Implementation of e-Navigation Strategies for RIS Centres Supporting Inland Navigation

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ABSTRACT: The article presents at e-Navigation strategy and implementation plan for RIS centres supporting inland navigation.

The author describes the RIS centre system architecture and modules collaborating in the process of data transmission based on e-Navigation technologies.

The functional requirements of e-Navigation strategies for distress communications procedures and ensuring the safety of inland navigation in compliance with the EU directives are described.

The components of e-Navigation, which integrate state-of-the-art satellite and terrestrial radio communications systems in the process of effective and efficient management of navigational data transmission, are presented.

The feasibility of implementation of e-Navigation strategies for the Multifunctional Communication System integrating digital and analog data processing systems in maritime and inland navigation are analysed.

A technological model of the Maritime Navigation Cloud supporting data exchange in the e-Navigation system is put forward.

1 INTRODUCTION

The e-Navigation technologies, which integrate the operation of sea and inland waterway navigation systems, are applied in the River Information Services (RIS) system in the process of communications data management. [9]

Improvement of the safety of navigation and reduction of the number of errors, including human errors, e.g., committed by the officer of the watch, is the most important criterion of collaboration of the integrated communications platform at a RIS centre with the VTS systems, rescue coordination centres (RCCs), and shore-based stations. [11],[12]

2 NAVIGATION DATA PROCESSING IN THE RIS SYSTEM USING THE E-NAVIGATION STRATEGY [9]

2.1 *River Information Service (RIS) system [2]*

The River Information Service (RIS) system supports and coordinates the planning of transport on inland waterways. [1],[3]

Using advanced ICT technologies, a RIS centre manages traffic in inland waterway transport by providing operational (e.g., immediate navigation-related decisions) and strategic (e.g., voyage planning) services related to the management of terminals and cargo handling operations. [16]

A RIS centre facilitates reliable verification and processing of statistical data on inland waterways in

the EU Member States. The e-Navigation strategy makes it possible to harmonise data transmission standards used by inland navigation authorities for the purpose of monitoring and strategic planning of the entire transport chain. [15],[23]

2.2 *The e-Navigation strategy architecture for services provided by RIS centres [6], [23]*

The e-Navigation strategy is aimed to integrate navigational data transmission systems. Increasing the radio communications capacity, e-Navigation technologies utilize terrestrial and satellite systems as well as broadband Internet. [4], [5]

Elements of the e-Navigation strategy (Fig. 1) integrate state-of-the-art ICT systems available onboard ships with shore-based stations through RIS centres. [8]

The module of collaboration between the World-Wide Radio Navigation System (WWRNS) and the Common Maritime Data Structure (CMDS) presented in Fig. 1 ensures uniform operation of the data management system. [6], [24]

The services performed at a RIS centre are aimed at coordinating distress alerts. The World-Wide Radio Navigation System uses the FleetBroadband satellite broadband terminal equipped with a Distress Call button in the Voice Distress Services application, implemented onboard inland waterway craft. [12]

The proposed e-Navigation architecture, which meets the functional requirements of the RIS system, features the Marine Service Portfolio module integrating both sea and inland waterway services. The MSP is designed to supervise efficient and effective transmission of navigation data required by the OOW, with simultaneous correction and elimination of transmission errors. [6]

3 MODEL OF E-INS INTEGRATED WITH THE RIS SYSTEM [17]

The e-INS navigation module (Fig. 3), based on e-navigation technology and integrated into the RIS system, performs the following functions [13]:
- records, verifies and delivers processed data from external and internal sensors of navigational instruments, ensuring reliable distribution of information;
- provides a real-time graphical representation of the navigation process to the OOW;
- warns the data operator at the RIS centre of imminent danger and prepares the system for the distress procedure;
- by means of the Integrated Radio Communication (IRS) module, enables the captain to communicate via VHF, MF/HF radio and satellite systems (SAT). [23]

Using the integrated e-INS navigation system, the RIS centre applies the UN/EDIFAC (Electronic Data Interchange for Administration, Commerce and Transport) standard, uniform across the EU, in the process of data transmission in electronic ship reporting. [3], [7]

Application of the e-INS navigation system in the operation of the RIS centres allows collaboration with the navigation bridge of inland craft and facilitates: [14], [17]
- finding parameters of the ship's motion;
- imaging the navigational situation on the basis of ECDIS and Inland ECDIS;
- finding the vector of motion of one's own ship;
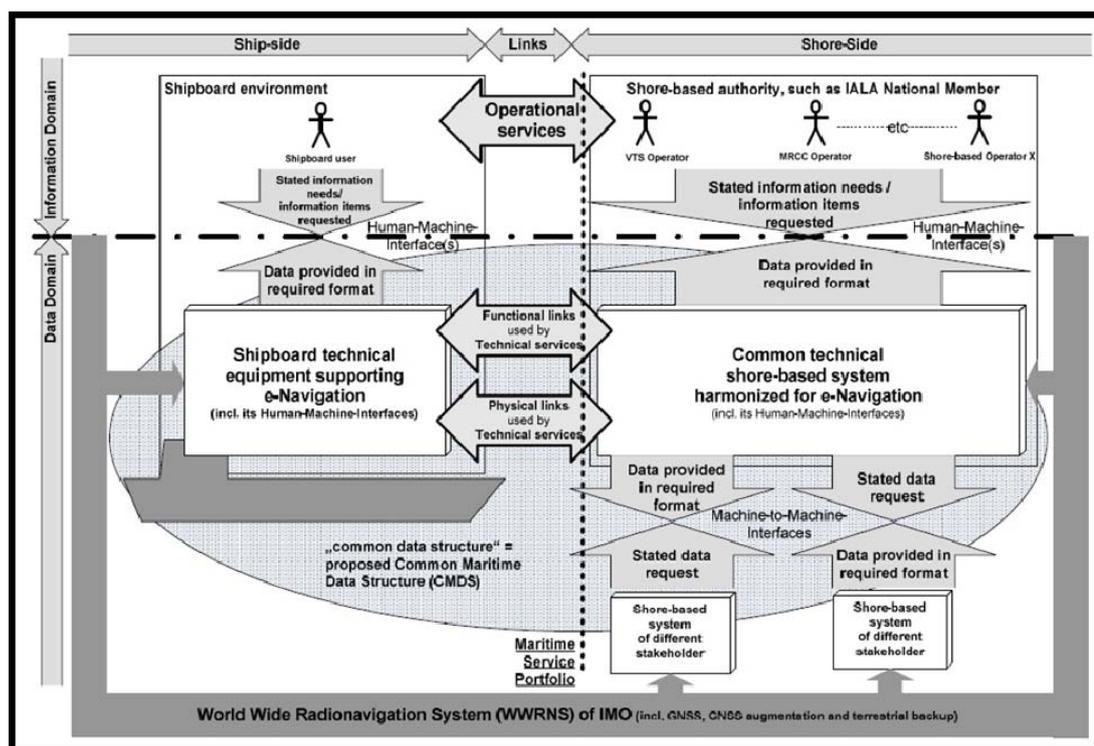- position fixing, using the radio navigation and satellite methods. [8]

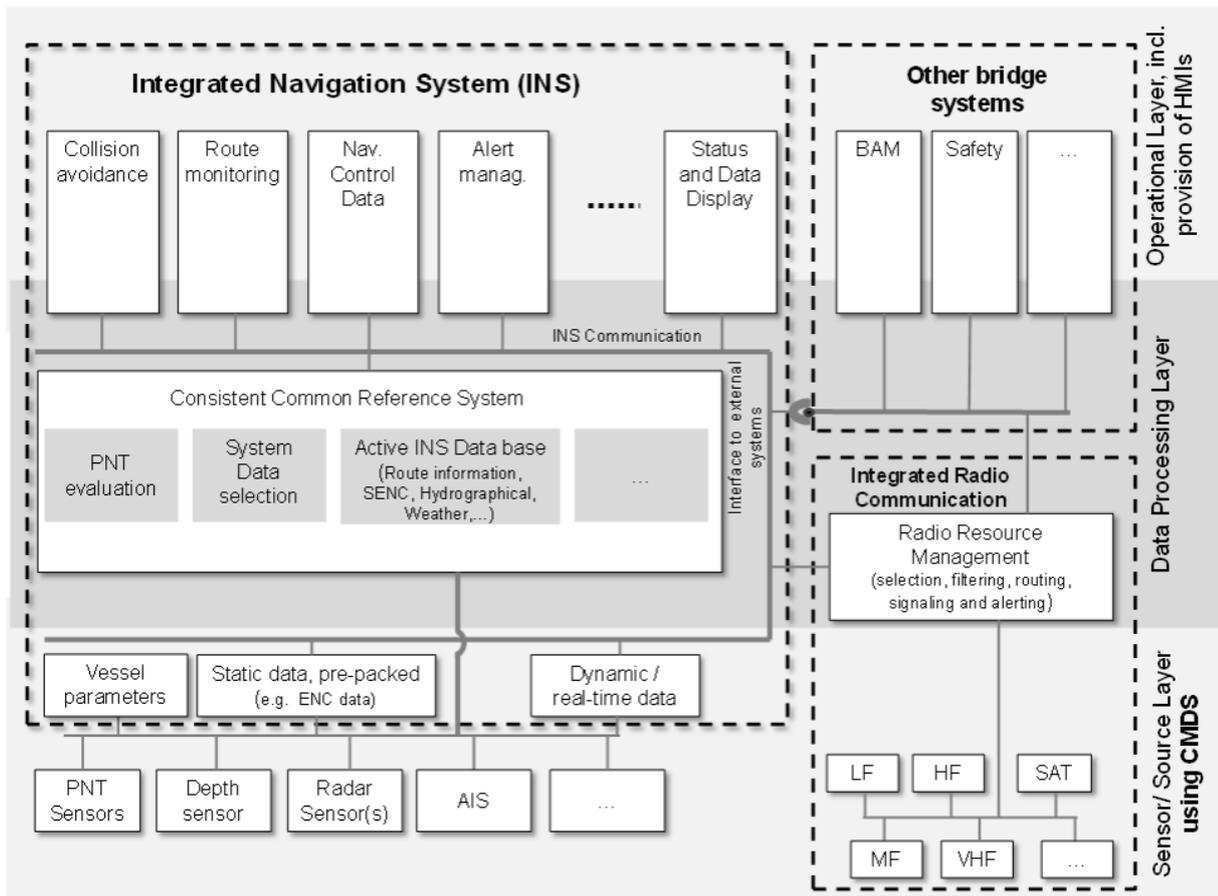Figure 1. The e-Navigation strategy architecture performing services in the RIS system.[9].

Figure 2. Model of e-INS integrated navigation system at a RIS centre.[7].

4 E-NAVIGATION IN SUPPORT OF THE MULTIFUNCTIONAL COMMUNICATION SYSTEM [12]

The Multifunctional Communication System operating in the RIS system facilitates: [1]

- electronic ship reporting in accordance with the EDI (Electronic Data Interchange) standard;
- display of electronic navigational charts showing a graphical representation of ships' positions;
- navigational data interchange among the EU countries in inland waterways transport;
- automatic identification and tracking of navigational situations in fairways. [21], [22]

Figure 3 shows communication modules collaborating in the process of electronic ship reporting to the RIS centre, using digital and analog radio communications systems, VHF, MF/HF bands, and satellite systems. [13]
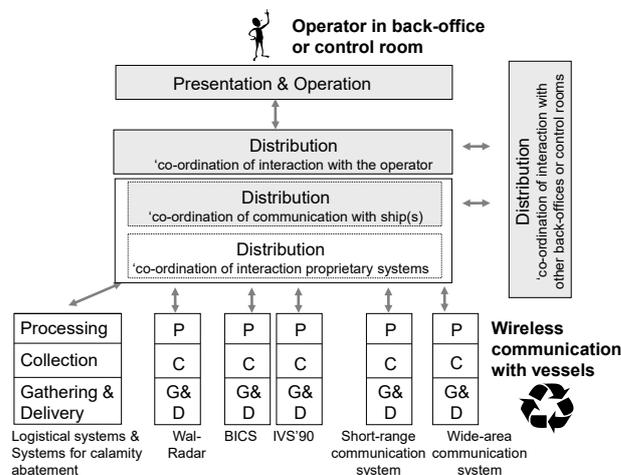

Figure 3. Electronic chip reporting to the RIS centre. [10].

Efficient and reliable communication is an underlying feature of e-Navigation services. The architecture of the Multifunctional Communication System operating in the RIS centre system includes the following terrestrial radio communications systems: [4], [11]

- VHF radio telephony, DSC VHF, MF/HF, NAVTEX, EPIRB, SART AIS-SART;
- as well as satellite systems, such as:
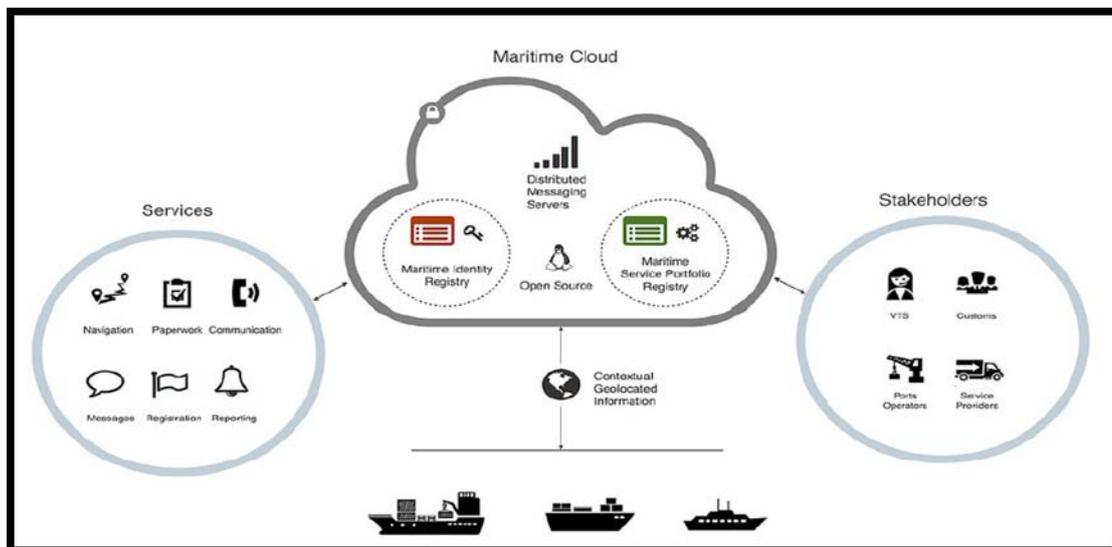- FleetBroadband, VSAT- Terminals, INMARSAT, EGC, and COSPAS-SARSAT.

Figure 4. Structure of the Maritime Cloud implemented at a RIS centre. Source: Own work, based on [20].

5 THE MODEL OF MARITIME CLOUD ARCHITECTURE IMPLEMENTED IN THE RIS SYSTEM FOR DATA TRANSMISSION [11], [18]

Owing to the development of the e-Navigation technology, the maritime cloud technology could have been implemented into the RIS system to increase the safety of data transmission and interchange. [11]

There are two modules integrated into the structure of the Maritime Cloud (Fig. 4), which perform the following functions: [20]
– record transport services in real time; and
– identify navigational databases.

The Maritime Cloud creates a database accessible to selected users.

The service ensures communication and data interchange between vessels and shore-based stations.

6 SUMMARY

The paper discusses e-Navigation technologies supporting harmonised services performed by the RIS centres in inland waterway transport, within the framework of the strategies set out in relevant EC directives. [9]

RIS centres archive and process information and make it available to captains of inland going vessels, as well as provide decision-making support in the processes of transport planning and management.

Application of e-Navigation technologies in RIS centres defines standards and ensures sufficient availability of services to meet the increasing needs of inland navigation users. The e-Navigation strategy facilitates verification of quality of the processed data and boosts the competitiveness of communication technology suppliers who ensure quick, reliable and integrated signal transmission. [15]

The e-Navigation technologies implemented in a RIS centre adapt the inland waterway transport to the logistic solutions proposed by the European Commission, and through broadband access to Internet services, integrate into the European intermodal transport network. [19]

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3. Directive 2005/44/EC of the European Parliament and of the Council of 7 September 2005 on harmonised river information services (RIS) on inland waterways in the Community (O. J. L 255, 30/09/2005).
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