Opportunistic Routing for Packet Backup and Path by Underwater Base Station in WSN

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Abstract- Underwater wireless sensor networks (UWSNs) have been showed as a promising technology to monitor and explore the oceans in lieu of traditional undersea wireline instruments. Nevertheless, the data gathering of UWSNs is still severely limited because of the acoustic channel communication characteristics. One way to improve the data collection in UWSNs is through the design of routing protocols considering the unique characteristics of the underwater acoustic communication and the highly dynamic network topology. In this paper, we propose the GEDAR routing protocol for UWSNs. GEDAR is an anycast, geographic and opportunistic routing protocol that routes data packets from sensor nodes to multiple sonobuoys (sinks) at the sea's surface. When the node is in a communication void region, GEDAR switches to the recovery mode procedure which is based on topology control through the depth adjustment of the void nodes, instead of the traditional approaches using control messages to discover and maintain routing paths along void regions. Simulation results show that GEDAR significantly improves the network performance when compared with the baseline solutions, even in hard and difficult mobile scenarios of very sparse and very dense networks and for high network traffic loads.

Keywords- *UWSN, GEDAR, DBN*

I. INTRODUCTION

OCEANS represent more than 2/3 of the Earth's surface.These environments are extremely important for human life because their roles on the primary global pro-duction, carbon dioxide (CO2) absorption and Earth's cli-mate regulation, for instance. In this context, underwater wireless sensor networks (UWSNs) have gained the attention of the scientific and industrial communities due their potential to monitor and explore aquatic environ-ments. UWSNs have a wide range of possible applications such as to monitoring of marine life, pollutant content, geo-logical processes on the ocean floor, oilfields, climate, and tsunamis and seaquakes; to collect oceanographic data, ocean and offshore sampling, navigation assistance, and mine recognition, in addition to being utilized for tactic surveillance applications .Acoustic communication has been considered as the onlyfeasible method for underwater communication in USWNs.[1]

High frequency radio waves are strongly absorbed in water and optical waves suffer from heavy scattering and are restricted to short-range-line-of-sight applications. Nevertheless, the underwater acoustic channel introduces large and variable delay as compared with radio frequency (RF) communication, due to the speed of sound in water that is approximately 1:5 103m/s (five orders of magnitudelower than the speed of light (3 108m/s)); temporarypath loss and the high noise resulting in a high bit errorrate; severely limited bandwidth due to the strong attenua-tion in the acoustic channel and multipath fading; shadow zones; and the high communication energy cost, which is of the order of tens of watts.In this context, geographic routing paradigm seems apromising methodology for the design of routing protocols for UWSNs . Geographic routing, also calledof position-based routing, is simple and scalable.[1]

II. LITERATURE SURVEY

1 Geographic and opportunistic routing for Underwater Sensor Networks[1]

In this paper,the GEDAR routing protocol for UWSNs. GEDAR is the anycast, geographic and opportunistic routing protocol that routes data packets from sensor nodes to multiple sonobuoys(sinks) at the sea's surface. When the node is in a communication void region, GEDAR switches to the recovery mode procedure which is based on topology control through the depth adjustment of the void nodes, instead of the traditional approaches using control messages to discover and maintain routing paths along void regions. Simulation results show that GEDAR significantly improves the network performance when compared withthe baseline solutions, even in hard and difficult mobile scenarios of very sparse and very dense network and for high network traffic loads.

2Underwater acoustic sensor networks: research challenges[5]

Underwater sensor nodes will find applications in oceanographic data collection, pollution monitoring, offshore exploration, disaster prevention, assisted navigation and tactical surveillance applications. Moreover, unmanned or autonomous underwater vehicles (UUVs, AUVs), equipped with sensors, will enable the exploration of natural undersea resources and gathering of scientific data in collaborative monitoring missions. Underwater acoustic networking is the enabling technology for these applications. Underwater networks consist of a variable number of sensors and vehicles that are deployed to perform collaborative monitoring tasks over a given area. In this paper, several fundamental key aspects of underwater acoustic communications are investigated. Different architectures for two-dimensional and three-dimensional underwater sensor networks are discussed, and the characteristics of the underwater channel are detailed. The main challenges for the development of efficient networking solutions posed by the underwater environment are detailed and a cross-layer approach to the integration of all communication functionalities is suggested. Furthermore, open research issues are discussed and possible solution approaches are outlined.

3Data collection, storage, and retrieval with an underwater sensor network[6]

In this paper we present a novel platform for underwater sensor networks to be used for long-term monitoring of coral reefs and fisheries. The sensor network consists of static and mobile underwater sensor nodes. The nodes communicate point-to-point using a novel high-speed optical communication system integrated into the TinyOS stack, and they broadcast using an acoustic protocol integrated in the TinyOS stack. The nodes have a variety of sensing capabilities, including cameras, water temperature, and pressure. The mobile nodes can locate and hover above the static nodes for data muling, and they can perform network maintenance functions such as deployment, relocation, and recovery. In this paper we describe the hardware and software architecture of this underwater sensor network. We then describe the optical and acoustic networking protocols and present experimental networking and data collected in a pool, in rivers, and in the ocean. Finally, we describe our experiments with mobility for data muling in this network.

4Efficient Geographic Routing in Multihop Wireless Networks.

We propose a new link metric called normalized advance (NADV) for geographic routing in multihop wireless networks. NADV selects neighbors with the optimal trade-off between proximity and link cost. Coupled with the local next hop decision in geographic routing, NADV enables an adaptive and efficient cost-aware routing strategy. Depending on the objective or message priority, applications can use the NADV framework to minimize various types of link cost. We present efficient methods for link cost estimation and perform detailed simulations in diverse scenarios. Our results show that NADV outperforms current schemes in many aspects: for example, in high noise environments with frequent packet losses, the use of NADV leads to 81% higher delivery ratio. When compared to centralized routing under certain settings, geographic routing using NADV finds paths whose cost is close to the optimum.

5On Geographic Collaborative Forwarding in Wireless Ad Hoc and Sensor Networks

In this paper, we study the geographic collaborative forwarding (GCF) scheme, a variant of opportunistic routing, which exploits the broadcast nature and spatial diversity of the wireless medium to improve the packet delivery ef- ficiency. Our goal is to fully understand the principles, the gains, and the tradeoffs of the node collaboration and its associated cost, thus provide insightful analysis and guidance to the design of more efficient routing/forwarding protocols. We first identify the upper bound of the expected packet advancement (EPA) that GCF can achieve and prove the concavity of the maximum EPA. With energy efficiency as a major concern, we propose a new metric, EPA per unit energy consumption, which balances the packet advancement, reliability and energy consumption. By leveraging the proved properties, we then propose an efficient algorithm which selects a feasible candidate set that maximizes this local metric. We validate our analysis results by simulations, and justify the effectiveness of the new metric by comparing the performance of GCF with those of the existing geographic and opportunistic routing schemes.

III. PROPOSED METHODOLOGY

GEDAR is an anycast, geographic and opportunistic protocol that tries to deliver a packet from a source node to some sonobuoys. During the course, GEDAR uses the greedy forwarding strategy to advance the packet, at each hop,towards the surface sonobuoys. A recovery mode procedure based on the depth adjustment of the void node is used to route data packet when it get stuck at a void node. The proposed routing protocol employs the greedy for-warding strategy by means of the position information of the current forwarder node, its neighbors, and the known sonobuoys, to determine the qualified neighbors to continue forwarding the packet towards some sonobuoys.Despite greedy forwarding strategy being a well known and used next-hop forwarder selection strategy, GEDAR considers the anycast nature of underwater routing when multiple surface sonobuoys are used as sink nodes.

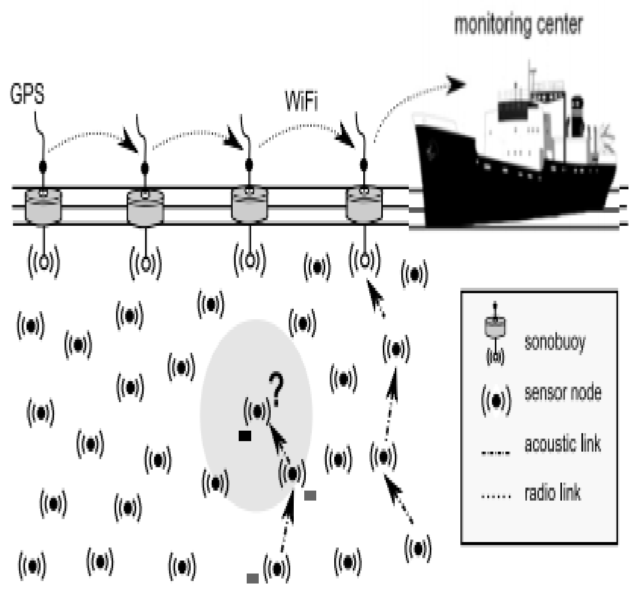

Fig.1: System Architecture of GEDAR

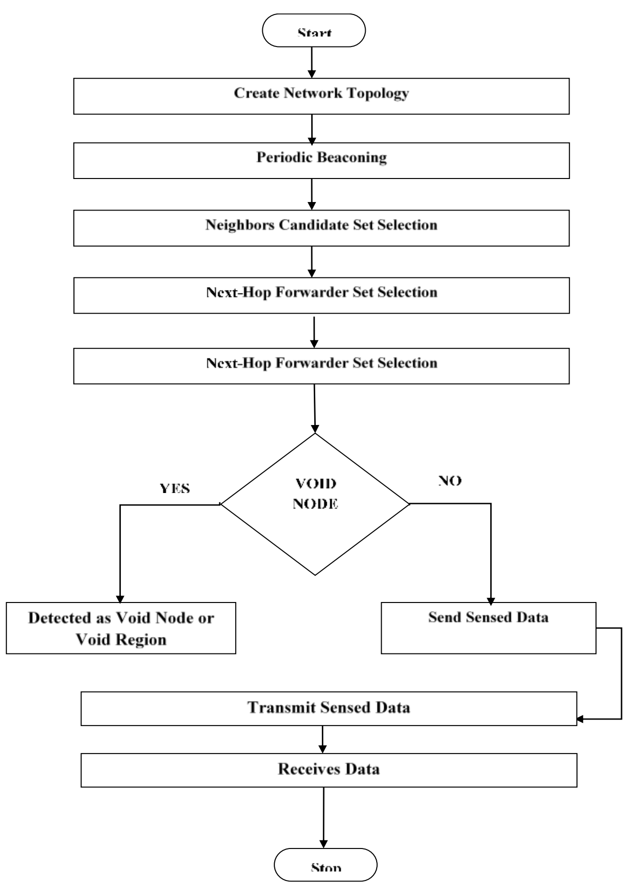

Fig.2: Flow Diagram of Proposed System

Topology Creation

In our simulations, the 32 number of sensor nodes are deployed and the number of sonobuoys is 6. They are randomly deployed in a region the size of 2265 X 1000. In each sensor, data packets are gene-ated according to a Poisson process with the same parameter to very low traffic load;to simulate a mobile network scenario, considers the effect of meandering sub-surface currents (or jet streams) and vertices. We set the main jet speed range from max 5 m/s to min 2.70 m/s. the nodes have a transmission range (rc) of 250 m and a data rate of 50 kbps. The size of the packet is deter-mined by the size of the data payload and by the space required to include the information of the next-hop for-warder set. We consider that data packets have a payload of 150 bytes.

Enhanced Beaconing

Periodic beaconing plays an important role in GEDAR. It is through periodic beaconing that each node obtains the location information of its neighbors and reachable sonobuoys, where each node can be informed beforehand concerning the location of all sonobuoys (as long-term underwater monitoring architecture is formed by static nodes attached to buoys and/or anchors), we need an efficient beaconing algorithm that keeps the size of the periodic beacon messages short as possible. For instance, if each node ni embeds its known sonobuoy locations $|S_i|$ together with its location, the size of its beacon message in the worst case, without considering lower layer headers, $2(m+n) \times |N_s| + 2m + 3n$ bits,wheremandnare the size of the sequence number and ID fields, and eachgeographic coordinates, respectively. Given that the transmission of large packets in the underwater acoustic channel is impractical , we propose an enhanced beaconalgorithm that takes this problem into consideration.Similarly, each sensor node embeds asequence number, its unique ID and X, Y, and Z position information. Moreover,
the beacon message of each sensor node is augmented with the information of its known sonobuoys from its set $S_i(t)$ .Each node includes the sequence number, ID, and the X, Y location of the its known sonobuoys. The goal is for the neighboring nodes to have the location information of the all reachable sonobuoys. GPS cannot be used by underwater sensor nodes to determine their locations given that the high frequency signal is rapidly absorbed and cannot reach nodes even localized at several meters below the surface. Thus, each sensor node knows its location through localization services. Localization services incur addi-tional costs in the network. However, the knowledge regarding the location of sensor nodes can eliminate the large number of broadcast or multicast queries that leads to unnecessary network flooding that reduces the network throughput. In addition, the location

information is required to tag the collected data, track underwater nodes and targets, and to coordinate the motion of a group of nodes.In order to avoid long sizes of beacon messages, a sensor node includes only the position information of the sonobuoys it has not disseminated in the predecessor round (lines 5-12). Whenever a node receives a new beacon message, if it has come from a sonobuoy, the node updates the corresponding entry in the known sonobuoy set $S_i(t)$ (line 20). Otherwise, it updates its known sonobuoys |Si| set in the corresponding entries if the information location con-tained in the beacon message is more recent than the loca-tion information in its set Si. For each updated entry, the node changes the appropriate flag L to zero, indicating that this information was not propagated to its neighbors (line 25). Thus, in the next beacon message, only the entries in $S_i(t)$ in which the L is equal to zero are embedded (lines 7-10). We add random jitters between 0 and 1 during the broadcast of beacon messages, to mini-mize the chance of both collisions and synchronization. Moreover, after a node broadcasts a beacon, it sets up a new timeout for the next beaconing.

Recovery Mode

Void node recovery procedure is used when the node fails to forward data packets using the greedy forwarding strat-egy. Instead of message-based void node recovery proce-dures, GEDAR takes advantage of the already available node depth adjustment technology to move void nodes for new depths trying to resume the greedy forwarding. We advocate that depth-adjustment based topology control for void node recovery is more effective in terms of data deliv-ery and energy consumption than message-based void node recovery procedures in UWSNs given the harsh environment and the expensive energy consumption of data communication.The GEDAR depth-adjustment based topology control for a void node recovery procedure can be briefly described as follows. During the transmissions, each node locally determines if it is in a communication void region by exam-ining its neighborhood. If the node is in a communication void region, that is, if it does not have any neighbor leading to a positive progress towards some surface sonobuoy (C¼;), it announces its condition to the neighborhood and waits the location information of two hop nodes in order to decide which new depth it should move into and the greedy forwarding strategy can then be resumed. After, the void node determines a new depth based on two-hop connectiv-ity such that it can resume the greedy forwarding.

IV. RESULT ANALYSIS

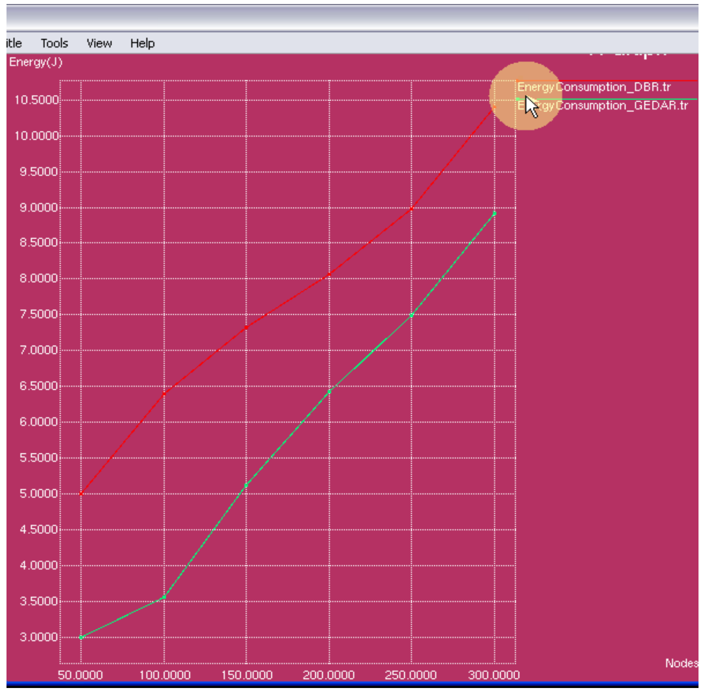

Fig.3: Energy Consumption graph for Exisitng and Proposed System

Above graph shows the energy consumption of existing and proposed system. The green line shows proposed system parameter values which are much lower as compared to existing system shown in red line.

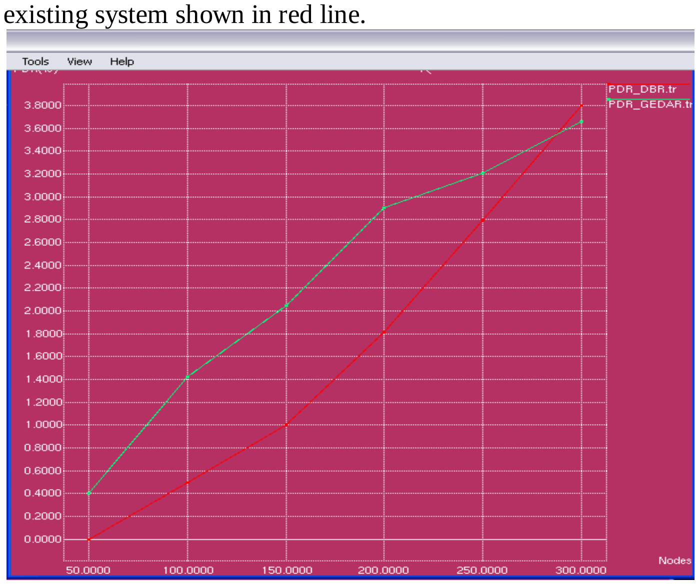

Fig.4: Packet Delievery Rate

The above graph shows the PDR rate for existing and proposed system. As seen the grren line shows higher packet delievery rate as compared to existing Red line system.

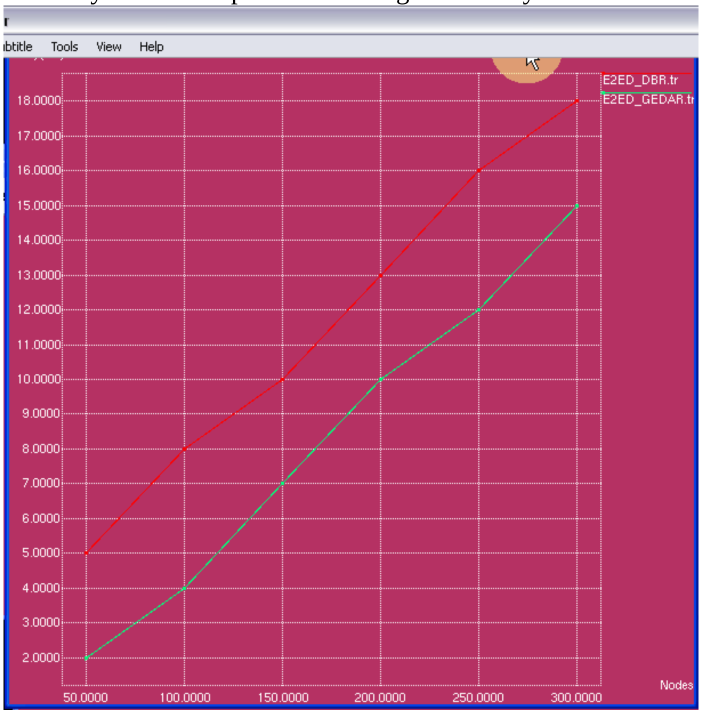

Fig.5: End to End Delay

Above graph shows the overall end to end delay of time for deleievery of packets from source node to monitoring station. The gren line denotes the proposed system that has less delay as compared to existing system.

Comparison of existing system and proposed system.

Parameter	Exisitng System	Proposed System
Energy Efficiency	Low	High
Packet Delievery Rate	Low	High
End to End delay	High	Low

V. CONCLUSION AND FUTURE SCOPE

In proposed and evaluated the GEDAR routing protocol to improve the data routing in under-water sensor networks. GEDAR is a simple and scalable geographic routing protocol that uses the position infor-mation of the nodes and takes advantage of the broadcast communication medium to greedily and opportunistically forward data packets towards the sea surface sonobuoys. Furthermore, GEDAR provides a novel depth adjustment based topology control mechanism used to move void nodes to new depths to overcome the communication void regions. Our simulation results showed that geographic routing protocols based on the position location of the nodes are more efficient than pressure routing protocols. Moreover, opportunistic routing proved crucial for the performance of the network besides the number of trans-missions required to deliverthe packet. The use of node depth adjustment to cope with communication void regions improved significantly the network performance. GEDAR efficiently reduces the percentage of nodes in communication void regions to 58 percent for medium density scenarios as compared with GUF and reduces these nodes to approximately 44 percent as compared with GOR. Consequently, GEDAR improves the network per-formance when compared withexisting underwater rout-ing protocols for different scenarios of network densityand traffic load.

VI. FUTURE SCOPE

As future work, we plan to apply this topology controlof depth adjustment principles to the design of opportunis-tic routing protocols for UWSNs, considering differentQoS requirements for data delivery, the cost for reaches aneighbor node, and the lifetime of the network. We also tends to improve the security of the system using monitoring station and basedstation and some syphertext based policies. Aslo in future, we can find a way to recover the void node for faster process.

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