Chapter 1
Routing Protocol Design Issues and Challenges in Underwater Wireless Sensor Network

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ABSTRACT

An underwater wireless sensor network (UWSN) is a group of spatially distributed sensors for monitoring the physical changes of underwater environment and organize the measured data at a base station. Out of many big challenges in this field, network protocol design is of great concern due to the idiosyncratic nature of underwater environment. As underwater sensor networks are very much distinct in nature from terrestrial network so as the challenges, some of the major issues of concern in underwater environment are long propagation delay, available bandwidth, error rate, restricted battery power, movement of sensor nodes, etc. Because of all these issues and challenges, the routing protocols for terrestrial network can't be implemented in UWSNs. Hence, there is demand for new and different routing protocols for UWSNs. In this chapter, an overall survey of various routing protocols along with pros and cons are explained with challenges for designing new routing protocols for vast and enormous UWSNs.

INTRODUCTION

Almost 71% of earth's surface area is covered with water. Due to this large coverage, huge opportunities and way of wireless communication under the water attracted many of the research participants and also experts from the industry. Underwater Wireless Sensor Networks (UWSNs) are the networks, consisting of number of sensor nodes which sense or control various activities that are occurring under the water and the vehicles which are deployed under the water for communication (Kumar et al., 2014). One of

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the major differences between UWSN and terrestrial networks is the use of signals i.e. acoustic signals for UWSNs communication, whereas WSNs uses radio signals plays an important role in communication. This movement from radio signals to the acoustic channel comes because of the low pursuance of the radio signals in the aqueous environment. Underwater Sensor network have received extensive attention of many research personnel and form the industry experts due to the increasing number of utilization for ample range of usage involved in military, scientific, environmental and commercial sectors. These areas have a huge scope of underwater sensor network applications in it (Goyal et al., 2014). To accomplish all these work and monitoring an efficient communication among the sensor nodes is required which is a challenging task due to the hard and rigid conditions under the water as compare to terrestrial network which are completely different to it. For this purpose we need highly efficient routing protocol that provides shipshape and satisfactory communication between all the nodes and maximizing the performance (Khurana et al., 2012). Many of researchers have worked on it and designed superior quality routing algorithms but still it needs improvement (Gaba et al., 2013; Goyal et al., 2013). The major challenges in aqueous environment are float mobility, long propagation delays that is due to the acoustic signal used for communication that is almost 1500 meter per second, bandwidth limitations (approximately less than 100 KHz) and water pressure (Goyal et al., 2016). Due to this, UWSN degrades the output in terms of the throughput and life of nodes. The design of such routing protocol faces major challenges because of the idiosyncratic properties of the acoustic communication channel, an efficient routing protocol for data forwarding is crucial to UWSNs.

The dynamic network topology is also one of the challenges in underwater environment. Every algorithm works according to their routing techniques and the problem area it handles and solves in that particular domain. In UWSN those protocols are required that are more smart, reliable and perform well with respect to the covet parameters (Goyal et al., 2017). In this chapter, all the UWSN requirement with its architecture and its advantages and disadvantages are discussed which can provide basic concepts to researchers with clear and unambiguous perspicacity for further research. The main contribution of this article is towards the challenges and design issues regarding the routing protocol which is of high demanding area of research. Routing is a technique that enables the movement of packets or messages from source to sink node (Goyal et al., 2018). Whenever there is any kind of communication involved in the networks there is need of routing as it is also defined as the method of selecting or finding best route for routing or forwarding data packets. Routing always involves the concept of network topology which is the topological structure or arrangement of network physically and logically. Here in UWSNs, the sensor nodes having different capabilities are spread out in aqueous environment.

All the sensor nodes are connected using any network topologies which construct its network structure. But Routing packets, in UWSN face numerous challenges; one of them is that dealing with void communication areas (Goyal et al., 2019a; 2019b). The communication takes place by broadcasting packets from bottom of the level to the seashore, in this all the deployed sensor nodes communicates with other nodes to determine and uses routes that performed well according to the condition for selection which are followed for routing. Routing protocols used in UWSNs chooses such routes to forward data packets for reliable and efficient communication. Newly, it draws an attention of many of the researcher participants, practioners and engineers and they have utilized these protocols to monitor and investigate the aqueous medium for highest applications. These applications include monitoring and controlling of the under the water conditions for different purposes like army and habitat monitoring, disaster forecasting and its management and general exploration of underwater environment. As an example of UWSN there is large number of application areas one of them is Sea-web. In sea web there is a large network