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Branching based Underwater Clustering Protocol

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Abstract

Background/Objectives: Underwater wireless sensor network has widely influenced the scientist to explore the data and to study the underwater environment deep inside the ocean. **Methods**: The new clustering technique which is effective in prolonging the lifetime of the underwater nodes. An AODV (Ad-Hoc on-Demand Vector) routing protocol has been used in order to find the shortest path between nodes. SNR (Signal-to-Noise Ratio) based dynamic clustering mechanism partition the nodes into various clusters and select the Cluster Head (CH) among the nodes based on energy whereas other nodes join with a specific CH based on the SNR values the clustering technique is effective in prolonging the lifetime of the UWSN (Underwater Sensor Network). **Findings**: Due to the mobility nature of underwater sensors, ocean currents and unique characteristics of acoustic signals such as long propagation delay, low bit error rate, low bandwidth make the transmission period longer. Hence more energy is consumed by the sensor nodes while transmission. Our proposed system introduces signal to noise ratio based clustering mechanism which improves the energy consumption of network and minimizes the transmission delay. **Applications/Improvements:** The simulation result verifies the effectiveness and feasibility of the proposed technique and also shows increased rate in PDR (Packet Delivery Ratio) and less energy consumption.

Keywords: Ad-Hoc on-Demand Vector Routing, Cluster Head Component, Signal to Noise Ratio, Underwater Sensor Network

1. Introduction

Underwater wireless sensor network has always facilitated the scientist, researcher and educational steam to gather the information about deep inside the ocean. UWSN provide suitable solution for adventuring the environment of Deep Ocean. The existing ways of approaches for oceanographic monitoring have many drawbacks such as high establishment cost, consumes enough time in monitoring, no real-time implementation etc. UWSN provides mechanism to explore the ocean. It uses acoustic communication as a medium for transmission of data under the ocean[1]. Underwater sensor nodes are small and less expensive which are able to communicate with each other via acoustic signals[2]. In the UWSN, the sensor nodes have the characteristics such as limited processing, low storage and less transmission range. The clustering technique is effective in prolonging the lifetime of the UWSN.

Single cluster head in a cluster-based replication to improve the energy efficiency rate with clustering routing technique[3] whereas data aggregation using single cluster head. The simulation result demonstrates that dual cluster heads in distributed hash table replication can improve the performances of a replica manager with respect to updates propagation in comparison to that of a single cluster head in distributed hash table replication system[4]. The replica is

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a similar copy of a file. The replica managers are the mobile nodes that hold on and query requests are accepted from other mobile nodes and respond back with requested files. In Vector based routing protocol, each node knows its location. The data is traveled by virtual routing pipe from source to sink and only those nodes which are present in the pipe can transmit the packets[5]. It easily reduces the network traffic and can manage dynamic topology. Data transmitted to destination hop-by-hop manner. In Delay-tolerant Data Dolphin (DDD), mobile nodes access the data with the help of stationary nodes. The energy consuming multi-hop communication is avoided. In AUV (Autonomous Underwater Vehicle) assisted routing protocol, AUV's can act as relay node and hence the total data transmission can be minimized.

2. Proposed Methodology

The proposed system ensures prolonging lifetime of the network and consumes low energy of each and every node in the network. The transfer of the information from source to destination is secured and faster way.

AODV routing protocol is implemented to find the shortest route to the destination. An energy efficient clustering algorithm is developed for mission critical UASN databases in cluster network architecture. In clustered network, the collection of nodes is grouped to form clusters. Each cluster is having a cluster head which is used for processing all of its cluster members[6]. This clustering technique is useful in prolonging the network lifetime especially in the environment where replacing the battery of sensors is not possible once they are deployed in the target region. Therefore the use of dual cluster head in the same cluster is vital in increasing the network lifetime.

The replication techniques improve the availability and decrease the query response delay[7]. It organizes all the mobile nodes into non-overlapping clusters. The Ad Hoc On-Demand Distance Vector routing uses both unicast and multicast routing. The benefits of the proposed method are as follows:

- Aggregated data can be transmitted to sink.
- The number of nodes in transmission is less.
- Communication overhead is low in single and multi hop.
- Scalable to large number of nodes.
- Less energy consumption.

3. System Implementation

Implementation of underwater clustering protocol requires the various software and tools. To know the outcome of the protocol and to measure its effectiveness and efficiency, we need to run it in NS2 software on Linux operating system. This will provide the animated view of the various processes that will carry on in real time.

3.1 AODV Route Management

The route node uses the reactive protocol to find its neighbor. The AODV protocol is one of the reactive protocols. The route node first sends the root request to all the nodes in the network. In reactive protocol we just find the shortest route as we travel in the network. So which ever node accepts the request sent, the source sends the response to it. And the source travels through those nodes.

3.2 Cluster Head Formation Algorithm

In this algorithm, the cluster heads are formed for the clusters that are present in the network. The cluster head is formed to save the energy of the nodes and also the lifetime of the network. To select the cluster head, a node should have two properties basically. It should be able to communicate with all the other nodes in the cluster and should have maximum energy when compared to all the other nodes in the cluster. The cluster head selects its cluster nodes by using SNR values. It should be in the ratio 1:1. Thus by selecting the cluster head, the energy is saved and data can be transmitted from source to destination in a shorter time period.

3.3 Create Dual Cluster using Cluster Head Selection and SNR based Values

In a larger network, managing all the nodes by a single cluster head is not efficient. Therefore the dual cluster heads are formed in a single network as sown in Figure 2. The formation of the dual cluster head is as same as the formation of cluster head in previous module. All the cluster heads should have both the properties that they

should be able to communicate with all the nodes and even with the other cluster heads. The problem arises when the cluster heads are not able to communicate with each other.

3.4 Creating Single Cluster with Dual Cluster to Increase Energy

In the proposed system, a single cluster is taken from the dual clusters in the network and again split it into dual clusters Figure 1. The replica manager is created which takes the responsibility of transferring information from the source to destination in the failure of the cluster head. This will prevent the time delay and also saves the energy of the network. The formation of cluster and cluster heads are same as the previous modules.

4. System Architecture

The various nodes are settled stationary in the water,

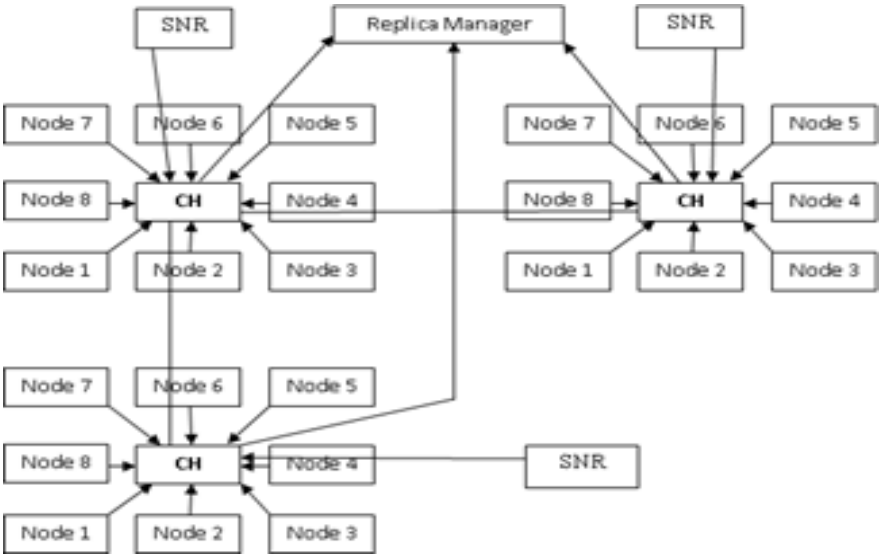

Figure 1. System architecture.

Data Flow Diagram

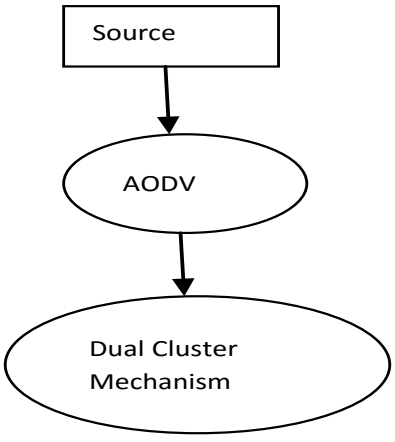

Figure 2. DFD level 0.

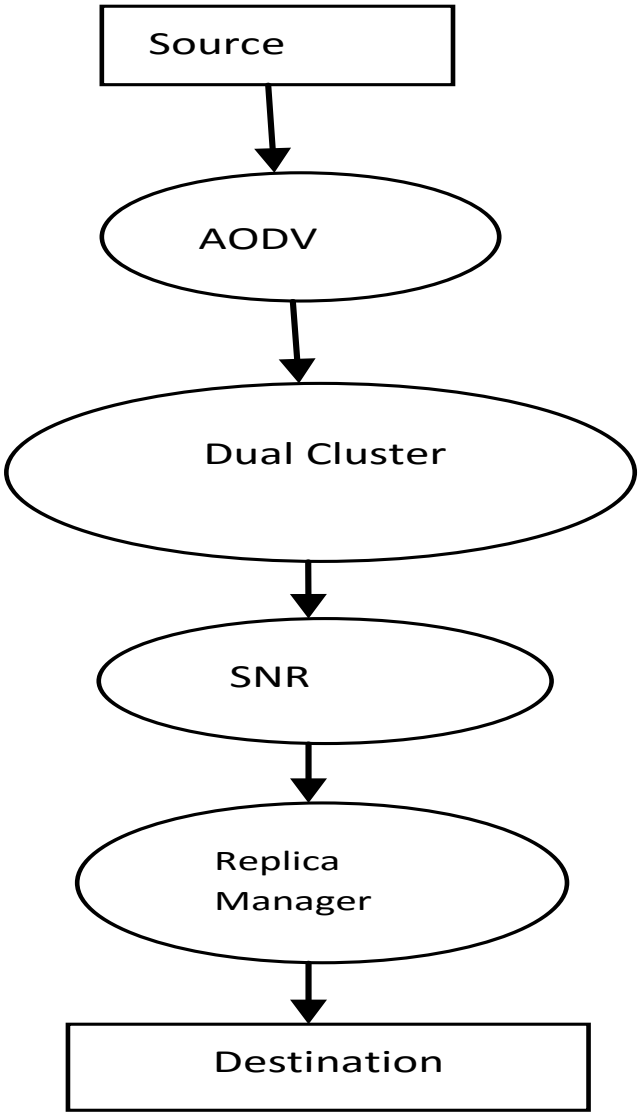

Figure 3. DFD level 1.

except the replica node which is dynamic in nature to receive the packets. As shown in Figure 3, each node is associated with the SNR system which helps in transmission of the packets. The nodes access and release the packets not only to the replica node but also to its

cluster head on the basis of message priority. After collection of data, at certain point the packets are transmitted to receiver.

5. Application

There are various fields in which the underwater sensor networks are used[8]:

- It is used for military purposes.
- It is being used to locate the minerals present deep inside the ocean.
- It is used in ships and boat to measure the depth.

- It is used by scientist and researcher to get the information of sea.

6. Result

In this section, the performances of the proposed system are evaluated using NS2 simulation. Various cluster nodes with their Result cluster head are assumed to be established in the water with SNR system as shown in Figure 4. The replica keeper, dynamic in nature travels through each node to receive the information and transmit to the receiver.

The throughput of the proposed system is shown in Figure 5. It is the total energy consumed by the various nodes in order to deliver the packet. The X-axis gives the time interval whereas Y-axis gives the amount of energy.

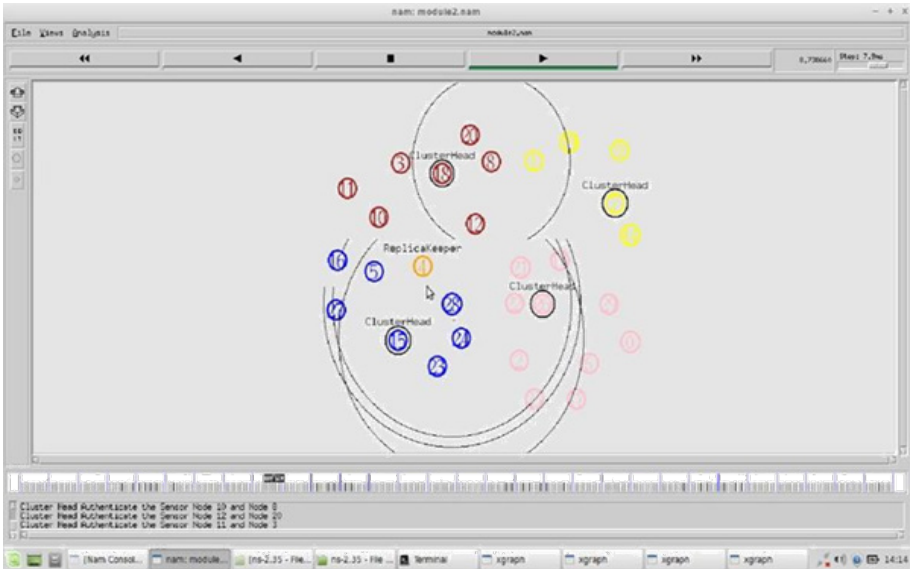

Figure 4. Simulation diagram.

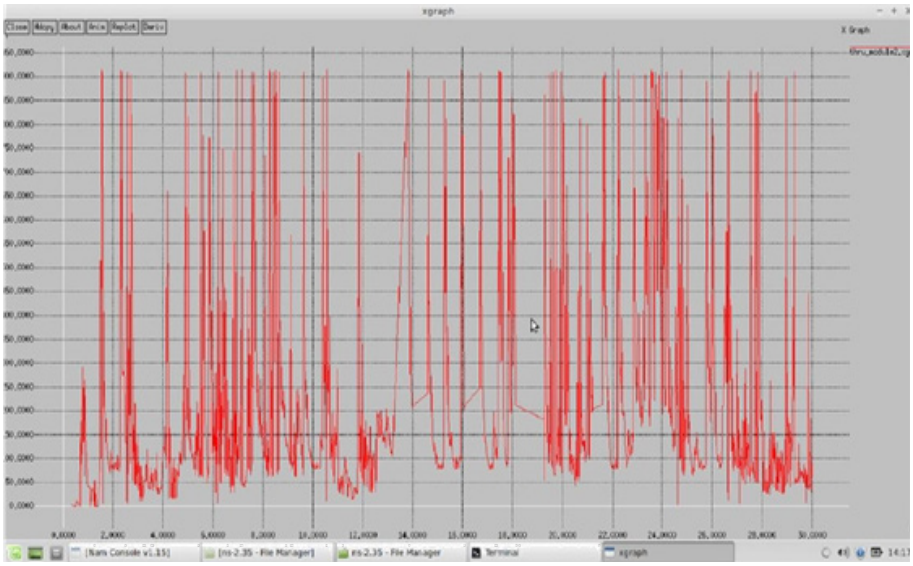

Figure 5. Throughput.

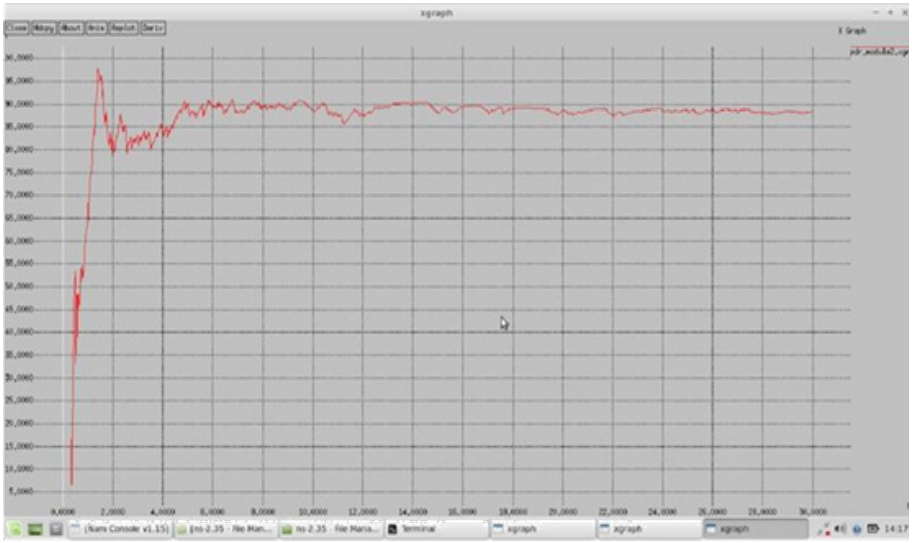

Figure 6. Packet delivery ratio.

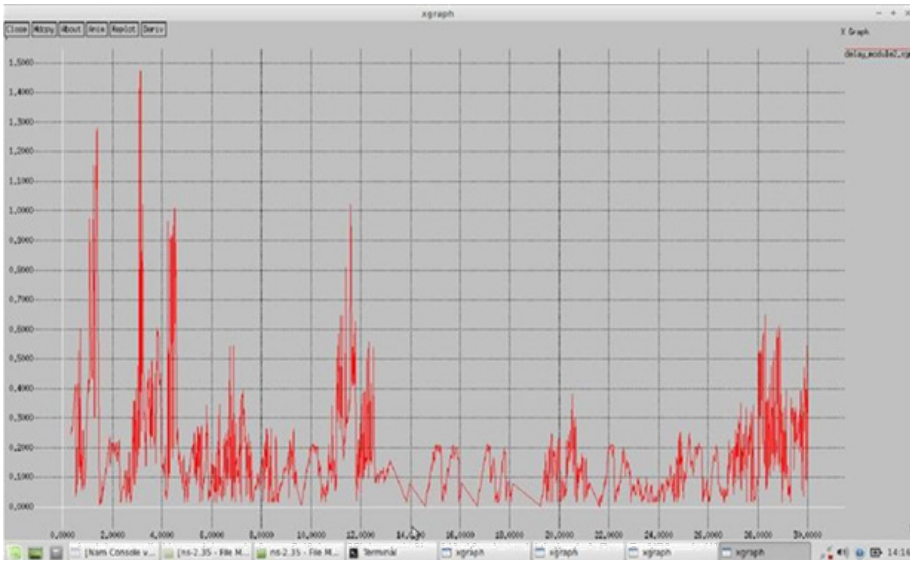

Figure 7. Delay.

According to the graph, the outcome is 36.2 J which is relatively very small in comparison to other routing protocol.

The packet delivery ration of the proposed system is shown in Figure 6. The Packet Delivery Ratio (PDR) is the amount of data that is transferred per units of time. The PDR rate is given by,

PDR = Number of packet delivered/Number of packet sent

In simulation result, the PDR is found to be 0.88 which is very efficient in comparison to other routing protocol and transfer rate is around 80%.

The delay of the proposed system is shown in Figure 7. The graph shows network delay Vs time. In this graph, time is considered on X-axis and network delay is considered on Y-axis.

7. Conclusion

This system evaluates the feasibility and performances through both theoretical analysis and simulations. The results show that the system outperforms than other existing methods in 60-100 percent improvement in energy saving and provides support for error handling communication. It was not focused in the earlier studies.

8. Acknowledgement

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9. References

1. Caiti A, Grythe K, Hovem JM, Jesus SM, Lie A, Munafo A, Reinen TA, Silva A, Zabel F. Linking acoustic communications and network performance: integration and experimentation of an underwater acoustic network. IEEE Journal of Oceanic Engineering. 2013 Oct; 38(4):758–71.
2. Naik SS, Nene MJ. Self organizing localization algorithm for large scale underwater sensor network. Proceedings of RACSS; 2012 Apr. p. 207–13.
3. Harb H, Makhoul A, Couturier R. An enhanced K-means and ANOVA-based clustering approach for similarity aggregation in underwater wireless sensor network. IEEE Sensors Journal. 2015 Oct; 15(10):5483–93.
4. Sasikumar R, AnanthanarayananV , Rajeswari A. An intelligent pico cell range expansion technique for heterogeneous wireless networks. Indian Journal of Science and Technology. 2016 Mar; 9(9):1–9.
5. Gomathi RM, Manickam MLJ. A comparative study on routing strategies for underwater acoustic wireless sensor network. Contemporary Engineering Sciences. 2016 Jan; 9(2):71–80.
6. Khan G, Gola KK, Ali W. Energy efficient routing algorithm for UWSN – A clustering approach. Proceedings of 2nd ICACCE; 2015 May. p. 150–5.
7. Yu H, Martin P, Hassanien H. Cluster-based replication for large-scale mobile ad-hoc networks. Proceedings of International Conference on Wireless Networks Communications and Mobile computing; 2005 Jun. p. 552–7.
8. Gomathi RM, Manickam ML, Madhukumar JT. Energy preserved mobicast routing prorocol with static node for underwater acoustic sensor network. IEEE International Conference on Innovation Information in Computing Technologies (ICIICT); 2015 Feb. p. 1–8.