

Research Article

The Feasibility of Exploiting IEEE 802.11n for Addressing MAC Layer Overheads in UASNs

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Underwater acoustic sensor networks (UASNs) consist of remotely deployed sensor nodes under sea or other water environments. Due to the extreme limitations faced by radio signals under water, acoustic channels are utilized for communication in such networks. However, UASNs are challenged by the characteristics of underwater acoustic channels such as lower signal propagation speed and higher signal attenuation. On top of such a challenged physical medium, MAC schemes which are designed based on their terrestrial counterparts are required to add extra overheads to the communication channel wasting the limited network resources. MAC layer overheads such as bandwidth wastage for interframe spaces and contention for occupying physical medium put limitations to the maximum reachable throughput of UASNs. IEEE 802.11n has well defined various MAC and physical layer enhancements to overcome throughput barrier in wireless LANs which includes two frame aggregation schemes, namely, A-MPDU and A-MSDU. In this paper, we study the feasibility of applying those frame aggregations well defined in IEEE 802.11n for reducing MAC layer overheads in UASNs. Based on simulation studies, we evaluate that these frame aggregation schemes are applicable in UWSNs.

1. Introduction

While supporting various kinds of applications in the terrestrial environments, wireless sensor networks (WSNs) have evolved to be deployed undersea and other underwater environments with emerging applications. The undersea oil pipeline monitoring, intruder detection for harbor security, marine biology exploration, and so forth are examples of such promising UASN applications [1]. In these applications, the sensor network consists of sensor node with underwater communication capability and data collecting node(s), called sink(s), attached to the buoy(s) floating on the water surface. Radio communication techniques cannot effectively work in the underwater environment due to intrinsic limitations of the underwater channel. Therefore, the acoustic communication techniques are used in the underwater environment to carry out communication. Hence, this type of network is called *underwater acoustic sensor network* (UASN). The basic functionality of UASN is to monitor and collect various application based underwater physical parameters, for

example, underwater pipeline pressure, temperature, and vibrations. These parameters are monitored by UASN nodes and communicated to the sink(s) attached to the buoy(s).

These buoys then transmit this aggregated data to the remote locations via radio channel for further processing.

Acoustic communication is very useful in the underwater environment; however, there are many challenges that underwater acoustic channel poses to UASNs. Acoustic signals have slow propagation speed that is approximately 1500 m/s, in the underwater environments, which is extremely lower than the radio signal propagation speed in terrestrial environment. Therefore, the communication between two underwater sensor nodes faces the extra amount of communication delay, which in turn affects the performance of the higher layers of the communication protocol stack. For example, after successful transmission of data packet from one UASN node to another, the medium access layer of the sender node has to wait for longer time to send another data packet. The reason behind this delay is the long communication latency of data plus acknowledgement for

