A LOW LATENCY MAC PROTOCOL WITH REDUCED HANDSHAKING FOR PROVISIONING SPATIAL FAIRNESS IN UNDERWATER SENSOR NETWORK

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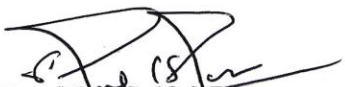

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Dedication

THIS THESIS IS DEDICATED
TO
MY PARENTS
AND
MY BELOVED WIFE

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List of Abbreviations

UASN	Underwater Acoustic Sensor Network
WSN	Wireless Sensor Network
AUVs	Autonomous Underwater Vehicles
FCFS	First Come First Serve
MAC	Medium Access Control
MHEE	Multi-Hop-Enabled Energy-E_cient
SF-MAC	Spatially Fair Medium Access Control
RET-MAC	Response to the Earliest Transmitter Medium Access Control
RTS CP	Request to Send Contention Period
ROSS	Receiver Oriented Sleep Scheduling
TDMA	Time Division Multiple Access
MR-MAC	Multi-Receiver Medium Access Control
ATR	Ask-To-Receive packet
TNI	Target Node Information
MSP	Main Schedule Packet
SP	Schedule Packet
DTS	Distributed Tactical Surveillance
IDS	Intrusion Detection System
RSSI	Received Signal Strength Indicator
ISI	Inter-Symbol Interference
WSN	Wireless Sensor Network
ACK	Acknowledgement
RTS	Request To Send
CTS	Clear To Send
LARP	Location Aware Routing Protocol
NED	Network Description Language

List of symbols

$t_s(m)$	Start time of node m
$t_s(e)$	Start time of node set e
$X_e(m)$	Serial number of m in the receiving sequence of e
C(m)	The number of children of m
$L_e(m)$	Link delay from m to e
T_p	Time needed to send/receive a data packet
T	TDMA slot time for ROSS protocol
D_{max}	Maximum propagation delay
$Node_{pd}[max]$	Maximum propagation delay among selected nodes
P_{delay}[node]	Node's self-propagation delay to receiver
CC[node]	Contention count for a node
Backoff[node]	Backoff of a sensor node
A PD	Average propagation delay
Pd_2	Propagation delay of terminal nodes
Pd_1	Propagation delay of closer region nodes
M	Size of data packet
t	Time to transfer the packets in seconds
R	Link rate in kbps
N:T	Normalized Throughput

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Abstract

Underwater acoustic sensor network (UASN) is composed of different number of sensors and moving vehicles which are distributed over a long range area to perform collective monitoring. Underwater acoustic channel, characterized by long propagation delay and low data rate, suffers from space time uncertainty causing spatial unfairness in UASN. A sender node which sends its request to send (RTS) at earlier time may not always be allowed to send its data packets earlier due to its long propagation delay. In UASN, usually a receiver node allows a sender node to transmit based on the earliest reception of its RTS packet which eventually deprives the terminal nodes with earlier transmission time, thereby creating spatial unfairness problem. In order to solve the problem, existing Medium Access Control (MAC) protocols allow the sender node which initiates its RTS packet at the earliest time. However, by allowing earliest RTS transmitter, existing MAC protocols create another kind of unfairness among the closer neighbor nodes. In this research work, a spatially fair MAC protocol is proposed in which a receiving node divides all its neighbor nodes into two groups based on average propagation delay of all of its neighbor nodes. The receiver then permits one prospective sender node from each group based on the earliest transmission time within a group. Receiver node, by employing a collision avoidance algorithm which exploits the benefit of propagation delay mapping of all its neighbor nodes, ensures that the two transmitted data packet will not collide at receiver's end. Otherwise, only a single sender node with the earliest transmission time within two groups is allowed to transmit. A simulation model based on OMNeT++ is developed to compare the performance of the proposed MAC protocol. Simulation results show that the proposed scheme achieves better performance in terms of latency, handshaking, fairness, network throughput, average RTS collision and clear to send (CTS) success rate compared to the contemporary SF-MAC and RET-MAC protocol.