A Review on Different Routing Protocols for UWSN

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***Abstract*:** *The recent applications of UWSNs are tsunami warnings, pollution detection, military application, etc., UWSNs has many research challenges and limitations such as long propagation delay, less available bandwidth, more interference, and noise, limited battery life of the nodes. The design of routing protocol plays a major role in minimizing these limitations. This paper gives the study of different routing protocols for underwater wireless sensor networks.*

Keywords – *Underwater Wireless Sensor Networks (UWSNs), Routing Protocols.*

Introduction

UWSNs attracted many researchers as they are using in various applications like an underwater exchange, surveillance, disaster prevention, etc.. As UWSNs communication occurs below water level, it has low data rates because it uses sound waves instead of electromagnetic waves. But sound communication has certain limitations like low bandwidth, high error rate, and long transmission delay.

The major problem in the design of UWSNs is limited battery power, inadequate bandwidth, high propagation delay, and high bit error rates. As all sensor nodes are battery-operated, so the major challenge in UWSNs is energy efficiency. To have guaranteed reliable and active data transmission, the design of routing protocols is one of the major concepts.

This paper's content is planned as follows: Section II Gives the Classification of the UWSNs Routing Protocols. Section IIIGives the Comparative analysis of routing protocols discussed in Section II. Section IV presents the conclusion and future work.

DifferentRouting protocols for UWSNs

In this sector, we show different routing protocols used for UWSNs

- Location oriented routing protocol
- Depth oriented routing protocol
- Cluster oriented routingprotocol

A. *Location Oriented Routing*

Vector Forwarding Protocol (VBF)

VBF protocol is proposed to solve the underwater atmosphere. As nodes usually run on battery, energy-saving and node mobility are the important factors in UWSN.

VBF protocol is the first protocol; it is proposed to solve the underwater atmosphere. In UWSN, energy saving is the main factor, where nodes usually run on battery. Apart from energy-saving, node mobility is also one of the important factors in UWSN.

V**BF protocol is a location-oriented routing protocol designed to handle energy efficiency and node mobility in reliable mode. It is also called "Routing pipe." In this protocol, each packet transmission gives the sender's location, the sink, and the advancing node. The routing vector gives the specific path to send a packet from the sender to the sink.**

VBF protocol is a location-oriented routing protocol designed to handle energy efficiency and node mobility in reliable mode. VBF is called "Routing pipe." In VBF protocol, each packet points to the sender's location, the sink, and the advancing node. The path to advance a packet is specified by the routing vector from the sender to the sink.

In VBF, each node doesn't need state information. Hence it is scalable. In VBF, packet forwarding occurs to only nodes near the routing vector, and all other nodes are in idle state. Thus this protocol saves energy. Hence VBF is Energy Efficient and scalable protocol.

The packet cannot forward to the sink node in a sparse network if it does not lie within the routing

pipe, even though other paths may exist outside the pipe. These paths cannot be discovered; hence the delivery ratio will be severely affected. So to improve this enhanced version of VBF is required.

Hop by hop Vector-Based Forwarding (HH-VBF)

HH-VBF is a location-based advanced version of VBF. It addresses the problem faced by VBF. A single routing pipe is used in VBF, but in HH-VBF, every forwarder node will use Routing-pipe. Because of multiple routing pipes end-to-end delay, energy efficiency is higher. The advantage of this method is that each node can decide the direction of the pipe. HH-VBF gives better data delivery paths with respect to sparse networks.

B. Depth Oriented Routing

Depth based routing Protocols(DBR)

In DBR protocol, all node in the network needs depth information and depth of forwarding nodes. When a node senses the highest depth, it starts sending data to higher nodes. Once the sensed node receives data, it collects the information of the previously visited node. After receiving the information, it compares the depth of the previously visited node. The same procedure will be continued until the target node receives the packet.

DBR protocol mainly concentrates on the node's depth, so DBR is greatly energy effective in terms of energy. The drawbacks of DBR are the lifetime of the network, as it always sends data to the same higher node without any checking. DBR is not suitable for dynamic topology.

Energy-Efficient Depth Based Routing (EE-DBR)

EEDBR is a depth-based energy-efficient routing protocol.EEDBR selects a forwarding node based on the depth and energy information of the sensing nodes. When a node wants to send a data, it starts comparing the receiver node's depth with the sender node. If the receiver node's depth is less than the sender node, it starts checking the residual energy of the receiver node. Node with higher residual energy and less depth will be the next node for transmission.

EEDBR protocol gives energy-efficient and long network lifetime. But fail in multipath communication, and there is no significant improvement in data delivery rate.

C. Cluster Oriented Routing Protocols

Low Energy Adaptive Clustering Hierarchy (LEACH)

LEACH is a cluster oriented routing protocol. In this protocol, by minimizing the energy dissipation, the lifetime of the network can be improved. LEACH protocol involves two phases: set up phase and steady phase. In the setup phase, the cluster head is selected from each cluster by considering the maximum energy of that node. In the steady phase, the cluster head performs data collection and transmits collected data to the base station.

The traffic in the entire network decreases due to the collection of data at the cluster head. Single hop routing from nodes to cluster head leads to the saving of energy. Hence the life period of the sensor network also increases. LEACH's disadvantages are that data received by the cluster head never reaches its destination if the cluster head dies. As clusters are distributed unevenly, it results in high energy consumption.

Position Based Aggregator Node Election (PANEL)

PANEL is a cluster oriented position-based protocol for UWSNs. It operates for asynchronous network applications, where the BS fetches information about sensor nodes. It works under the assumption that nodes are arranged in a restricted area divided into geographical clusters. The CH election procedures need intra-cluster communication. A path is established to send a message to the aggregator of a given cluster using Intra-cluster routing. PANEL is Energy Efficient because load balancing at each node i.e., CH so that PANEL can provide a better network lifetime. The main drawback of PANEL is the assumption of a cluster's determination before deployment cannot be applied to the dynamic network.

Power Efficient Gathering in Sensor Information System (PEGASIS)

PEGASIS is a hierarchical routing protocol that uses a chain based approach. The Chain formation takes place with the sensor nodes itself. The chain is recreated if any node dies in between to bypass the dead node.

The cluster head is accountable for transferring data to the base station/sink node. It uses a greedy algorithm for data gathering. PEGASIS conserves energy because it uses a multi hop technique to transmit data that takes less power to carry data from source to any destination node.

Table 1.Comparative analysis of Different Routing Protocols for UWSNs

Routing Protocol	Routing Technique	Packet Delivery Ratio	Energy Efficient	Packet Overhead	Advantages	Limitations
VBF	Location-based routing	Low	High	Less	Broadcast overhead is reduced.	The exact location of node identification is difficult.
HH-VBF	Hop-by-Hop Enhanced Vector-Based routing	High	Medium	Less	Better performance	High Propagation delay
DBR	Depth Based Routing	High	Low	Low	Less cost	Collision avoidance required
EE-DBR	Depth Based routing	Low	Medium	Medium	Low Energy Consumption	The data delivery rate is lower than the DBR.
LEACH	Cluster-Based Routing	Low	Low	Medium	Less delivery delay	Load balancing is not uniform
PANEL	Position based Clustering routing	Medium	Medium	Low	Supports asynchronous applications	Delay is not predictable
PEGASIS	Chain cluster-based routing	Low	Low	Medium	Reduced overhead due to dynamic cluster formation	The network is not very scalable

Conclusion and Future scope

In this article, the study shows different routing protocols for underwater wireless sensor networks(UWSNs). Energy efficiency, best packet delivery ratio, less transmission delay, and low routing overhead are the main objectives of any routing protocols in any network as routing is a challenging task in UWSN. Different protocols are considered for different scenarios. In this research paper, a comparative analysis of other routing protocols is presented. Even though routing protocols used in UWSNs are efficient in terms of performance, still some challenges need to be solved, for example, efficient energy, stability in dynamic topology, security, and so on. In future work, we aim to include recent developments in the routing protocols, which address challenges like efficient energy, scalability in dynamic topology.

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