

Integrated Communications Platform for RIS Centres Supporting Inland Navigation

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ABSTRACT: This article looks at the architecture of the Integrated Communications Platform for the RIS Centres supporting inland navigation.

It analyses the feasibility of application of satellite-based telecommunications, localization and navigation systems in inland navigation, and presents methods of integration of radio communications systems which carry out distress communications algorithms and procedures in inland navigation.

Feasibility of integration of the AIS-SART and AIS-Satellite, guidance and positioning subsystems into the RIS Centre is examined.

The technical specifications of the FleetBroadband and Mini-VSAT systems are examined for usability in the multifunctional information service of the RIS Centre Communications Platform.

1 INTRODUCTION

Inland waterway freight transport is an important field of transport of goods in Europe.

The European Commission Directives on inland waterway transport are intended to strengthen the competitiveness of inland shipping in the transport system and facilitate its integration into the maritime transport in the intermodal logistics chain. [1], [5]

Inland navigation has immense potential and ensures a high level of safety, especially with regard to the transport of dangerous goods.[6]

Rapid development of communications technologies, such as digital transmission of signals and satellite systems, has contributed to the introduction by the European Commission of new data exchange and processing standards to be implemented in the operation of the RIS (River Information Service) Centres. [2]

RIS Centres manage, process and transmit information which supports ships' captains in their navigation decisions.

Dynamic transmission of data processed at the Integrated Communications Platform requires the use of maximum channel throughput and bitrate in all the systems collaborating with the RIS Centre.

The module which supports verification of ingoing and outgoing data at the RIS Decision Centre is the key element of the system integration.

Implementation of the Integrated Communications Platform, which combines modern terrestrial and satellite radio communications, will facilitate effective and efficient management of data transmission. [9]

2 INTEGRATED COMMUNICATIONS PLATFORM ARCHITECTURE FOR THE RIS CENTRE IN INLAND NAVIGATION

Data transmission and integration of harmonised services and functions performed by RIS Centres for inland navigation requires the application of digital and analogue radio communications systems and satellite transmission channels.

In order to ensure compatibility of information exchange in inland navigation and on maritime ships in areas where sea and inland waterways intersect, e.g. in countries such as the Netherlands, Germany, Poland, France or Croatia, immediate implementation of a universal radio communications platform supporting data streaming is required. [10], [11].

Ensuring safety of verification and transmission of navigational data is the key driver of the development of inland navigation. Communication between captains of sea-going and inland waterway vessels, as well as between the Vessel Traffic Service (VTS) and the RIS must be supported with state-of-the-art data transmission solutions. The application of innovative technologies ensures real-time data processing and transmission, and guarantees high quality of data. [3]

For many years, communication on inland waterways has been executed by means of VHF radio-telephony. The proposed Integrated Communications Platform has been designed to support the tasks carried out by the RIS Centres in the European countries.

The architecture of the Integrated Communications Platform comprises the following subsystems: of the terrestrial communications segment – the VHF, MF/HF radio telephony, VHF, MF/HF Digital Selective Calling, NAVTEX, NBDP, EPIRB SART and AIS-SART (components of the GMDSS)[10]; of the satellite systems segment – INMARSAT, EGC, and COSPAS-SARSAT (components of the GMDSS); as well as satellite navigation systems, satellite telecommunications systems, and Satellite-Based Augmentation Systems (SBAS), which are not part of the GMDSS. [12],[13].

The Integrated Communications Platform, which transmits data to the RIS Centres, collaborates with navigational bridges on inland waterway vessels in the performance of the following functions: [7], [8]

- position fixing by the radio navigation and satellite-based methods;
- determining the parameters of movement of inland waterway vessels;
- obtaining data on the ship's own movement vector;
- vessel traffic imaging, supported by electronic ECDIS and Inland ECDIS navigational charts;
- collision avoidance imaging, supported by the radar/ARPA and the Automatic Identification System (AIS).

The architecture of the Integrated Communications Platform is shown in Fig. 1.

3 APPLICATION OF SATELLITE SYSTEMS IN INLAND NAVIGATION

In recent years, the position of an inland waterway vessel has been fixed on an ongoing basis with the use of traditional methods. However, the development of and widespread access to state-of-the-art radio communications technologies have facilitated the use of satellite systems in position fixing. At present, GPS and GLONASS are the most advanced systems. However, they will soon be surpassed by the European Galileo. [10]

Satellite systems support visualisation of a vessel's position in real time, on a screen displaying Inland ECDIS charts. [7]

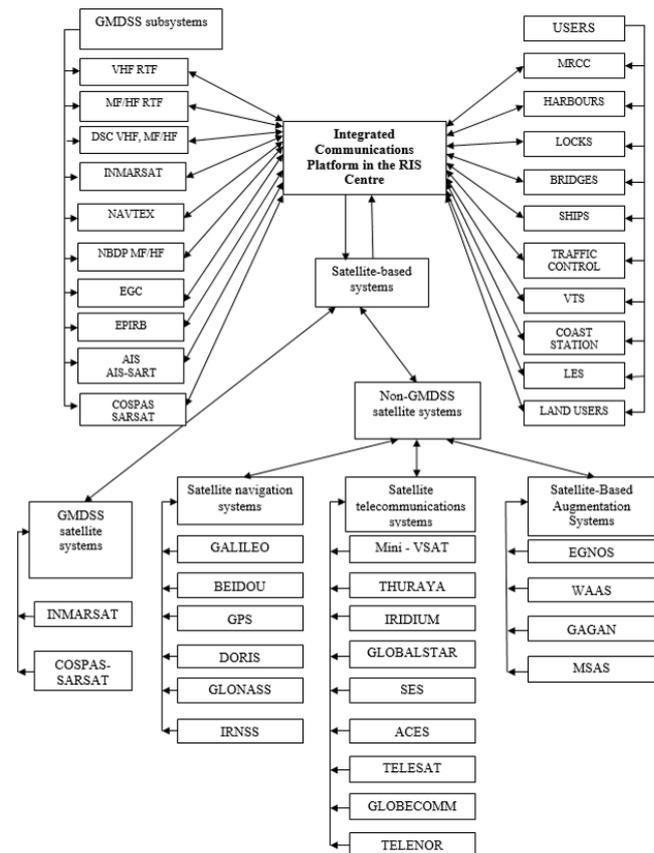


Figure 1. Integrated Communications Platform architecture. Source: Own work.

The position of a vessel navigating on an inland waterway should be interpreted as the location of the vessel's waterline rather than as a point. Navigation in restricted inland waters consists in maintaining the vessel's position on the right side of the safety contour. The use of modern position fixing instruments, such as satellite systems, is the key driver in the improvement of navigation safety standards. [8]

In order to increase the accuracy of positioning data, the EGNOS satellite-based augmentation system, which at present covers the entire European continent, is being developed to include Europe's inland fairways. [7]

The accuracy of the position of an inland waterway vessel determined with the use of satellite systems depends on the number of visible satellites whose signal reaches the receiver antenna.

Inland navigation is impeded by such obstacles as elevated banks, hills, buildings and urban structures. Therefore, in order to facilitate the receipt of a signal transmitted by a satellite at a lower topocentric altitude, antennas on inland waterway vessels should be located possibly high above the water surface.

4 DISTRESS ALERTING IN INLAND NAVIGATION WITH THE USE OF SATELLITE SYSTEMS

As part of the GMDSS, the Inmarsat Mini-C option of the Inmarsat satellite system is used in distress communications in inland navigation. [3], [4]

A small antenna, easy to use interface, energy-efficient power supply and low cost encourage enthusiasts of inland navigation to equip their watercraft with the system.

Another Inmarsat module used in inland navigation is FleetBroadband. Apart from the alerting functionality, it supports message priority assignment.

In the FleetBroadband system, alerting procedures can be deployed by two state-of-the-art methods:

- 1 Selecting the 505 Emergency Calling button – an innovative solution for inland waterway vessels, which supports voice alerts to the RIS Centre and the MRCC in situations of distress and risk to life;
- 2 Selecting the red Distress Call button on the Voice Distress Services module deployed on board inland waterway vessels and at the Integrated Communications Platform module at the RIS Centre.

The function of alerting in distress on inland waterways is also performed by the Emergency Position Indicating Radio Beacon (EPIRB), which uses the satellite-based COSPAS-SARSAT. [9]

5 AIS-SART AND AIS-SATELLITE SUBSYSTEMS IN THE INTEGRATED COMMUNICATIONS PLATFORM

AIS-SART is a radio-based device which supports the positioning of vessels in distress. It operates at frequencies within the VHF band, and sends its position via the Automatic Identification System (AIS). The position is provided by the GNSS receiver embedded in the device. The transmission of VHF radio waves is significantly restricted by the Earth's curvature and the horizontal range of propagation of the V wave.[11]

Using the latest satellite technology solutions, data sent by AIS-SART is received by Low Earth Orbit satellites implemented in the ORBCOMM satellite system. [2], [12]

Another solution is the Satellite AIS (SAT-AIS), where the ship's identification and identity are recorded and decoded by a satellite.

Integration of the AIS-SART and AIS-Satellite into the Integrated Communications Platform at the RIS

Centre increases the efficiency and minimizes the time required to locate a vessel in distress by the search and rescue centre.[6]

6 FUNCTIONAL UTILITY ANALYSIS OF THE FLEETBROADBAND AND MINI-VSAT SYSTEMS IN TERMS OF THEIR INTEGRATION INTO THE MULTIFUNCTIONAL INFORMATION SERVICE OF THE INTEGRATED COMMUNICATIONS PLATFORM AT THE RIS CENTRE [2], [10]

Mini-VSAT and FleetBroadband systems are currently two leading systems which ensure communications in distress and comprehensive communications among inland waterway vessels.

The main difference between the devices implemented in the systems is their efficiency.

The V11-IP modem, implemented in Mini-VSAT, provides the maximum data download/upload speed of 1Mbps. It is integrated into the RIS Centre system by means of the CommBox V11 modem.

The FB 500 TracPhone modem, implemented in FleetBroadband, provides the maximum data download/upload speed of 432Kbps. It is integrated into the RIS Centre system by means of the TracPhone modem.

Inland waterways (e.g. the River Danube) run through restricted areas, such as e.g. mountainous terrains, where ground-based Internet signal is unavailable, or through areas where mobile network access is required.

The modules of both systems, being part of the Integrated Communications Platform at the RIS Centre and deployed on inland waterway vessels, provide access to broadband Internet on board inland waterway vessels which operate also in sea areas, in countries such as the Netherlands, Germany, Poland, Croatia and France.

Owing to an antenna of a diameter of 1.1m for Mini-VSAT and 66cm for FleetBroadband, deployed at the RIS Centres and on board inland waterway vessels, bidirectional services providing the radio telephony signal, broadband Internet and text message functionality are realized safely and without any disruptions.

The Mini-VSAT system, which supports higher speed of data transmission and a larger bandwidth, is more efficient than FleetBroadband in terms of downloading patches for Inland ECDIS devices and handling email services on board inland waterway vessels.

One of the key prerequisites for efficient collaboration of the modules integrated within the RIS Centre is their reliability. Compared to Mini-VSAT, FleetBroadband offers greater reliability, owing to the support of the L band frequency range, where precipitation and variability of the atmospheric and meteorological conditions does not have a material impact on the system operation.

The components of the collaborating systems presented above ensure stable operation of the

multifunctional information service at the RIS Centre. [15]

7 SUMMARY

An analysis of the technological solutions of data transmission via ground-based and satellite systems within the Integrated Communications Platform at the RIS Centre has been performed, taking into consideration the specific character of inland navigation and the topography of inland waterways. [9].

In areas where maritime and inland waterways adjoin, integration of the RIS and VTS systems is essential.

The proposed Integrated Communications Platform for the RIS Centre performs the following functions:

- data transmission in compliance with the Electronic Data Interchange standard;
- information exchange between partners in inland navigation;
- inland traffic management;
- services for passengers of inland waterway vessels;
- exchange of electronic data among the authorities of the European Union Member States.

The presented model of Integrated Communications Platform for the RIS Centre is part of the navigational decision support systems being developed, which improve the safety of navigation on inland waterways. [14]

At the next stage of the planned development of the inland navigation management system, a harmonised system of cooperation of the RIS Centres and the maritime VTS centres with the modules supporting the decision-making process, coordinated with the Maritime Rescue Coordination Centres (MRCC), will be deployed.

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