems on shore using simulators
from September 2020	Collection of field data from ships and analysis of systems operation without possibility to control the ships
December 2020	Approval in Principle by Russian Maritime Register of Shipping
from February 2021	Tests of automated and remote operation of ships in real conditions under control of the crew
September 2021 (We are here)	Demonstrational voyages in real commercial operation
October – November 2021	MASS national regulation adoption



The national experiment on wide MASS operation
(currently, five companies intended to equip 27 vessels)

Trial operation in real conditions

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Thank you!