Modern Maritime Communication Augmenting Maritime Operations and Resource Explorations

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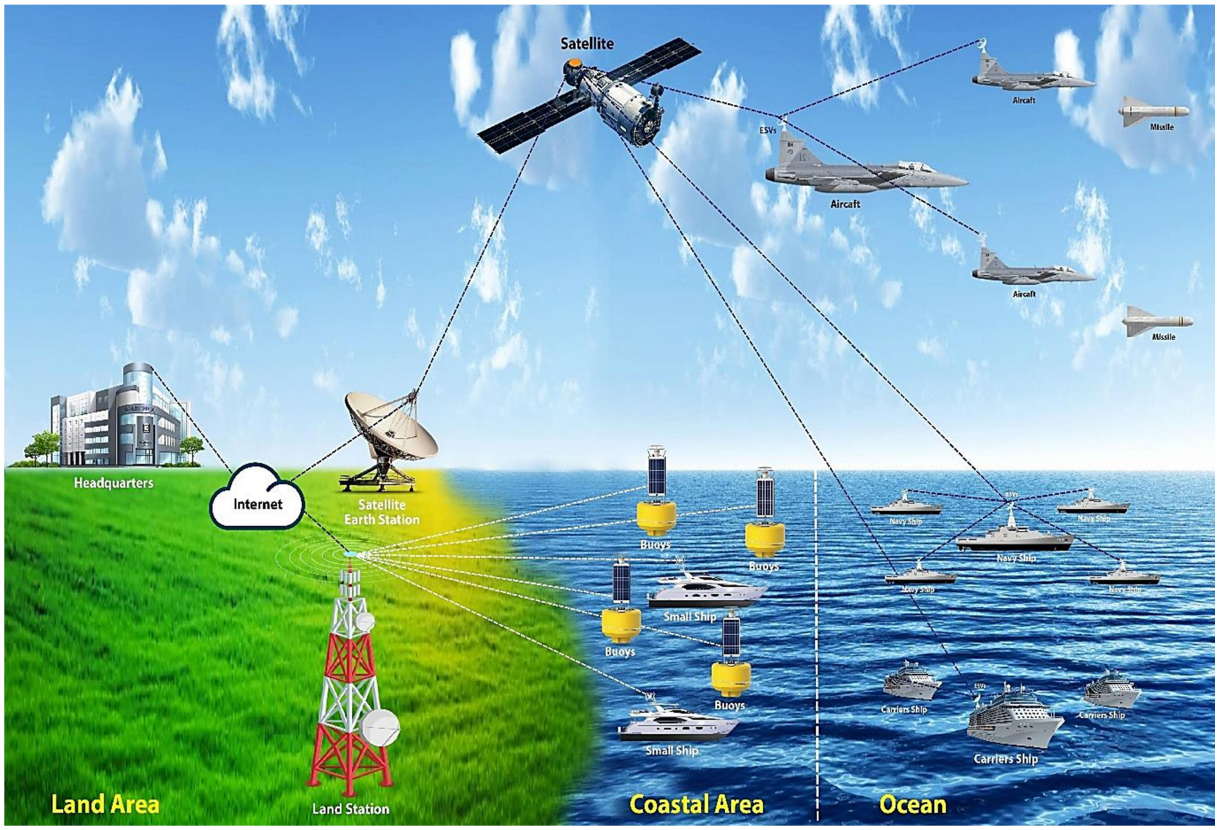


Introduction

Every aspect of our lives is becoming dominated by technology and new technology offers a simple, quick, informative, intelligent and effective solution. Maritime operations, such as maritime communication, dynamic integration, resource exploration, maritime trade & shipping, navigation, environment monitoring, disaster management, surveillance, search & rescue, ocean mapping, climate change impact and many others, are all being shaped by rising tides of maritime technology. The recent changing geopolitical and geo-economic aspects of the maritime security & surveillance environment are even more complex. Threats become covert and more dynamic. Ensuring maritime security is an essential enabler for optimum exploration of blue opportunity, economic stability and growth of a coastal nation. For assuring marine security, operation, resource exploration and dynamic integration, high-speed, wideband, reliable, accurate, full coverage sensor centric communication network, data fusion & processing, artificial intelligence and real-time robust video communication become dominating factors.

The radio-based ship-to-ship and ship-to-shore communication is limited only to the target group with a narrow frequency band. Satellite-based marine communication is very costly and limited to voice calls, data services for satellite email & internet access, weather and oceanographic data access for navigation, GMDSS, Inmarsat C, satellite phone, fishing and emergency services. However, currently, ships are also using satellite vessel tracking services like Personal Locator Beacons

and more recently, satellite emergency notification devices like SPOT and DeLorme InReach on a limited scale. Satellite communication services are currently limited to emergency service and low bandwidth only due to high cost. To satisfy the impending maritime needs, communication must be wideband, high speed, robust, accurate and low cost. These kinds of trend-setting maritime communication models are still in the works. As a result, this article will offer a hybrid marine communication architecture that will enable a smart, intelligent, high-speed communication solution to support safe and efficient maritime operations and resource explorations.

History of Maritime Communication

In old age, marine communications were limited to the semaphore and flashing services only. The first telegraphic Morse code messages were passed in 1844 between Washington and Baltimore. However, by the 1890s practical wireless sets were built by Marconi. British Admiralty purchased 50 sets of Marconi's products and installed 42 sets on-board ships and eight sets at shore stations from Dover to Scilly Islands. British Admiralty required to communicate simultaneously with a large number of ships spread over the worldwide oceanic area. By the end of the 19th Century, the British Empire owned over 60% of intercontinental radio communication service. The first significant contribution of marine radio communication was the rescue operation of the RMS Republic in 1909, where 1,500 lives were saved. In addition to the rescue operation of the RMS Republic, the rescue operation of the RMS Titanic in 1912 brought the field of marine radio to public consciousness.

Present Trend of Maritime Communication

Currently, diversified maritime communications are being used by maritime stakeholders. Legacy voice, data and encrypted message communication from ship-to-ship and ship-to-shore through on-board radio sets and VSAT supported communication are the primary means of maritime communication. Geo-positioning and navigation of the vessel through Electronic Chart Display and Information System (ECDIS) and Global Positioning System (GPS), Automatic Identification System (AIS), Long Range Identification and Tracking (LRIT), Maritime Mobile Service (MMS), Vessel Traffic Schemes (VTS), VHF Data Exchange System (VDES) support the safe navigation and monitoring. Resource explorations, oceanographic data transfer, pollution monitoring, ocean floor mapping, surveillance, disaster communication, search and rescue, port security and storing, accessing, managing and disseminating environmental data and information are all possible with maritime communication. The use of Information Technology (IT) in communication has cleared the road for electronic devices to be used in a variety of applications.

Future Trend in Maritime Communication

Maritime communication will be more widely used to enhance maritime security through long-range Vessel Traffic Management System (VTMS), AIS and maritime surveillance. It will enable the ships to navigate accurately and safely using electronic Navigation (eNAV) system, artificial intelligence and other navigation devices. Moreover, in future, wideband maritime communication will facilitate the resource exploration, seismic survey and real-time hydrographic data transfer to the shore/ on-board ships laboratory for further data processing. The fisheries department will be able to track the fishing vessel and monitor whether they are fishing in the authorised area or not. The system will offer to monitor the performance of the equipment and devices on-board ships from a remote location and even maintenance

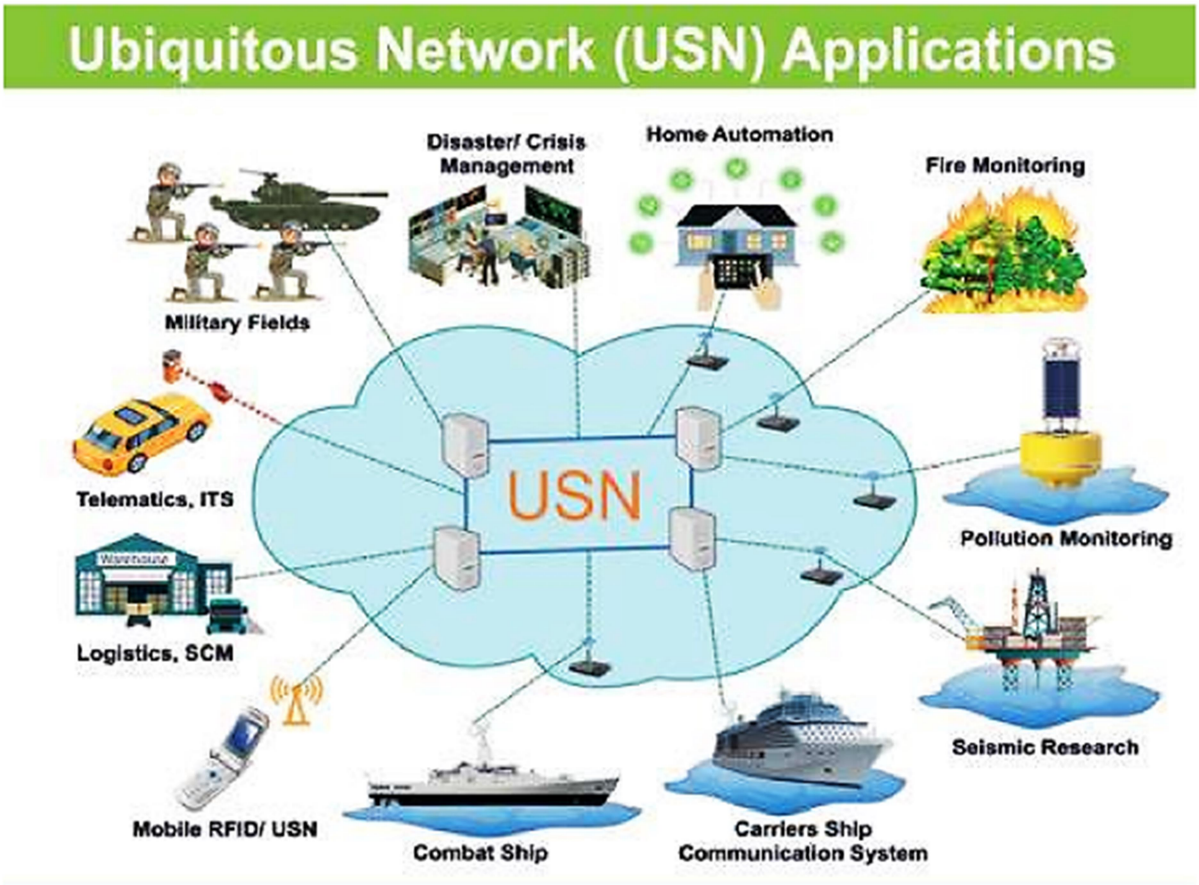
supervision can be conducted remotely by the manufacturer expertise. The network-centric communication system will provide high-quality real-time video, voice and data communication to Maritime Headquarters and Command ships, as well as other law-enforcement agencies, to allow for enhanced assessment and decision-making.

Proposed Maritime Communication Architecture

We require a durable, high-quality, integrated, secure and cost-effective communication system to augment diversified marine communication. The communication architecture will be hybrid with combinations of both terrestrial and satellite communication. However, the current static frequency allocation schemes cannot accommodate the requirement of higher data rate devices. So, we need a system that will dynamically sense, measure and leam the environment and intelligently allocate available networks, bandwidth, frequency, power and modulation. This intelligent radio system is called Software Defined Radio Network (SDRN), and the more recent version is known as Cognitive Radio Network (CRN) which is especially helpful for disaster communication and military operations on foreign soil.

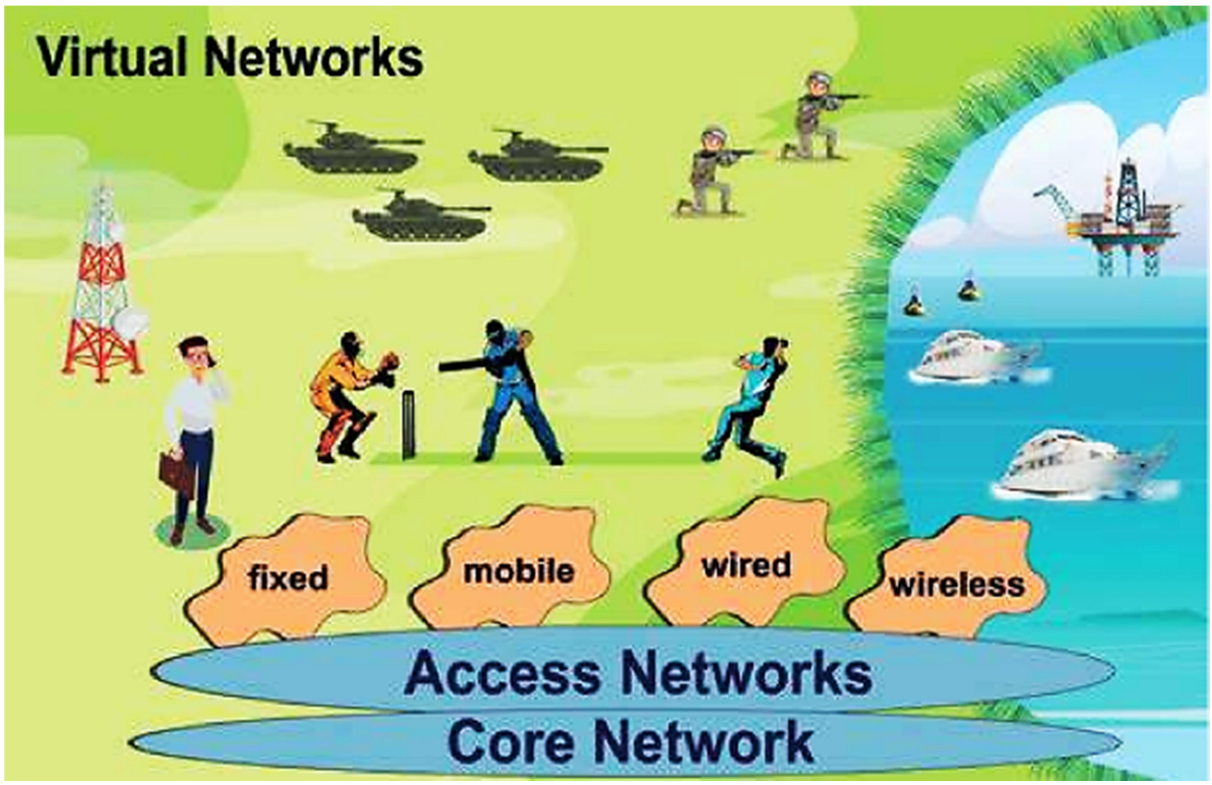
Future communication will be ubiquitous, meaning network for any devices, anywhere, anytime. The system will interface several access networks with one core network to enable the Internet of Things (IoT) facilities. The upcoming 5G internet facility will also strengthen connectivity and cybersecurity for shipping companies and vessels. It will facilitate vessels and autonomous ships with low latency connectivity for a remote operation like search and rescue.

Now, let's focus on satellite communication. Earth stations are a vital element in any satellite communication network. The function of an earth station



is to receive a signal from or transmit information to the satellite network in the most reliable manner maintaining high signal quality through both Ground Earth Station (GES) and Earth Station on-board Vessels (ESVs). The fixed band satellite signal, received by the ground earth station, can cover the coastal area through a terrestrial transceiver fitted with a tower near the coast. ESVS offers Fixed Satellite Service (FSS) frequencies on various large vessels

numerous options for vessels travelling across the country's seas and rivers to be connected to the internet. The interconnection is projected to assist Bangladesh's inland river ports, ferry terminals and other riverside establishments. The link is supposed to aid the vessels in avoiding mishaps while also allowing crew members to surf the web, watch television and engage in other communications activities.



such as passenger ships, seismic research and petroleum exploration ships, naval ships, aircraft, oil and gas drilling platforms for the exchange of high-speed data essential to their operations. An ESV utilises an extremely reliable stabilised platform and proven Very Small Aperture Terminal (VSAT) technology. The vessel fitted with ESV can also share its communication network with the surrounding target group for high-speed communication, including remotely control the weapons launched from on-board ships/ aircraft for homing the target. The launch of Bangladesh's first communication satellite, Bangabandhu-1, has created

Likely Challenges

The prime challenge will be designing hardware to attain the desired high speed, wide operating range, high quality, secured communication and cost-effective service to meet the future diversified maritime communication demand. The system will require very high-speed processors to process the wideband signal and need a special antenna to cover an extended operating range. Moreover, the future trend of cooperative sensing, signal fusion and intelligence decision for accurate and interference-free high-quality signals will be a real challenge. The communication will also be challenging to maintain

security from cyber-attack or attack from any malicious user due to the wide range of diversified use. It will be a real challenge to protect the communication system from a malicious user who can modify its air interface to mimic the system or user. Of course, it will also be a challenging task to offer low-cost service maintaining quality.

Conclusion

Technology is dominating every aspect of our daily life. Similarly, intelligent and electronic devices incorporated diversified use of marine technology that touched the entire gamut of the maritime domain. Artificial intelligence-based smart navigation, crew recreation, port security, vessel and cargo tracking, sensor-based communication network for pollution monitoring, hydrographic real-time data analysis, resources exploration, fish stock assessment and surveillance have all made marine life easier and faster. Real-time high-quality video link from warship to ship/ shore command-and-control station will also enable remote naval operation, including online monitoring of the status of the equipment and condition of crew members. We require a high-speed, wideband, secure, low-cost hybrid communication infrastructure to serve all of these smart communication needs. Future communication could be supported by Software-Defined Radio, IoT under 5G network support, terrestrial and satellite communication. However, we anticipate significant difficulties in building hardware for broad data sensing, acquisition, online transmission, analysis and subsequent best decision. We eagerly anticipate Bangladesh's efforts to create modern marine communication in order to safeguard maritime security and maximise resource exploration.

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