Telecommunication infrastructure of the polish national maritime safety system

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ABSTRACT

Polish maritime administration, implementing the regulations of the European Union on Vessel Traffic Monitoring and Information System (VTMIS) and ships reporting formalities, currently forwards into operation National Maritime Safety System (KSBM). The paper presents telecommunications infra-structure of the systems with particular emphasis on the Pomeranian Telecommunication Bus, which has enables the efficient communication between sensors and transmission and exchange of data between users and meet expected requirements of e-navigation, structure and tasks of the telecommunication network and data transmission and exchange rules.

KEYWORDS: VTMIS, SafeySeaNet, telecommunication infrastructure

1. Introduction

In order to fulfil requirements of regulations issued on the base of the Acts of Polish Parliament of 16 March 1995 on prevention of pollution from ships, as amended, of 18 August 2011 on maritime safety and of 24 July 2015 amending the act on maritime safety and some other Acts implementing, among others, regulations of the European Union on Vessel Traffic Monitoring and Information System (VTMIS) and ships reporting formalities, Polish maritime administration currently forwards into operation National Maritime Safety System (KSBM).

Implemented system shall enable monitoring and analysis of the situation in the Polish maritime areas and ports, warning about the dangers and providing information relating to maritime safety and security and pollution threat in order to prevent maritime accidents and pollution of marine environment and coast and to conduct efficient action in the event of their occurrence, supporting the decision making process for granting place of refuge and respond to custom threats, supporting safety and security management and assistance in the accident investigation and detection of polluters through the use of identification, tracking and data archiving subsystems. Its technical infrastructure shall ensure the acquisition,

storage, exchange and display of data and information about ships and events necessary to ensure the safety and security of the Polish maritime areas and the adjacent coastal zone, especially [1,2,4]:

- posing a potential hazard to shipping or a threat to maritime safety and security and safety of people and marine environment, the effects of which may extend to a Polish maritime areas or maritime areas in other Member States of the European Union; and
- necessary to effective organization and conducting of the search and rescue (SAR) operation at sea, vessel traffic monitoring comprising the management and surveillance of ship movements and affective work of the Polish ports and harbours.

2. KSBM - basic information

Establishing of the National Maritime Safety System (KSBM) shall allow [3]:

- increasing the EU's external border security at sea;
- increasing the capacity of the environmental protection;
- more efficient monitoring of maritime traffic;

- ensuring adequate transmission medium for the supervision of the exploitation of the Polish maritime areas and compliance by vessels regulations in force in those areas;
- more effectively protection of the economic interests of Poland in Polish maritime areas; and
- combating of poaching at sea.

The technical infrastructure of the KSBM creates [4]:
1. Marine Traffic Surveillance and Monitoring System consisting of:
- 28 shore based radars with tracking facilities, installed as elements of the vessel traffic service "VTS Zatoka Gdańska", vessel traffic management service "VTMS Szczecin – Świnoujście" or stand alone port and shore remote controlled sensors;
- 12 AIS shore based stations created Polish net of these stations connected through the national server located in Gdynia with regional Helsinki Commission (HELCOM) Baltic server in Kopenhagen and EU server operated by European Maritime Safety Agency (EMSA) in Lisbon;
- nets of 12 shore radio stations enabling communication with vessels in the VHF band and 8 shore radio stations designated for SAR purposes;
- 26 video cameras located in ports and on the fairway Szczecin - Świnoujście;
- 5 radio direction finders (RDF) working in the VHF band;
- 14 hydro-meteorological stations; and
- national contact point of the Long Range Identification and Tracking (LRIT) System in Gdynia,
2. Information exchange system consisting of:
- Polish Harbour Information and Control System (PHICS), with the exception of the STCW component containing a database of seafarers' documents, including databases of: ships of Polish flag, ships entering Polish ports and dangerous, harmful and polluting cargoes loaded and unloaded in Polish ports; and
- Electronic System for the Exchange of Maritime Safety Information (SWIBŻ), called the National SafetySeaNet.

The National Maritime Safety System encompasses areas of responsibility of the Directors of Maritime Offices in Gdynia, Słupsk and Szczecin shown in Fig. 1, in particular: approaches to ports, their roadstead, anchorages and coastal areas. Each one of them, for the management of its territory, has regional centre located respectively in Gdynia, Słupsk and Szczecin subordinated to the national maritime safety centre situated in Gdynia and cooperating with domestic and foreign institutions, services and authorities, including Helsinki Commission (HELCOM) and EU institutions.

Additionally there are local, presented in Fig. 1, decision-making centres: vessel traffic service "VTS Zatoka Gdańska" vessel traffic management service "VTMS Szczecin – Świnoujście" and harbour master offices in: Darłowo, Dziwnów, Elbląg, Gdańsk, Gdynia, Hel, Kołobrzeg, Łeba, Szczecin, Świnoujście, Ustka and Władysławowo.
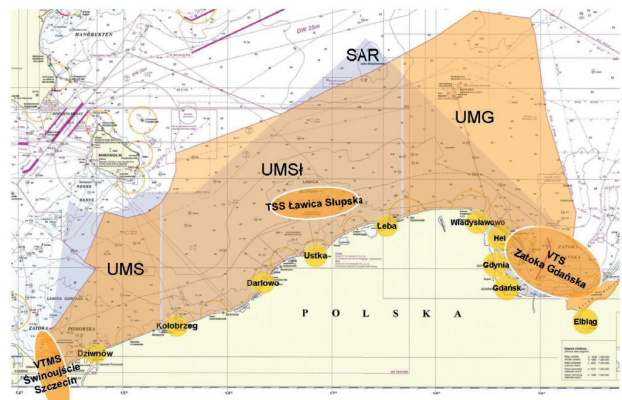

Fig. 1. Polish maritime areas and areas of responsibilities of particular Directors of three Polish Maritime Offices in: Gdynia (UMG), Słupsk (UMSł) and Szczecin (UMS), Polish Maritime Search and Rescue Service (SAR), VTMS Szczecin – Świnoujście, VTS Zatoka Gdańska and harbour masters offices equipped with new installed radars [own study]

Telecommunication infrastructure shall connect all above mentioned decision-making centres, provide them with the access to databases (PHICS) and sensors, remote operation of sensors and communication with each other, with ships in the Polish maritime areas and institutions and services cooperating with maritime administration (Polish Maritime Search and Rescue Service, Coast Guard, customs, etc.).

2. National SafetySeaNet

According to the legal regulations the main tasks of the National SafeSeaNet Service PPS include, among others [1,2,4]:
- providing information required by the competent authorities from other European Union Member States; and
- immediate notification of the National SafeSeaNet users on received information from the European SafeSeaNet system on ships or events that constitute a potential danger to navigation or a threat to maritime safety or security, the safety of people or the marine environment, the effects of which may extend to the Polish sea areas.

It allows accesses to the information in National Maritime Safety System (KSBM) eligible employees, inspectors and officers of the Polish [4,5]:
- maritime administration (ministry supports the minister responsible for maritime economy and local maritime administration - maritime offices in Gdynia, Szczecin and Słupsk);
- State Commission on Marine Accident Investigation;
- Search and Rescue Service;
- Coast Guard;
- Customs Service;
- recognized organizations authorized to carry out the tasks of the Polish maritime administration;
- Maritime Chambers leading Polish register of maritime ships;

- sports association leading Polish register of maritime yachts;
- Hydrographic Office and Maritime Operations Centre of the Polish Navy;
- marine fisheries authorities;
- entities managing sea ports or harbours;
- sea and port pilot stations;
- State Sanitary Inspection;
- the regional governmental authorities; and
- other entities, which the administrator provides access to the database because of their responsibilities related to the needs of the maritime administration.

Additionally, information collected in the databases is available, through the national centre in Gdynia for the [4]:

- authorities of the Member State of the European Union if it is necessary to ensure the safety and security of shipping and marine environmental protection of that country;
- European Commission to ensure maritime safety and security and protection of the marine environment of the Member States of the European Union; and
- European Maritime Safety Agency (EMSA in Lisbon) and NATO Management Centre in Northwood (UK).

All KSBM users have to be fitted with terminals of the Electronic System for the Exchange of Maritime Safety Information (SWIBŻ) realizing following functions [3]:

1. Presentation of:
   - data received from KSBM inner sensors: VTS, VTMS, port radars, AIS-PL, hydro-meteorological sensors, RDF, PHICS databases, e-inspection, etc.;
   - data from outer AIS systems (HELCOM, EMSA);
   - data from outer radars (Polish Coast Guard and Polish Navy); and
   - weather forecasts and navigational and hydro-meteorological warnings.
2. SafeSeaNet notifications.
3. Modelling the drift of oil pollution.
4. Risk assessment.
5. Supporting crisis management and exchange of information.

Each user has defined domain, specifying the level and scope of its access to the system: priority of the access, type of shared information from databases, available sensors, etc.

Data is delivered to the PHICS databases by ship-owners of Polish vessels, Flag State Control and Port State Control inspectors, inspectors of recognized organizations, Polish entities responsible for the investigation of marine accidents and incidents and entities leading Polish registers of maritime ships and yachts. The information contained in the database is updated continuously. Delivered information is introduced to the database within 7 working days from the date of receipt. Entering information into the database, its update, and delete from the database are recorded and kept in the memory for at least two years [5].

According to the legal requirements ICT (Information and Communications Technology) systems operating within the National SafeSeaNet shall [5]:

- have an availability of not less than specified in the ICFD drawn up by the European Commission in cooperation with the EU Member States and defining detailed requirements for the operation, technical standards and operational procedures of national SafeSeaNet systems and the central part of SafeSeaNet system;
- provide the ability to archive and recover data for the period specified in the document IFCD;
- allow the transmission of information 24 hours a day, 7 days a week;
- allow the transfer immediately after receiving the request, to the competent authorities of the EU Member States, information on ship and dangerous or polluting goods carried on board the ship;
- maintain constantly required level of IT security; and
- provide access to the information to authorized users only.

Exchange of information using the telephone, fax or e-mail is ensured in the event of a failure or planned downtime if the ICT systems operating within the National SafeSeaNet.

3. Pomeranian Telecommunication Bus

Pomeranian Telecommunication Bus (PTB) is a fiber optic cable built along the Polish coast between Gdynia, Hel and Świnoujście in the scope of KSBM project as shown in Fig. 2 to [3,6,7]:

- provide reliable and secured transmission medium in tge frame of KSBM for Maritime Offices in Gdynia, Szczecin and Słupsk, Polish Maritime Border Guard, Polish Navy and Polish Maritime Search and Rescue Service;
- make possible adoption of the standards for maritime supervision and monitoring to the objectives set out, among others, in the Communication from European Commission on an integrated maritime policy for the European Union (the "Blue Book") adopted by the European Council on 14 December 2007 and the Communication from the Commission to the Council and the European Parliament, the European Economic - Social Committee and the Committee of the Regions "Towards the integration of maritime surveillance: A common information sharing environment for the EU maritime domain" of 15 October 2009.

The investment included [7]:

- construction of the cable pipeline 3xRHDPE 40 mm and the system micro duct 1xDB7 in relation Świnoujście – Hel;
- construction of main fibre optic cable with a capacity of 144 fibres G.657, and taps into additional locations in the form of fibre optic cable with a capacity of 24 fibres;
- construction of the offshore cable section in relation Hel-Gdynia with a capacity of 24 fibres G.657;
- delivery and installation of DWDM (Dense Wavelength Division Multiplexing) system for the relation Hel-Gdynia-Gdańsk;

- supply and construction of IP/MPLS (Multiprotocol Label Switching) network with speeds of 10 Gbps between nodes and endpoints;
- delivery and installation of optical fibre fault detection system with fixed reflectometers and optical switches;
- construction of 19 containers for nodes and installation of network terminations in 22 endpoints; and
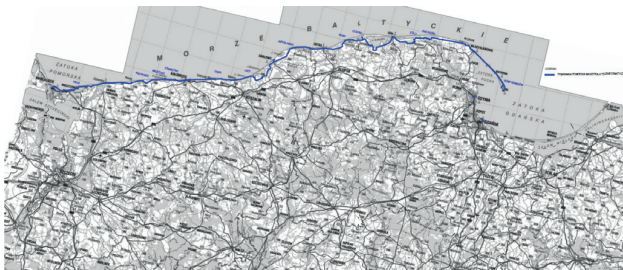- delivery and installation of NMS (Novus Management System) network management system.

Fig. 2. Pomeranian Telecommunications Bus (PTB) [own study]

PTB was built in accordance with the recommendations of International Cable Protection Committee including recommendation regarding submarine cables for relation Hel-Gdynia. Its architecture due to the physical deployment of the nodes assumes the physical bus structure. Due to the reliability of the network set up a logical ring topology in the layer core. Endpoints were connected to the nearest nodes using separate fibre optic cables. As far as technically possible end devices were connected to the two nearest nodes (multihoming). Most nodes take the form of free-standing containers situated on the protected area. They are equipped with the necessary infrastructure to allow for the installation of active devices and components of the telecommunications equipment. In addition, each node is equipped with an alarm system, CCTV system, fire protection system with automatic extinguishing, installation of air conditions monitoring, own power generator and UPS. Alarm signals and the current node operating parameters are monitored remotely from the PTB Management Centre. In rare cases, the nodes are located in existing users or beneficiary data centres. Data transmission takes place in accordance with the standard IP/MPLS on the Carrier Ethernet platform [8,9].

Users interact with the KSBM system using the operator consoles. There were created three control centres (sub centres) located within each marine office responsible for proper work of the technical infrastructure of the system in the area of responsibility of particular directors of maritime offices, so called area of operation. To ensure high reliability, each area of operation is divided into subareas. The subarea servers collect data from sensors connected to them and maintain communication with the control centre server. When there is a break in communication between the centre and sub centre the system operates without the data from subarea served by the failed server. After removing a failure, data is completed. This solution ensures high reliability of the system.

4. Examples of the KSBM diagrams

Figures 3 and 4 present as an example wiring diagrams of servers and the operator consoles installed in the area of responsibility of the Director of Maritime Office in Gdynia called VTS Zatoka Gdańska and distribution of sensors located in subarea Gdynia [8].

5. Conclusion

Described in this paper telecommunication infrastructure of the Polish National Maritime Safety System (KSBM), after its completion and passing with positive results SAT (Side Acceptance Tests) procedures will enable compliance by the system all requirements defined in Polish and EU regulations for Vessel Traffic Monitoring and Information System (VTMIS) and will provide the technical means to collect and exchange data necessary to ensure safety and security of shipping and protection of the environment and economic interests of Poland in Polish maritime areas by effective monitoring and control of maritime traffic and economic activities in these areas. Data transmitted by the system will be useful to other services and institutions undertaking activities related to maritime safety and security, border protection, maritime economy and port activities. Server installed in the national maritime safety centre situated in Maritime Office in Gdynia has already passed successfully test of automatic data exchange with European Maritime Safety Agency (EMSA) in Lisbon.
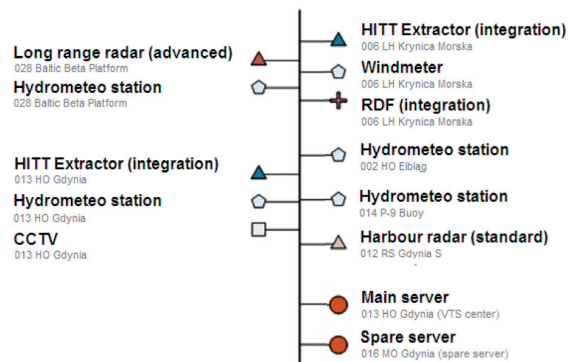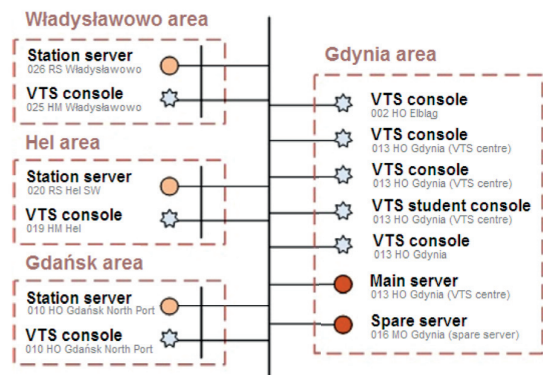
Bibliography

[1] Act of 18 August 2011 on maritime safety, Polish Journal of Low, Dz.U.2011.228.1368, 25.10.2011.

[2] Act of 24 July 2015 amending the act on maritime safety and some other Acts, Polish Journal of Low, Dz.U.2015.1320, 07.09.2015.

[3] Regulation of the Polish Minister of Transport, Construction and Maritime Economy of 4 December 2012 on National Vessel Traffic Monitoring and Information System, Polish Journal of Low, Dz.U.2012.1412, 14.12.2012.

[4] Regulation of the Polish Minister of Transport, Construction and Maritime Economy of 8 February 2012 on the operation of an electronic database of ships of Polish flag, Polish Journal of Low, Dz.U.2012.168, 14.02.2012.

[5] Regulation of the Polish Minister of Transport, Construction and Maritime Economy of 8 March 2012 on Maritime Telemedical Assistance Service, Polish Journal of Low, Dz.U.2012.320, 26.03.2012.

[6] WAWRUCH R.: New radar system along the Polish coast and inside the Polish ports. Scientific Journals of the Maritime University of Szczecin, No 44 (116)/2015, pp. 196-203.

[7] www. umgdy.gov.pl [date of access: 5.11.2015].

[8] www.umgdy.gov.pl [date of access: 5.11.2015].

[9] www.umgdy.gov.pl/architekturasystemuksbm [date of access: 5.11.2015].