MODERNIZATION OF THE POLISH SEARCH AND RESCUE SERVICE COMMUNICATION SYSTEM

In view of the need to ensure the safety and distress communications in the maritime VHF band, Polish Search and Rescue (SAR) service has decided to modernize its communications system. As a part of a deep modernization of the existing communication system COMPRO, Polish SAR has decided [1,2] to enlarge significantly the area of communication in marine VHF band – therefore it was necessary to install remote VHF station on the drilling platform Baltic Beta (located approx. 40 nm North of the Cape of Rozewie). To provide an access to the AIS base station, long-range radar and VHF communication of the Polish Maritime Administration and other data exchange, it was necessary to implement satellite backhaul link.

In the following paper, the authors presenting a concept of a new communications system for the Polish SAR service, the architecture of the implemented system using a satellite link between coast station at SAR HQ and remote station on the Baltic Beta platform. The authors also discuss some implementation problems and their recommended methods of elimination.

Keywords: COMPRO, SAR, MRCC, National Maritime Security System, VSAT.

1. COMPRO – SAR OPERATIONAL COMMUNICATION SYSTEM

Communication system (COMPRO) of the Polish Maritime Search and Rescue Service (SAR) has been designed and built in the mid-90s. The system has been built in accordance with generally approved standards adopted to the marine radio environment and therefore it was fully analogue system. This system works in the marine VHF band (156–172 MHz) [2], and consists of the shore stations along Polish coastline, SAR rescue vessels, Coastal and Marine Rescue Stations, Maritime Rescue Coordination Centre in Gdynia (MRCC), Maritime Rescue Coordination Sub-Centre in Świnoujście (MRCS-C).

Rescue vessels, Coastal and Marine Rescue Stations were equipped with radio stations operating on channels 11, 16 and 74 of the International Marine VHF Band [2]. Shore stations served as a base stations of the COMPRO system; control centre was located at the MRCC Gdynia premises. Duty Officers can control any of the shore stations deployed along Polish coast, and through them establish communication links between any rescue unit at shore and at sea. As it was mentioned, COMPRO system was fully analogue, and offered only voice communication, digital selective calling and simple data transfer for position of the rescue unit reporting.
2. THE CONCEPT AND ARCHITECTURE OF THE NEW OPERATIONAL COMMUNICATION SYSTEM FOR THE POLISH SAR

During long years of operation of the previous operational communication system, both communication range and the range of offered services provided by COMPRO, have proved its inadequateness. After twenty years of operation, the need of building a new radio communication system have become obvious.

The concept of a new communications system for SAR [3] operational communication coincided with the National Maritime Security System project planned by the Polish Maritime Administration. That project includes many areas and subsystems related to the general maritime safety and security issues, in particular:

- situation awareness system for marine traffic monitoring and analysis purposes;
- dangerous situation warning system – collision avoidance;
- Maritime Safety Information (MSI) broadcast for accidents prevention and marine environment protection;
- efficient action in case of accidents occurrence – for example supporting rescue operations and/or combating marine pollutions;
- supporting decision making process for designation of a place of refuge for the vessels;
- responding to the non-standard threats;
- supporting safety management;
- accident investigation;
- detection of the sources of pollution through use of identification and tracking systems.
This project is funded with the support of the European Union funds and is now in the final stage of its implementation. As a part of this project, construction of a new operational communication system for SAR Service is also carried out [1].

Proposed system is characterized by a high reliability and modernity of technical solutions. It is a radiotelephone communication system with simple data transmission services. Implemented system provides coverage of the entire Polish SAR area of responsibility in the Polish Exclusive Economic Zone (EEZ).

The system is based on state-of-the-art communication, radiocommunication and ICT technologies. It provides an efficient SAR service activities, which increases safety at sea. The main task of the system is response time minimization for the potential, as well as real danger at sea and thus effective search and rescue operations coordination.

![Fig. 2. Architecture of the new operational communication system for the Polish SAR](image)

New communication system supports also specialized services for pollution combating, marine environment protection and other tasks related to prevention and provision of safety at sea. New system provides operational radiotelephone communication between all service units (SAR MRCC and MRCS-C, rescue vessels and boats, coastal and marine rescue stations) as well as radiotelephone communications with other entities cooperating in the framework of its activities. New generation of the SAR communication system allows also digital data transmission between SAR units in both directions and units participating in the search and rescue operations. System has been designed as an open architecture system for easier implementation of the new services and features as well as easy system migration to new communication technologies in future.
New SAR communications system, implemented under the National Maritime Security System project consists of the following components [1, 3]:

- management centers (master and backup);
- terrestrial stations;
- telecommunications infrastructure;
- mobile stations at marine and coastal rescue stations.

The master and backup management centers have been located at the MRCC Gdynia and MRCS-C Świnoujście headquarters. The aim of management centers (fully doubling its features and capabilities) is to increase system reliability, enabling system activities in case of failure of one of them.

Shore stations, forming the core of the whole system are located at MRCS-C Świnoujście, Kikut Lighthouse, Gąski Lighthouse, Czołpino Lighthouse, Rozewie Lighthouse, MRCC Gdynia, Krynica Morska Lighthouse and Petrobaltic Baltic Beta drilling platform (located approximately 40 nm north of Cape of Rozewie).

All terrestrial system stations are connected via Wide Area Network (WAN) to the master and backup management centers, which control all dedicated radio links. The only exception is the link to the Baltic Beta drilling platform implemented in the form of leased satellite link. Communication in core network, in ISO/OSI layers 2 and 3 model, is done by IP/MPLS (Multiprotocol Label Switching) protocol stack. Routing is done by Open Shortest Path First (OSPF) protocol. At higher layers of the ISO/OSI model a highly effective protocols for voice communication (SIP, VoIP) are implemented.

3. WAN LINK TO BALTIC BETA

Baltic Beta drilling platform, located in the Baltic Sea at position $\varphi = 55^\circ$ 28'47" N, $\lambda = 018^\circ$ 10'48" E, about 40 nm (72 km) north of the Jastrzębia Góra, in the area of the Polish EEZ.

Due to the distance from the Polish coast, the platform is beyond the radio horizon. Within the National Maritime Security System project framework a number of devices and system components were installed on this platform, such as: long-range radar, 5 VHF radiostations, hydro-meteorological sensors and various sub-systems such as UPS, monitoring systems, WAN network equipment and, for providing network connectivity for all these devices – the VSAT system. The equipment listed above [1] has been installed in the dedicated container on board of drilling platform. Due to the fact of significantly reduced possibilities of the frequent physical access to the equipment, the requirements for the system reliability and quality are crucial.

As the provider of the VSAT satellite link the Tooway Pro service was proposed, which is addressed to governmental institutions and agencies, to Internet access to the regardless of the current localization of the satellite terminal in the coverage of the satellite. VSAT link utilize KA SAT covering Europe, Middle East and North Africa. Proposed service has been design for the users requiring public
IP address and declared level of Committed Information Rate (CIR). Currently provided service is a 6 Mbps symmetrical satellite link, with CIR 158 kbps in both directions (uplink and downlink). After achieving monthly data volume (75 GB) throughput, the bandwidth is reduced to the level of 512 kbps.

The most demanding, in terms of delay and volume of data is the VHF radio transmission. Due to the fact that the VSAT link uses geostationary satellite, IP datagram transmission delay is at the level of 500–700 [ms]. This lead to an operator's actions significant increase of the response time – from the moment of pressing the PTT button on the console till transmitter activation and radio transmitter state signalizing an about 1 second expire – which makes flow of communication more difficult. This phenomenon does not occur when an operator is using the other stations of the system, accessible via WAN radio links.

Another problem in the operation of radio station located in the Baltic Beta platform is limited volume of data, that can be transferred with the rate of 6 Mbps. If this limit is exceed, the rate drops automatically to 512 kbps, which leads into a low availability of stations located at the platform. Based on current experience, the volume of 75GB is easy to be exceed – for example in case of the low setup of VHF squelch threshold and low volume (because of utilizing of the satellite link for noise transmission). The operator, who is unaware of this phenomenon in a short time will exceed monthly data limit and, in result, will reduce overall system availability due to the dropped data rate.

**SUMMARY**

Apart from the disadvantages described above – easy to eliminate through the appropriate training of the operators, increasing the volume of available data transfer (cost) and the implementation of transmitted data counters, signalling achieved limits (using SNMP) the implemented satellite link, providing IP communication in relation with Baltic-Beta platform of the National Maritime Security System network, increases significantly the coverage range of the VHF communications for the Maritime Authorities and SAR Service, helping to raise the level of safety and security in the Polish EEZ and in the area of responsibility of the Polish SAR service.

**REFERENCES**

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MORSKIEJ SŁUŻBY POSZUKIWANIA I RATOWNICTWA

Streszczenie

W związku z koniecznością zapewnienia łączności w niebezpieczeństwie i łączności bezpieczeństwa podczas prowadzonych akcji poszukiwawczo-ratowniczych na morzu, Morska Służba Poszukiwania i Ratownictwa (SAR) postanowiła zmodernizować swój system łączności operacyjnej. W ramach głębokiej modernizacji istniejącego systemu komunikacyjnego COMPRO zdecydowano [1, 3] zna-czączo powiększyć obszar komunikacji w morskim paśmie VHF, w związku z czym konieczne było zainstalowanie zdalnej stacji VHF na platformie wiertniczej Baltic Beta (w odległości ok. 40 nm na północ od przylądka Rozewie). Aby zapewnić dostęp do stacji bazowych AIS, radaru dalekiego zasięgu i urządzeń radiokomunikacyjnych polskiej Administracji Morskiej oraz innej wymiany danych, konieczne było wdrożenie łącza satelitarnego.

W artykule autorzy prezentują koncepcję nowego systemu radiokomunikacyjnego Służby SAR, architekturę wdrożonego systemu wykorzystującego łącza satelitarne między stacją brzegową w Morskim Ratowniczym Centrum Koordynacyjnym i zdalną stacją na platformie Baltic Beta. Omówiono także pewne problemy wdrożeniowe oraz zalecane metody ich eliminacji.

Słowa kluczowe: COMPRO, SAR, MRCK, Krajowy System Bezpieczeństwa Morskiego, VSAT.