ISSN 2320-6802

INTERNATIONAL JOURNAL FOR ADVANCE RESEARCH IN ENGINEERING AND TECHNOLOGY

WINGS TO YOUR THOUGHTS…..

Underwater Wireless Communication for Monitoring Applications of the Ocean Environment

[1]Pavan M. Ingale, [2]Rameshwar T. Murade, [3]Rahul U. Kale

Abstract: *In this Paper we present model of IEEE 802.11 medium access control (MAC) protocol in underwater networks and Underwater Wireless Sensor Networks (UWSN).*

Key words: *underwater networks, MAC, wireless networks, underwater wireless sensor networks.*

1. INTRODUCTION

The present technology for underwater communication involves either light or sound. In underwater wireless communication system we use the infrared wireless communication for achieving a simple underwater wireless communication. Acoustic techniques are the most widely used in water communications. Underwater wireless communication system based on 3 parts, the land-based unit, the electrical unit and the submarine model. Mainly concern point in underwater wireless communication system is the low bandwidth and large propagation latency, floating node mobility, and power efficiency. We can also use IEEE 802.11 medium access control (MAC) protocol in underwater wireless communication system.

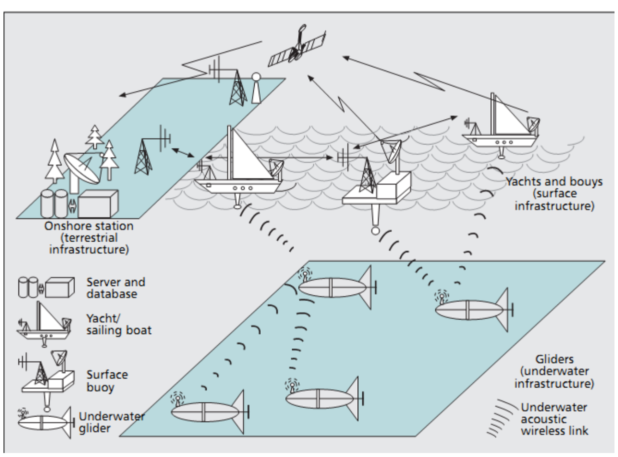

Figure 1: Underwater communication

Underwater Wireless Sensor Networks (UWSN)

UWSNs can be employed in a wide spectrum of aquatic applications, such as oceanographic data collection, pollution monitoring, disaster recovery, mine detection, and navigation [3]. UWSN we use high-frequency radio signals in underwater communication. Power efficiency is a critical and challenging issue in a protocol design for UWSNs because of much higher transmission and receiving power consumptions of acoustic modems [4–5]. In underwater communication use a tiny sensors and continuously they report parameters such as temperature, pressure, humidity, light, and chemical activity. UWSN support real-time applications and other monitoring applications, in which response time is critical. From the fig. 2 we observe that the source is located at bottom of the water. The data collected by the source is forwarded through other sensors to the sink at the water surface. Equipped with both radio-frequency and acoustic modems, the sink node receives acoustic signals forwarded from the sensors and transmits the packets to the control center ashore through radio-frequency signal [3].

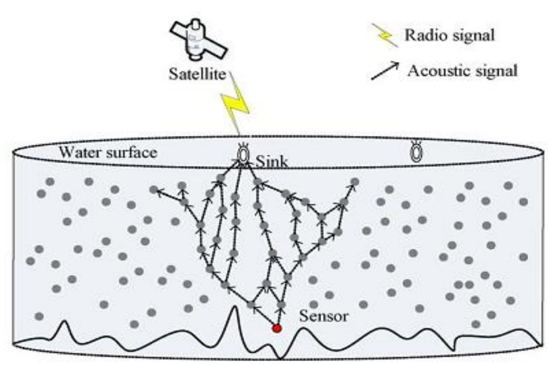

Fig. 2 Illustration of UWSN.

Fig. 3 Block diagram of power-efficient routing protocol (PER), which consists of two modules, including a forwarding node selector and a forwarding tree trimming mechanism. The forwarding node selector utilizes the three parameters and selects at most two candidate sensor

INTERNATIONAL JOURNAL FOR ADVANCE RESEARCH IN ENGINEERING AND TECHNOLOGY
WINGS TO YOUR THOUGHTS.....

nodes to forward the packets. The three parameters of the forwarding node selector include the distance and the angle between two neighboring sensor nodes, and the remaining energy left in the sensor node. A forwarding tree trimming mechanism is used to prevent unnecessary power consumption of the sensor nodes from fast spreading of packet forwarding over the UWSN [3].

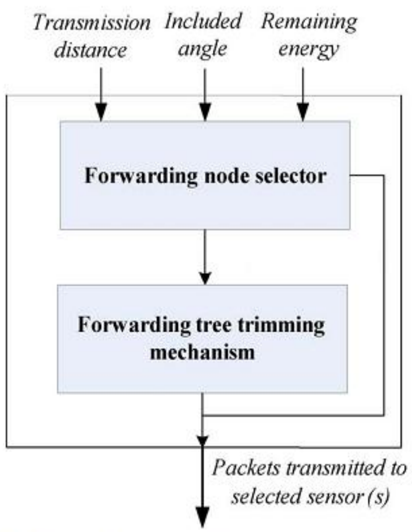

Fig. 3 Block diagram of power-efficient routing protocol (PER).

In UWSN protocol, a forwarding node selector is employed to determine the appropriate sensors to forward the packets to the destination, and a forwarding tree trimming mechanism is adopted to prevent excess spread of forwarded packets. Now discussion about the decision trees.

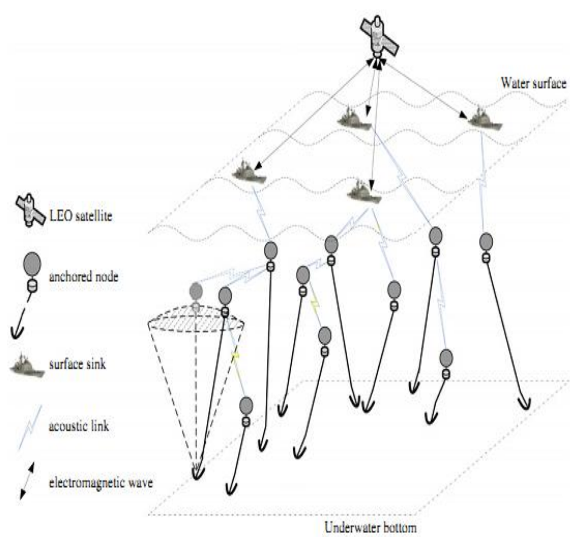

Fig. 4 UWSNs architecture with mobile nodes.

a. Decision trees:

A decision tree [6, 7, 3] is a predictive mode, a mapping of observations about an item to conclude about the item's target value. Decision tree is able to handle nominal and categorical data and perform well with large data set in a short time. Example as C4.5 decision tree performs well in prediction application as report in [6]. A decision tree is a hierarchy of yes/no questions in which the specific questions asked depend on the answers given to the previous questions, with the branches spreading out from the original question until an appropriate response is given.

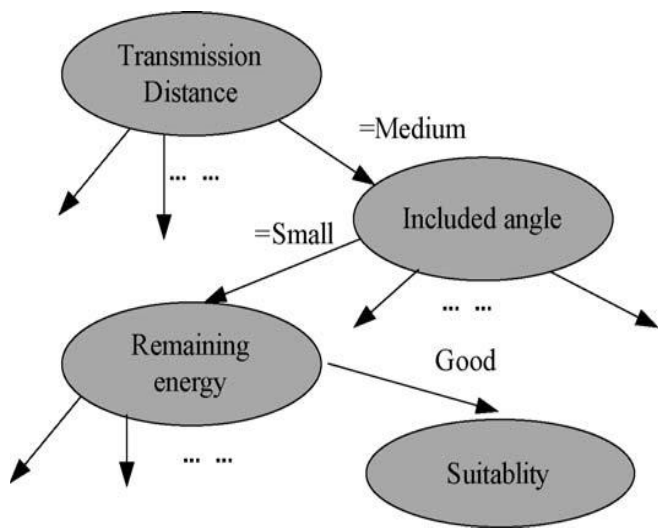

Figure 5: An example of building decision tree.

Fig. 5 Demonstrates an example of decision trees constructed with three parameters, including the transmission distance, included angle, and remaining energy [3].

INTERNATIONAL JOURNAL FOR ADVANCE RESEARCH IN ENGINEERING AND TECHNOLOGY
WINGS TO YOUR THOUGHTS.....

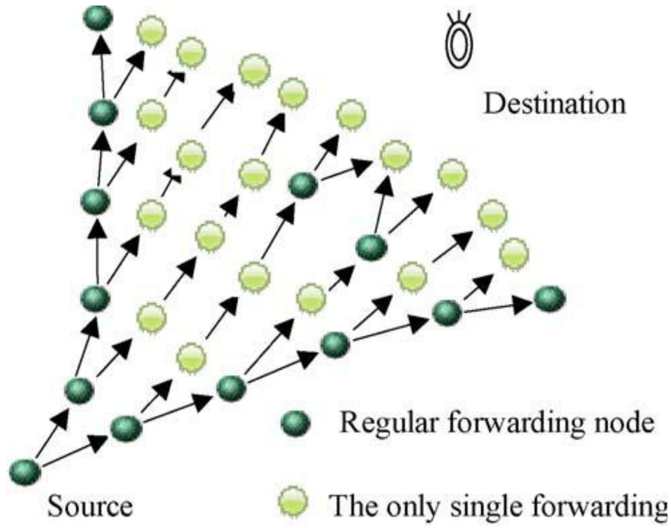

Figure 6: The effect of forwarding tree trimming mechanism.

Firstly, an intermediate sensor can employ the trimming mechanism to forward the packets to the top-selected forwarding node. The intermediate sensor then transmits the packets to the second selected forwarding node if the number of duplicated packet received by the intermediate sensor does not exceed a preset threshold. This mechanism not only resolves annoying packet broadcast problem, but also prevents the disruption of packet forwarding from the inappropriate selection of forwarding nodes (Fig. 6) [3].

2. IEEE 802.11 MAC

Acoustic waves are the most popular communication media for underwater wireless networks. Radio frequency (RF) electromagnetic waves can only propagate significant distances through sea water at very low frequencies [2]. The speed of sound in water is approximately 1500 m/s, resulting in propagation delays 200,000 times longer than those experienced by terrestrial radio communication networks, an acoustic system operates at frequencies of a few Hz to a few tens of Hz, and the system is wideband [2, 9].

Multiple nodes share a common broadcast channel through the use of a medium access control protocol. The focus the increased propagation delay and reduced bandwidth on the performance of IEEE 802.11 MAC in underwater acoustic networks. The propagation velocity of acoustic waves in the water is orders of magnitude slower than electromagnetic propagation in air, and is dependent on environmental conditions such as temperature, salinity, and depth [10]. The available bandwidth of an underwater acoustic channel depends on the signal frequency and transmission distance. The attenuation increases with frequency and distance. [2].

The minimum transmission power required to achieve a threshold SNR_0 at the receiver at a distance l is [2].

$$P(l) = SNR_0 B(l) \frac{\int_{B(l)} N(f)df}{\int_{B(l)} A^{-1}(l,f)df}$$

A. The 802.11 standard parameters

packet payload	1024 bytes
MAC header	34 bytes
PHY header	16 bytes
ACK	14 bytes +PHY header
RTS	20 bytes +PHY header
CTS	14 bytes +PHY header
W min	16
m	6
σ	δ+50μs
SIFS	0.56σ
DIFS	2 σ+SIFS

Table 1: Parameters Defined in the 802.11 Standard

B. *Disadvantages of IEEE 802.11 MAC protocol in underwater acoustic networks*

1. IEEE 802.11 MAC protocol performs poorly in underwater acoustic networks, particularly when the communication bit rates are high.
2. IEEE 802.11 MAC becomes extremely inefficient at long distances.
3. IEEE 802.11 MAC also less efficient, even at close distances.

Comparisons between land mobile and underwater communication systems

Parameters	Land Mobile	Underwater
Carrier frequency	1 GHz	10 kHz
Wavelength	3 cm	15 cm
Signaling rate	24 ksymbols/s	2 ksymbols/s
Symbol duration	42 µs	500 µs
Carrier cycles/symbol	4.2 x 10□4	5
Platform speed	100 km/h (car)	18 km/h (submersible)
Multipath time spread	10 ms	50-100 ms
Symbols in that time	0.24	100-2000

3. CONCLUSION

A power efficient routing protocol for UWSNs is design for enhancing performance of underwater environments. A power efficient routing protocol for UWSNs especially the need for ease of deployment and the severe power constraints of the nodes. From the point of disadvantage, IEEE 802.11 MAC protocol in underwater acoustic communication networks are based on large propagation delay there for as a result of this un-synchronized time slots for stations and thus increases collision probability and also IEEE 802.11 MAC protocol performs poorly in underwater acoustic networks at a long and closely distance.

REFERENCE

[1] Simple underwater wireless communication system, Mengying Jiang , Jingting Li, Lin Gao, Yiwen Wang, [CEIS 2011].

[2] Performance of IEEE 802.11 MAC in Underwater Wireless Channels, Alan C. Farrell and Jun Peng, 2012

[3] A power-efficient routing protocol for underwater wireless sensor networks, Chenn-Jung Huang a, Yu-Wu Wang a, Hsiu-Hui Liao, Chin-Fa Lin, Kai-Wen Hu, Tun-Yu Chang, www.elsevier.com/locate/asoc, 2011.

[4] J. Partan, J. Kurose, B.N. Levine, A survey of practical issues in underwater net-works, in: Proceedings of ACM WUWNet'06, Los angels, CA, USA, September, 2006, pp. 17–24.

[5] Crossbow Inc., Mica2 Data Sheet, 2008, http://www.xbow.com/products/ Product pdf files/Wireless pdf/MICA2 Datasheet.pdf.

[6] X. Zhu, J. Wang, H. Yan, S. Wu, Research and application of the improved algorithm C4.5 on Decision tree, International Conference on Test and Measurement 2 (2009) 184–187.

[7] S.R. Samantaray, Decision tree-initialized fuzzy rule-based approach for power quality events classification, IET Generation, Transmission & Distribution 4 (April (4)) (2010) 530–537.

[8] Topology control algorithm for underwater wireless sensor networks using GPS-free mobile sensor node s- Linfeng Liu, Ruchuan Wang, Fu Xiao-www.elsevier .com/locate/jnca-2012

[9] M. Stojanovic,"Underwater Acoustic Communications: Design Considerations on the Physical Layer," Wireless on Demand Network Systems and Services, 2008. WONS 2008.

[10] APL-UW TR 9407,"High-Frequency Ocean Environmental Acoustic Models Handbook," 1994.