R-Mode Baltic

Safe Navigation in the Baltic Sea

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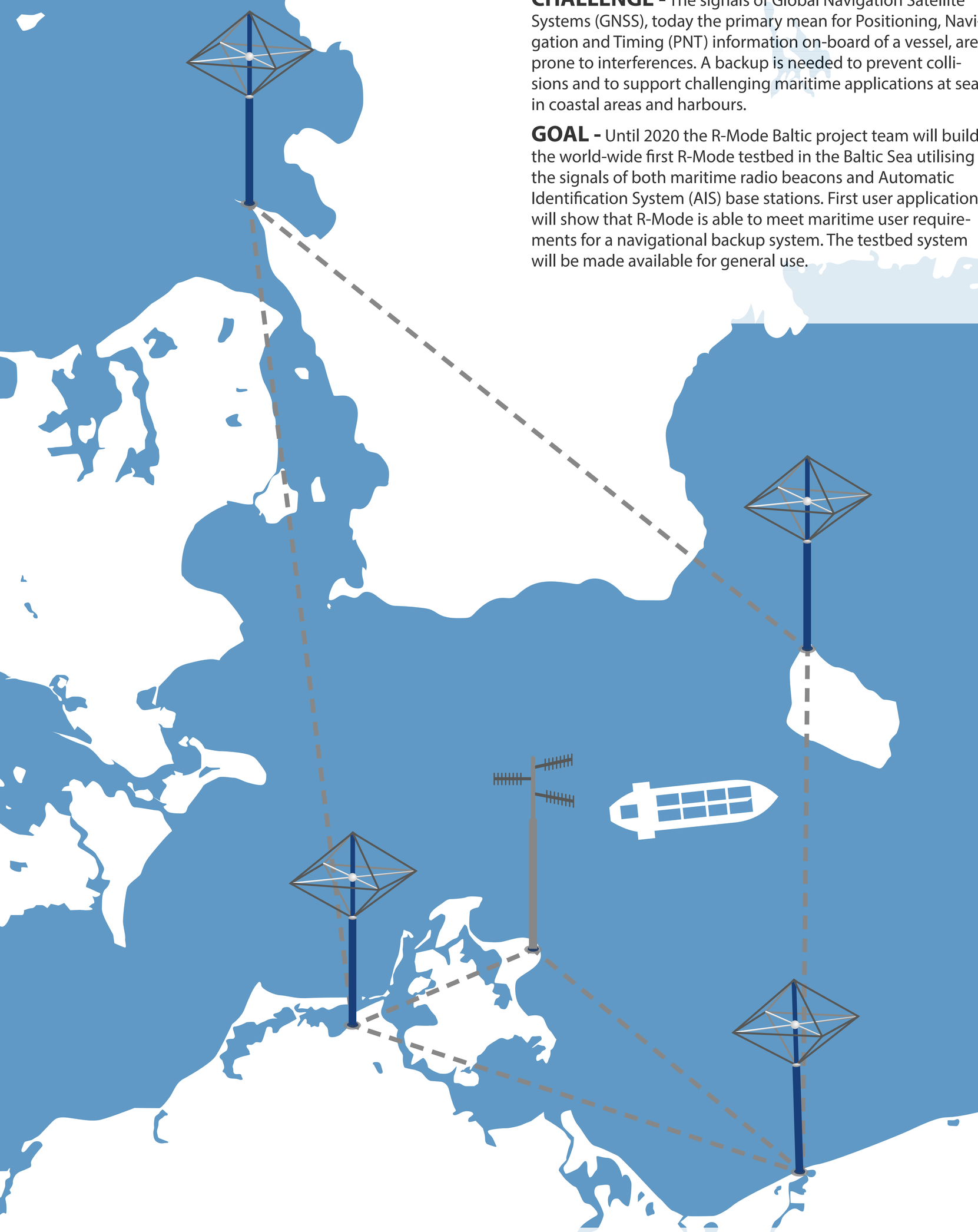
CHALLENGE - The signals of Global Navigation Satellite Systems (GNSS), today the primary mean for Positioning, Navigation and Timing (PNT) information on-board of a vessel, are prone to interferences. A backup is needed to prevent collisions and to support challenging maritime applications at sea, in coastal areas and harbours.

GOAL - Until 2020 the R-Mode Baltic project team will build the world-wide first R-Mode testbed in the Baltic Sea utilising the signals of both maritime radio beacons and Automatic Identification System (AIS) base stations. First user applications will show that R-Mode is able to meet maritime user requirements for a navigational backup system. The testbed system will be made available for general use.

APPROACH – R-Mode is a maritime positioning system that utilises existing maritime infrastructure by adding ranging signals to the legacy transmission scheme. The project team, consisting of 12 project partners from four European countries from the fields of research, industry and maritime administration, will develop robust methods for the implementation of ranging signals onto the two maritime signals-of-opportunity without disturbing the function of legacy receivers. Furthermore, it will develop system and user hardware, as well as first applications and implement R-Mode on the maritime infrastructure of Sweden, Poland and Germany. Project standardisation activities will enable other administrations to upgrade their infrastructure.



R-MODE ENABLED MARITIME RADIO BEACON

Radio beacons provide differential corrections for GNSS by low data rate transmissions in the medium frequency radio band around 300 kHz. Based on already available R-Mode developments using continuous wave and the legacy signal, the project team will explore an advanced signal design which enables solving the ambiguity problem. Furthermore, methods will be developed to mitigate the impact of the skywave induced fading and other error components, e.g. ground dependent propagation speed. Up to six stations will be upgraded.

R-MODE ENABLED AIS BASE STATION

AIS base stations provide information from ashore to the maritime user using AIS messages, which are transmitted in the very high frequency (VHF) radio band around 162 MHz. The project team will prove ways to implement R-Mode on AIS and VHF Data Exchange System (VDES) signals. An optimal signal design will be selected and algorithms for range estimation will be developed. The data channel load will be considered. Furthermore, AIS base station equipment of four stations will be adjusted for the transmission of R-Mode signals.

R-MODE POSITIONING

Based on existing GNSS receiver platforms, hardware for two prototype receivers and processors with different level of integration will be developed. The included software will meet the R-Mode requirements and will include the project research results on R-Mode positioning methods on radio beacon and AIS signals. The prototypes will show their capabilities at the end of the project in the Baltic Sea testbed.

TIME SYNCHRONISATION OF R-MODE TRANSMITTER

R-Mode transmitters must operate with a mutual time accuracy of a few 10 ns to support finishing already begun manoeuvres. The project will analyse the performance of currently available time comparison methods and station clock alternatives, and will suggest a suitable R-Mode timing infrastructure. Furthermore, self-synchronisation of R-Mode will be studied. A proof-of-concept of a cost efficient cross-border time synchronisation solution with suitable holdover clocks at the transmitter sites will be developed and demonstrated.

THE LONG WAY TO R-MODE STANDARDISATION

Maritime radio beacons and AIS base stations are designed to meet international standards, recommendations and guidelines of IMO, ITU, IEC, IALA and others. Therefore the implementation of R-Mode signals on these stations requires the change and extension of the existing standards. The project team will forward and communicate findings impacting standardisation to the various standardisation committees.

R-MODE APPLICATIONS

An existing prototype of a PNT Data Processing unit will be expanded by adding raw data interfaces to the R-Mode receiver and by the implementation of new processing channels. This approach facilitates the position calculation based on one or both R-Mode signal sources. In case of identified loss of GNSS it will automatically provide an R-Mode based position. A portable pilot unit (PPU) will be equipped with an R-Mode module. When GNSS is available the unit works in its standard operation mode with very high accuracy – otherwise it will automatically switch to R-Mode operational mode. The R-Mode PPU will provide the pilot with information regarding the positioning mode currently in use on the PPU screen.

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