Chapter 16
Real-Time Data Transfer in Marine Environment Monitoring Applications

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ABSTRACT

Due to immense application scenarios emerged by underwater communication, the researchers have shown their ardent interest in this field. Underwater wireless sensor network (UWSN) provides a promising approach for realism of such type of applications such as pollution monitoring, data agglomeration, natural calamities prediction, etc. In UWSN, sensor nodes are deployed at a number of different points of depths based upon the application requirements. Nodes at different locations collect the information and forward it to the sink node at surface. As a node cannot directly communicate to the sink node at surface, the multi hop communication takes place which poses great challenges underwater such as limited resource, bandwidth unavailability, end-to-end delays, temperature, water pressure, etc. However, congestion control is considered to be fundamental issue to be solved for effective data transfer underwater. This chapter presents the importance of real-time data in marine environment for plenty of applications and discuss the major issue in efficient data communication.

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INTRODUCTION

In UWSN, the sensor nodes are deployed in particular acoustic regions for the core purpose of data collection as well as collaborative monitoring. The nodes in this network are equipped in such a way that they can communicate with the base station located on shore. This communication is performed through messages by effectively utilizing the sound propagation mechanism in sea water environment, which is called acoustic communication (Akyildiz et al., 2006). Acoustic communication is a type of physical layer mechanisms used in underwater networks. It is considered that radio wave covers a large space at very small frequency of about 30 Hz, which creates a need for high transmission power and big antennas. One of the other alternatives is through optical waves, which are not affected by high attenuation but these waves suffer from scattering problem. Therefore, the communication in underwater is effectively performed by acoustic mechanisms (Kumar et al., 2014).

As compared to traditional under water networks, the nodes in the UWSN are of dynamic nature. The nodes can freely move from one location to another based on the requirements of the activity or application scenario. However, in traditional networks, sensors were deployed at static locations for purpose of monitoring and data collection. The nodes are then recovered after the completion of the mission. There are a couple of disadvantages with this approach, as pointed below:

1. **Lack of Interaction:** The connectivity between underwater deployed sensors and monitoring equipments is not maintained on real time basis. However in some applications such as environmental monitoring applications, real time monitoring is paramount.
2. **Unavailability of Data During The Mission:** The sensed data can be accessed only after the recovery of the nodes which may take long time.
3. **Difficulty to Detect Failures:** It is not possible to detect failures or mis-configuration before the recovery of the instruments which may sometimes lead to the loss of sensed data or failure of complete mission.

These shortcomings demand for deployment of underwater networks which can support real time monitoring, configuration as well as interaction with onshore receiving station. This can be achieved by connecting wireless sensor nodes with base stations at water surface through acoustic communication as shown in Figure 1.

A network of sensor nodes can be set up for monitoring and recording temperature, pressure as well as pollutants from underwater eco-system which results into a plethora of applications (Srinivas et al., August 2019). Some of the major applications are disaster prevention, military surveillance, assisted navigation, aquatic data monitoring, sampling and many more as shown in Figure 2.

The major objective in underwater wireless sensor network is to accomplish efficient data collection and communication (Yan et al., 2008). The congestion in the network hinders the performance of the network. In UWSN, congestion control is a significant and difficult task as it also helps in improving QoS in the network.

To achieve this, there are lots of issues or challenges to be faced by researcher fraternity as compared to terrestrial wireless sensor networks (Akyildiz et al., 2005). For incidence, the congestion control mechanisms specifically for terrestrial networks do not suit for UWSNs. This is due to the poor performance of TCP in UWSN as it finds difficult to differentiate loss of packets because of congestion or channel conflicts (Goyal et al., 2020). Thus the design of congestion control mechanism for UWSN is