Survey on Effective Compound Path Communication in Underwater Sensor Network

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Abstract:- **Underwater acoustic communication is a technique of sending and receiving message below water. There are several ways of employing such communication but the most common is using hydrophones. Under water communication is difficult due to factors like multi-path propagation, time variations of the channel, small available bandwidth and strong signal attenuation, especially over long ranges. In underwater communication there are low data rates compared to terrestrial communication, since underwater communication uses acoustic waves instead of electromagnetic waves. In the existing approach, the data can be collected from the sensor node and transfer the data to the destination. The same source information can be send through multiple paths through the same destination. So the packet bit error rate is high and power and energy consumption for transferring data is high. In the underwater sensor network, the main problem is the energy consumption. The bandwidth and the energy can be consumed. And then the packet bit rate is the serious problem in the existing system. It can be overcome by using the segment combination in the hamming code technique. The packet bit rate can be overcome by increasing the number of paths. The number of paths can be increased based on calculating the cost. For calculating the cost, least cost algorithm is used. And based on the minimum cost path, the path is chosen and data is transferred to the same destination.**

Index Terms— multi-path propagation, acoustic waves, packet bit rate, hamming code technique.

I INTRODUCTION

Recent advances in networking technologies and acoustic communications have enabled the deployment of Underwater Sensor Networks (USNs) for a variety of attractive applications, such as oceanographic data collection, pollution monitoring, offshore exploration, and military surveillance. However, the high Packet Error Rate (PER), long channel latency, and low bandwidth are the inherent issues in USNs characterized by the acoustic channels. Moreover, the feature of low energy efficiency brings fundamental challenges in design of USNs.

Hence, this unique characteristic motivates the research community of USNs to seek a reliable, scalable, robust, and energy-efficient approach for design and deployment of USNs. Here we attempt to address this issue by 1) integrating the Hamming Coding-based Forward Error Correction (FEC) scheme with multipath communications (MPC), 2) designing a novel packet recover technology based on segment combinations for the FEC scheme, and 3) designing a Decision and Feedback scheme for multipath communications.

USNs have attracted many research efforts from academy and industry. In industrial fields, Link Quest, Inc., a leading manufacturer of precise acoustic instruments, has developed a series of dominant products, Underwater Acoustic Modems (UWMs), which can achieve 10^{-9}, -10^{-7} Bit Error Rate (BER). However, the transmit model power is in the range of 1-40 W and the devices are heavy and expensive. As a result, they are not suitable for deploying large-scale USNs.

Wireless sensor network (WSN) has emerged as one of the most promising technologies for the future. This has been enabled by advances in technology and availability of small, inexpensive, and smart sensors resulting in cost effective and easily deployable WSNs. However, researchers must address a variety of challenges to facilitate the widespread deployment of WSN technology in real-world domains. In this survey, we give an overview of wireless sensor networks and their application domains including the challenges that should be addressed in order to push the technology further.

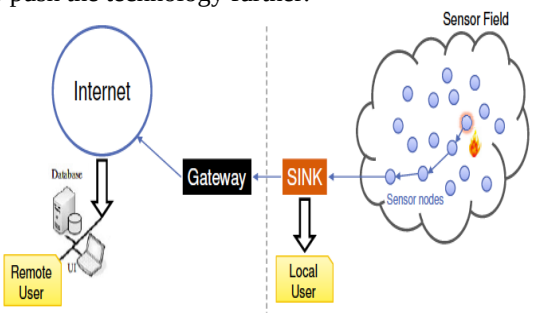

Fig.1.Working of WSN

A WSN should be reliable in order to function properly and depending on the application requirements, the sensed data should be reliably delivered to the sink node. WSNs are usually prone to unexpected node failures due to different reasons like nodes may run out of energy or might be damaged (in extreme environment conditions), or wireless communication between two nodes can be permanently interrupted.[10]

II LITERATURE REVIEW

Mr. Inam Ullah Khan studied the problem of low performance[1] and proposed Vector Based Forwarding which is based on self-adaptation algorithm which introduces extra delay in data forwarding for the purpose of differentiating the importance of nodes in the transmission range. If maximum delay T_{delay} is set to a smaller value, end-to-end delay can be reduced. However, T_{delay} must be

set large enough due to the purpose of delay time used by VBF.

Yuh-Shyan Chen and Tong-Ying Juang proposed the multipath routing algorithm which produces time efficient transmission of data[2]. Multi-path is utilized during the path construction from the source node to the destination node, which is composed of a series of multi-subpaths and overcomes the problem of low drift velocity.

HaiYan, Zhijie Jerry Shi, and Jun-Hong Cui proposed Depth-Based Routing technique for high packet delivery ratios in low cost which solves the problem of finding better deployment locations[3] for the multiple sinks. This protocol finds the merit of having multiple-sink underwater sensor network with low cost. His results show that DBR could achieve very high packet delivery ratios (at least 95%) for dense networks with only small communication cost.

Abraham Varughese and Seetharamaiah.P proposed an ordinary distance based protocol implementation which produces minimum number of transmissions[4] within a given time in the transmission of data and handle network dynamics efficiently without the assistance of a localization service. This protocol reduces the number of nodes and each node calculating the distance from source and also with sink. Then it checks for the node with lesser distance and forwards the packet.

Aman Sharma and Abdul Gaffer.H uses Vector-Based Forwarding Protocol[5] for finding route which reduces the limitation of much higher cost in packet transmission. He also studied various routing protocols for underwater sensor networks and provides the purpose of it for different applications. He also mentioned the advantages and disadvantages of each protocol along with the applications where it can be used.

Dashandeep Singh1, Harmeet Singh Bhare, Manu Singh uses efficient routing protocol[6] for finding the shortest path from source node to sink. He used the AODV protocol to implement shortest path and to study and analyze the various parameters like error rate, routing overhead, collision detection, throughput and packet delivery ratio. The main objective is to give efficient communication.

Weigang Bai, Haiyan Wang, Xiaohong Shen, Ruiqin Zhao and Yuzhi Zhang proposed Time Division Multiple Access (TDMA) scheme for enhancing time and uses multipath approach[7] and overcomes the problem of resource availability every time. The location information and propagation delay are calculated, based on that the forwarding nodes are identified.

Volkan Rodoplu and Min Kyoung Park proposed MAC and ALOHO scheme, a distributed and scalable approach[8] for enhanced energy efficiency because time factor is not considered. Because of collisions, the proposed protocol wastes 3 percent of transmit energy with average number of duty cycle is 0.004 and 1-hop neighbours is 5.

Zhong Zhou, Jun-Hong Cui proposed multi-path power-control transmission for reduction long delays in data transmission[9] with low end-to-end delays and hence an energy constrained approach. It introduces much shorter delay than the traditional one-path scheme with retransmission, since no hop-by-hop retransmission is allowed.

Henri Dubois-Ferri, Deborah Estrin Martin Vetterli uses Simple Packet Combining (SPaC) error correction scheme and multi-hop communication for data transfer at higher rate and reduced delay[10]. He introduced the error correction scheme through packet combining. He also proposed a future work of integrating packet combining with other network protocols.

III MULTI-PATH ROUTING PROTOCOL

Multi-Path Routing (MPR) protocol is used for UWSNs to improve the transmission delay. Multi-path is utilized during the path construction from the source node to the destination node, which is composed of a series of multi-subpaths. Each multi-subpath is a sub-path from a sending node to its two-hop neighboring node, called receiving node, by one more relay nodes, where these relay nodes simultaneously are neighboring nodes of sending and receiving nodes.MPR provides time efficient, network lifetime extending and scalability in UWSNs.

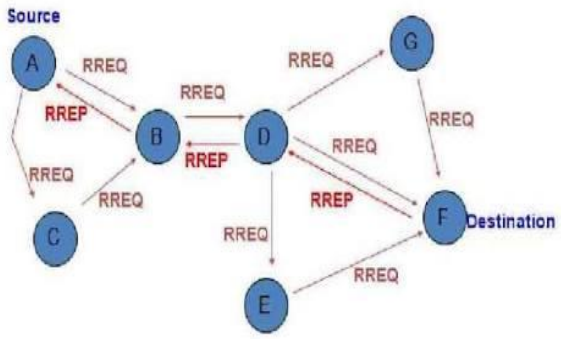

Fig.2. Multipath routing using AODV

Multipath routing is an effective technique to deal with instability underwater channel. This paper proposes a novel multipath routing scheme, named Min-delay routing. The multipath routing structure and conflict-free link scheduling algorithm based on TDMA[7] scheme are combined to overcome the multipath interference problem and end-to end delay difference problem.

Working of multipath routing algorithm:

The basic procedure of multi-path routing is when the source node has some packets to send, it will flood a “Route Request” message to the destination. Any intermediate nodes who receive this “Route Request” for the first time will forward it. When the destination receives “Route Request” messages, it will reply with “Route Reply” messages reversely along the paths of the corresponding “Route Request” messages[9]. The destination can also make path selection. For example, it can select node-disjoint paths and send “Route Reply” back on them. After the source node receives the “Route Reply” messages, the routes between the source and the destination are established. From the received “Route Reply” messages, the source node gets to know some path

characteristics, such as the number of available paths, *m*, and the hop lengths of the paths. Based on this information, the source node will determine the optimal number of paths, m^*, and select m^* paths from *m* available paths. It also needs to calculate the optimal power level that every intermediate node on these paths should use for packet transmission.

Applications:
Multipath routing can be used to support a variety of applications in MANETs. Multipath routing method support reliability (fault tolerance), energy conservation, minimization of end-to-end delay and satisfying bandwidth requirements.

IV TIME AND ENERGY BASED ANALYSIS TO FIND SHORTEST PATH

Different parameters [1] are analyzed on the basis of time to find out shortest path using dynamic routing scheme.

The parameters are explained below-

A. Throughput: In general, throughput is the rate at which something can be processed. But here, throughput is the rate of successful message delivery over a given communication channel. Throughput can be calculated as

T= (P-((dc+nc)*pd*dn))/P

Where T is the throughput which measures how many unit of information a network can process in a given amount of time. P is the number of packets which has to be delivered, dc is the number of dead collision, nc is the number of normal collision, pd is the packet drop and dn is the number of dead nodes in our proposed network.

B. Routing overhead: Routing overhead is flooding packets throughout the communication network. Here, Routing overhead can be calculated as

O= ((dc+nc)*pd*dn)

Where O is a routing overhead and on the basis of this formula, various observations have been made.

C. Packet delivery ratio: Packet delivery ratio is defined as the ratio of data packets received by the destination to those generated by the source. Here, experiment shows for packet delivery per 500 packet transfer in underwater sensor network.We have calculated packet delivery ratio as follows

PDR= (P - (pd*2))/P

D. Error rate: Error rate in dB between the total number of nodes and error encountered in the network. Error rate is the number of bit per errors per unit time. Error rate (E) is calculated as follows :

E=(mean (E) + (dn*pd+erroroccurance))/n

V CONCLUSION

Energy efficiency is one of the key parameters in battery constraint equipments such as sensors. Due to limited availability of energy for sensors, this resource considers to be the backbone for the wireless sensor networks lifespan. This survey attempts to study the ways which would increase the life span of the under-water sensors by reducing the energy consumption by each node in the network using a new multipath routing algorithm with reactive AODV protocol.

VI REFERENCES

[1] Mr. Inam Ullah Khan, “A Survey of Under Water Sensor Networks Routing Protocols”, 2012
[2] Yuh-Shyan Chen, Tong-Ying Juang, Yun-Wei Lin, and I-Che Tsai,”A Low Propagation Delay Multi-Path Routing Protocol for Underwater Sensor Networks” in International Journal of Ad-Hoc and Ubiquitous Computing ,2010
[3] H. Yan, Z. J. Shi, and J. H. Cui, ``DBR: Depth-based routing for underwater sensor networks," in *Proc. NETWORKING*, 2008, pp. 72_86.
[4] Abraham Varughese, Seetharamaiah.P, “Distance based Routing Scheme for Underwater Sensor Networks”,in International Workshop on Underwater Networks,2012
[5] Aman Sharma,Abdul Gaffar.H, “A Survey on Routing Protocols for Underwater Sensor Networks” in International Journal of Computer Science & Communication Networks,Vol 2(1), 74-82,2012
[6] Dashandeep Singh1, Harmeet Singh Bhare, Manu Singh,”Energy and Time Efficient Routing Protocol for Shortest Path in Underwater Networks” in International Journal of Innovative Research in Computerand Communication Engineering,Vol 4,2016
[7] Weigang Bai, Haiyan Wang, Xiaohong Shen, Ruiqin Zhao, a nd Yuzhi Zhang,”Minimum Delay Multipath Routing Based on TDMA for Underwater Acoustic Sensor Network” in International Journal of Distributed Sensor Networks Volume 2016.
[8] Volkan Rodoplu and Min Kyoung Park,”An Energy-Efficient MAC Protocol for Underwater Wireless Acoustic Networks in IEEE Access, 2014.
[9] Z. Zhou and J.-H. Cui, “Energy efficient multi-path communication for time-critical applications in underwater sensor networks," in *Proc. 9th ACM Int. Symp. Mobile Ad Hoc Netw. Comput.*, 2011, pp. 221_230.
[10] Henri Dubois-Ferri `ere Deborah Estrin Martin Vetterli,”Packet Combining in Sensor Networks” in *IEEE Trans. Ind. Informat.*, vol. 10 2005.
[11] Nadeem Javaid, Saman Cheema, Mariam Akbar, Nabil Alrajeh, Mohamad Souheil Alabad and Nadra Guizani, “Balanced Energy Consumption Based Adaptive Routing for IoT Enabling Underwater WSNs,” in IEEE Access, Volume 5, 2017.
[12] Ahmad Ali , Yu Ming, Sagnik Chakraborty and Saima Iram,”*A Comprehensive Survey on Real-Time Applications of WSN”* in IEEE Access, November 2017
[13] Mohamed Benaddy, Brhim El Habil, Othmane El Meslouhi, Salah-ddine. Krit, ”*A Mutlipath Routing Algorithm for Wireless Sensor Networks Under Distance and Energy Consumption Constraints for Reliable Data Transmission”* International Journal of Sensors and Sensor Networks,Volume 5,2017 .
[14]]M. García, S. Sendra, M. Atenas, and J. Lloret, “Underwater wireless ad-hoc networks: A survey,” in *Mobile Ad Hoc Networks: Current Status and Future Trends*. Boca Raton, FL, USA: CRC Press, 2011, pp. 379411.
[15] M. Tariq, M. S. Abd Latiff, M. Ayaz, Y.Coulibaly, and A. Wahid, “Pressure sensor based reliable(PSBR) routing protocol for underwater acoustic sensor networks,” *Adhoc Sensor Wireless Netw.*, vol. 32, nos. 34, pp. 175196, 2016.
[16] D. Wang, R. Xu, X. Hu, and W. Su, “Energy-efficient distributed compressed sensing data aggregation for cluster-based underwater acoustic sensor networks,” *Int. J. Distrib. Sensor Netw.*, vol. 12, no. 3, p. 8197606,2016.
[17] H. Yan, Z. J. Shi, and J. H. Cui, “DBR: Depth-based routing for underwater sensor networks,” in *Proc. NETWORKING*, 2008, pp. 7286.