Deployment of smart complex system optimizing transmission bandwidth from offshore to open seas

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General overview

This paper summarizes experience gained and presents results of design, development and deployment process of communication system of R/V "Oceania", the vessel of Institute of Oceanology, and development of NetBaltic Project: self organizing heterogeneous network in marine areas. The system is composed of components optimising data transfer for low bandwidth connection and foster integration of different communication systems (LTE, LEO and satellite communication respectively) into unique, transparent for users, low cost appliance ensuring access to Internet at offshore and open sea areas, both.
The system has been developed as the response for variety of problems with data transfer occurring when operations on the sea are going on, eg. switching of communication channels on the basis of QoS and cost of the transfer, encryption, security, reduction of network traffic using different techniques, priority of services in multiuser environment and remote management of the system, when IT maintenance is not available onboard.

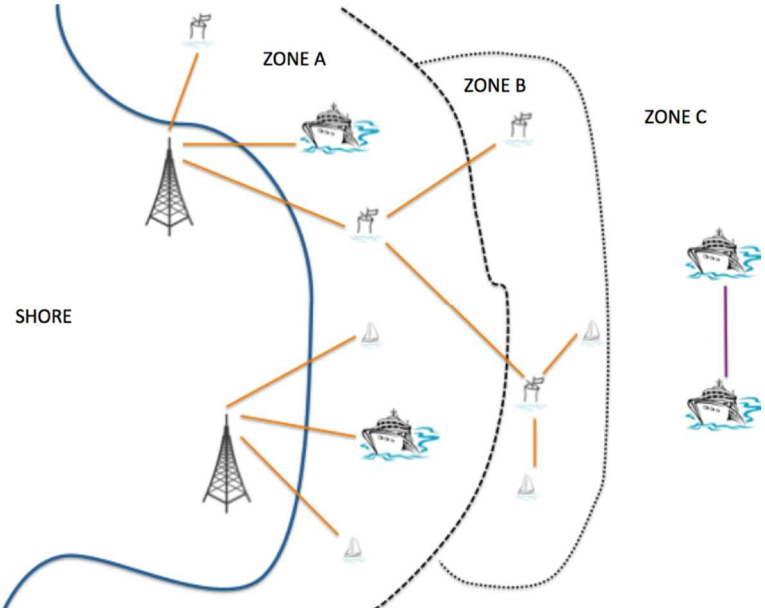

Figure 1: Connectivity zones

The key factor of further development of services (both for e-navigation and scientific research conducted on sea) provided by remote platforms (vessels, buoys, drifters and other autonomous devices) is connectivity. New services demand for expanding range, widening bandwidth of connection, decreasing latency and enabling mechanisms of secure and authorised connections and topology management. In general whole domain could be divided (regarding accessibility properties) into three zones (figure 1). Every zone differs from the others in range, bandwidth, topology and available technologies of connectivity.

Zone A covers areas where direct connection with onshore infrastructure is available. In this areas a large variety of different communication channels is available. Remote platforms connecting onshore infrastructure are able to use potentially high bandwidth and low latency technologies. Estimated cost of data transfer is relatively low, considering the costs of the connection terminal (eg. SRC or LTE

modem) and the costs of data transfer service charged by telecommunication operators. Onshore infrastructure in most cases can be developed according to the needs of the users.

Zone B extends Zone A range using platforms being in the range of Zone A and providing telecommunication infrastructure for units in range, which are not capable to use onshore infrastructure (are outside Zone A range). Depending on radio wave propagation properties (caused by weather conditions, but construction of antenna and terminal as well) these platforms can use relatively high bandwidth and still relay on low latency transmission of data. Communication depends on availability of proxy platforms in Zone A.

Zone C platforms are out of range of land based communication channels. In this zone platforms can communicate between themselves using short-range radio frequencies or establish connection on the basis of satellite communication. We can assume that platforms operating in this zone can not assure high bandwidth of data transfer and communication has high latency, either has to be buffered. These properties limit the possible applications and disable the services requiring connection protocols for data transfer or services relaying on quality of latency (eg. command and control of measurements and research). Services dependent on high bandwidth can still be provided by satellite telecommunication channels. Accessibility of this communication depends on geographical region (if geostationary satellites are used) and usually have higher requirements for power supply.

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