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Efficient Energy Use in Time-Critical Applications with a Multi-Layer Approach

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ABSTRACT: The ocean is still one of the uncharted territories. When it comes to taking use of cutting-edge information and communication technology, many marine and oceanic applications have been sluggish. The best option for underwater communication at the moment is acoustic communications. It is challenging to provide energy efficient communication via the acoustic channel due to its high error rate and lengthy propagation time. We put up a novel approach that ensures a healthy equilibrium among total energy efficiency, end-to-end packet latency, and end-to-end delivery ratio. A combination of power-control, multipath routing, and destination packet combining is cleverly done by this technique. Because multipath transmission does not provide hop-by-hop retransmission and power-control algorithms are properly crafted, the delay introduced by multipath transmission is much less than that of the conventional one-path approach with retransmission. To test how well multipath power-control transmission worked, we performed a battery of simulations. Low end-to-end packet delays and very energy efficiency are the hallmarks of multipath transmission, as shown by our results.

Keyword: Sensors installed underwater, conditions encountered underwater, transmission over many paths, and compression of data packets.

INTRODUCTION:

Most of Earth's surface is submerged in water. There has been a significant uptick in interest from humans in investigating this mostly uncharted region. There has been a surge in interest in monitoring ocean ecosystems for scientific, environmental, military, and other purposes due to the number of recent natural and man-made catastrophes. Industries are considering the possibility of submerging sensor nodes in order to carry out these monitoring tasks. Additionally, several innovative networking methods were made possible by technological breakthroughs. Sensor networks have far-reaching effects in many technological spheres, including academia, business, and public policy. This is due to the fact that on-board sensing units may be built using tiny electrical and mechanical systems, as well as low-powered processing and storage units [2].
The technology that allows for underwater applications is wireless underwater networking. A large number of sensor nodes and underwater vehicles make up underwater sensor networks that allow for better area monitoring. However, in order to accomplish these goals, sensors and vehicles need to be able to self-organize into an autonomous network that can adjust to the unique underwater conditions [1].

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UNDERWATER NETWORK:

Underwater sensor networks with several sinks and dispersed acoustic modems are being considered. Wireless and acoustic modems are placed on the water's surface; these modems receive signals from underwater modems and send them back to the main station.

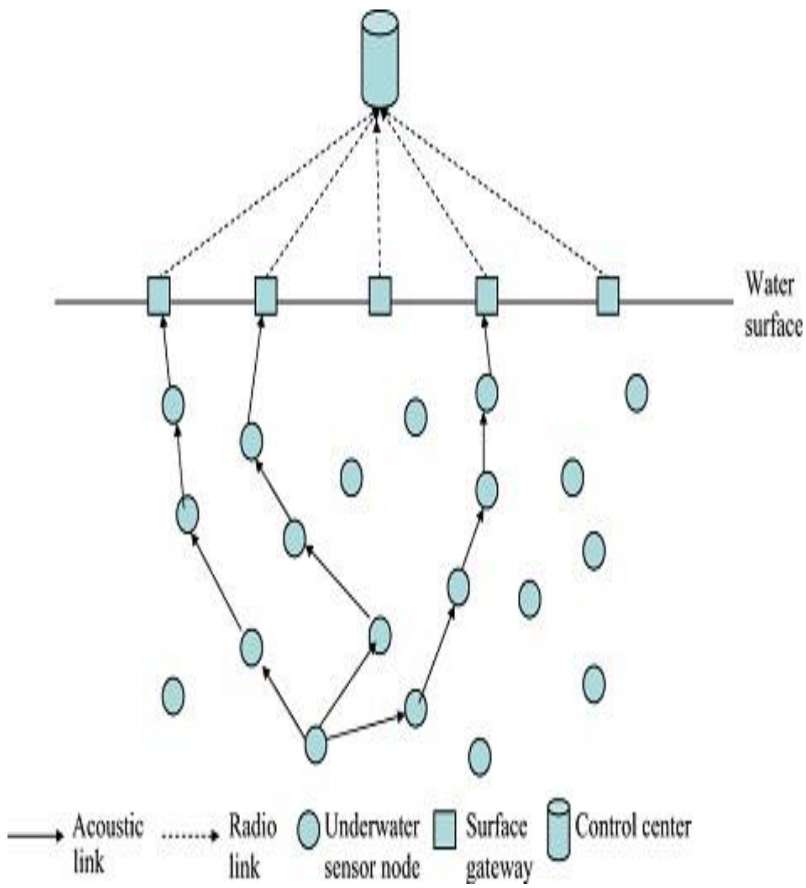

Fig 1: Underwater Network Model.

Network under the water will be as shown in Fig 1. Whenever a node has particular data to send, it distributes it through several paths to the gateways at the surface of the water. These gateways forward the received data using radio frequency link [6].

SYSTEM ARCHITECTURE

The system architecture for the simulated system is as shown in Fig 2 and consists of following sub components.

- Config: The Config provides a GUI interface to configure the number of nodes and acoustic channel parameters like packet error rate and delay.
- Acoustic Simulator: The Acoustic simulator is discrete event simulator. The nodes and sink don"t communicate directly instead send packets to the Acoustic simulator. This simulator introduces packet delay and error rate.
- Node: This emulates the wireless sensor nodes in the acoustic network. Nodes can generate packets, relay packets.
- MPT Routing: Nodes use MPT Routing to know about the routing paths and send across multiple paths.

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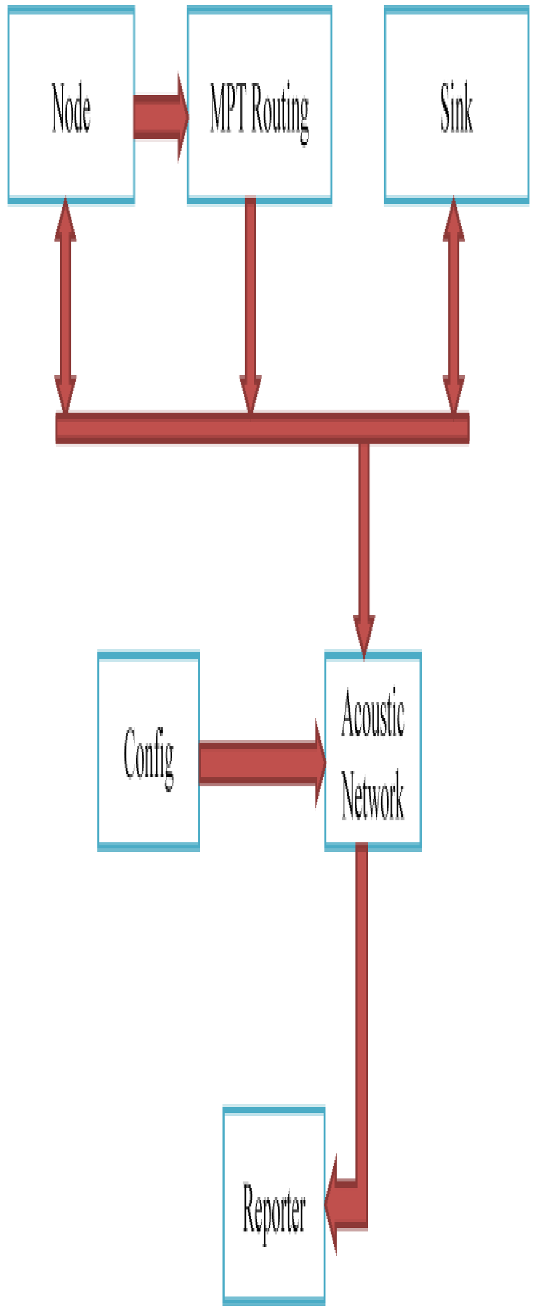
- Reporter: The Acoustic simulator module measure the energy spent by each node and calculate the average energy used by the nodes and provides the values to the Reporter. The Reporter modules store the values and draw the performance graph.
- Sink: The sink node combines and restores the packets [5].

Fig 2: System Architecture.



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I. Design Layout

The design layout of the system is as shown in Fig 3 and the system flow is described below:

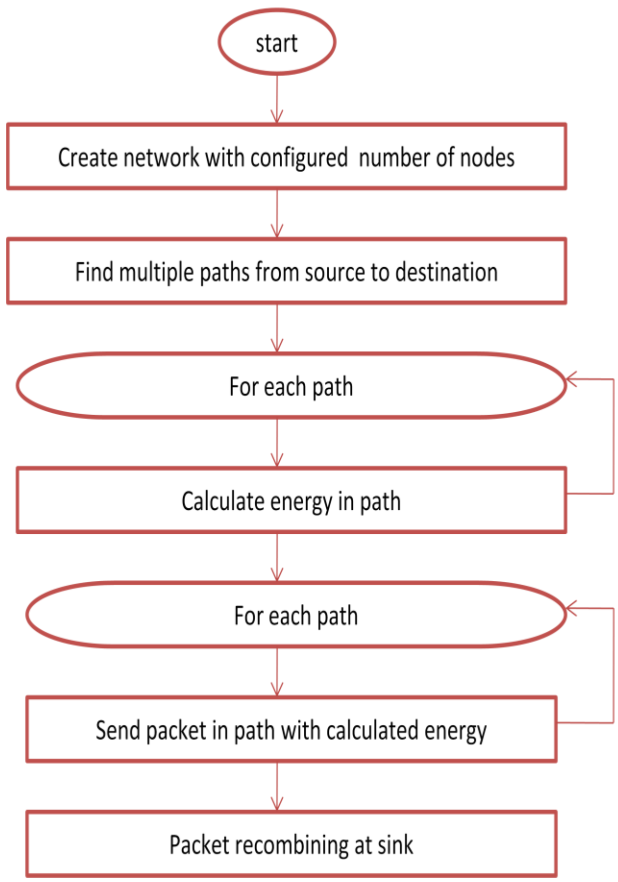

Fig 3: Design Layout.

Step 1: Create an underwater sensor network with pre configured number of node.
Step 2: Find multiple path from source to destination.
Step 3: For each path found, Calculate the energy spent in individual path
Step 4: Find the path from source to destination which is having minimum energy.
Step 5: Send packets through paths found in Step 4.
Step 6: Reassemble all the received packets at the destination.

II. MULTIPATH POWER CONTROL TRANSMISSION

The new scheme, multipath power-control transmission can be seen as a three-fold approach for time-critical application. The three approaches can be classified as:

- Multipath routing
- Source initiated power-control transmission.
- Destination Packet Combining.

A. Multipath Routing

For our system, we will be using modified Ad-hoc on demand distance vector algorithm to support multiple path routing. The basic procedure for multipath routing is as shown in Fig 4.

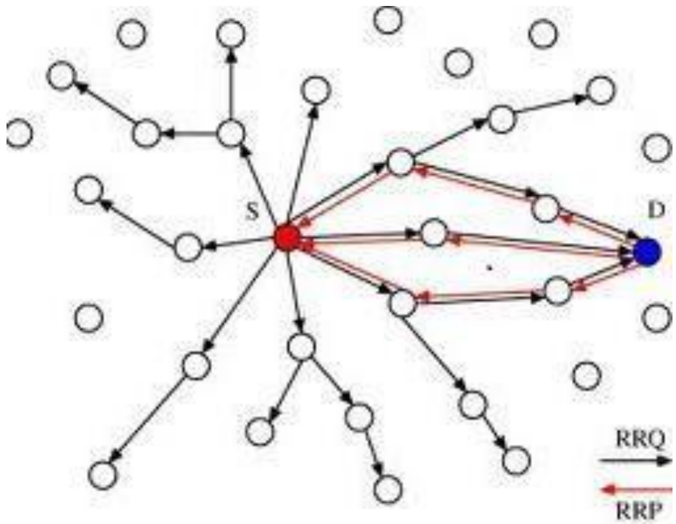

Fig 4: Multi-Path Routing Mechanism.

Whenever the source node has particular information to be sent to destination, it first sends a "Route Request" message through all the nodes to destination. When a particular node receives this message for the first time it forwards the message to destination. Once destination receives this message, it replies with "Route Reply" message through the path through which it had received request message. When source node receives the acknowledgement it sends the packet through the selected multiple paths to destination [4].

B. Source-Initiated Power-Control Transmission

New scheme is said to be Source-initiated because same packets sent by the source node is transmitted through all possible intermediate nodes through the selected nodes. It is a cross layer approach in which functionalities of power management plane, the co-ordination plane and the localization plane are necessary for efficiency.

C. Packet Combining at Destination

The packets sent by source node through multiple paths arrive at the destination. Since no retransmission is allowed, some packets might have been dropped with errors. The technique used is as shown in Fig 5.

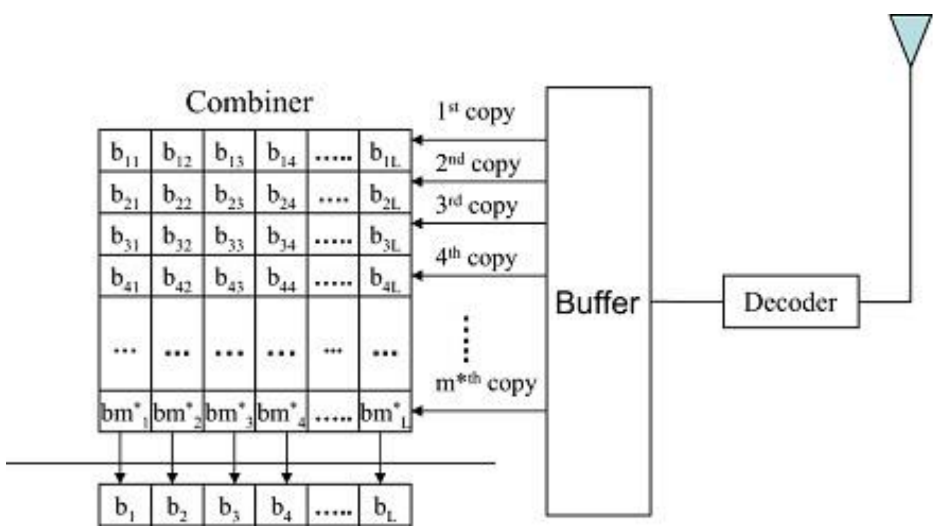

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Fig 5: Packet combining technique.

At destination when the message is received, it checks whether this message is correct or not. If it is correct then it has successfully received the message. But if the message is not correct it stores the message in its buffer. When multiple corrupted copy messages are received, it combines them to obtain original message.

III. ENERGY DISTRIBUTION PROCESS

The energy distribution process can be described as follows:

Step 1: Using source-initiated multipath routing process, the source node get to know all information like available paths, number of hops for each path and per hop distance.

Step 2: At source node, modified AODV is used for multipath distribution.

Step 3: For each selected path, messages are sent along with the calculated energy „E_i" and „G_i", constant defined by signal frequency, antenna gains and other parameter.

Step 4: For each node „j" along path „i", transmitting energy is calculated as:

$$E_{ij} = \frac{G_{ij}}{G_i} \times E_i.$$

Then it transmits packet with energy E_{ij}

Step 5: At destination, when it receives a copy of packet it checks for correctness of the packet. If it is correct then message will be sent to base station or else waits for other corrupted copies and combines to form original message [6].

PERFORMANCE EVALUATION

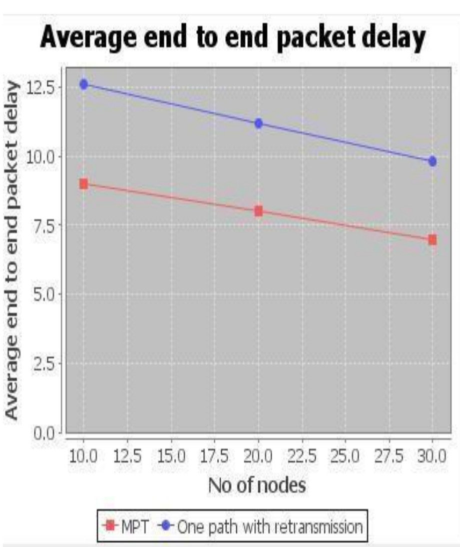
A. Simulation Settings

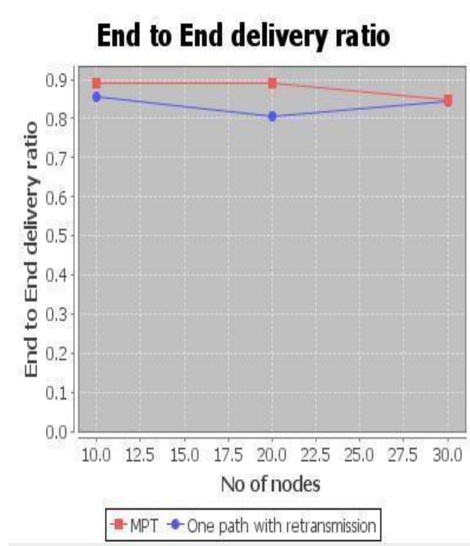
We used Prowler simulator for simulation with following parameters predefined:

Number of nodes	: More than 10.
Window size	: 400 X 400.
Transmission Range	: 200.
Broadcast protocol	: Vector Based forwarding.
Routing Protocol	: Modified AODV to support multiple paths.
Each Simulation	: 10000s.

B. Result

During simulation we compared new scheme with one-path with retransmission scheme and showed that our new scheme is efficient. During simulation we measured metrics like average and end-to-end packet delay and end-to-end delivery ratio. The comparison graph of the same is shown in Fig 6a and Fig 6b.





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(a) Average and end-to end packet delay. (b) end-to-end delivery ratio.

Fig 6: Simulation Result.

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CONCLUSION AND FUTURE WORK

For time-sensitive uses in underwater sensor networks, we suggested a new multipath power-control transmission approach. Packet recovery at destination, power-control methods, and multipath routing protocols are all part of this strategy. Low end-to-end packet latency is achieved by using a multipath power-control transmission technique, which eliminates the need for retransmission at intermediate nodes. A transmission technique that strikes a reasonable compromise between packet delay and energy economy is the multipath power-control scheme. It is particularly interesting for time-critical applications in underwater sensor networks that are energy restricted.

We want to enhance the system's performance even more in the future by integrating coding methods like erasure codes with multipath power-control transmission schemes. There is no longer a threshold below which node interference and collisions become significant in densely populated networks. Within the context of a multipath power-control transmission method, we are interested in exploring a novel distributed optimization model that accounts for node collisions and interference. It is our hope that combining a multipath power-control transmission method with more efficient MAC protocols can further increase the system's energy efficiency.

REFERENCES

1 "Underwater acoustic sensor networks: Research challenges," Ad Hoc Netw., vol. 3, no. 3, pp. 257-279, Mar. 2005, by F. Akyildiz, D. Pompili, and T. Melodia. 2. Visit http://www.ece.gatech.edu/research/labs/bwn/UWASN for more information. 3. R. Balasubramanian, L. Movva, and Chaithanya Kurra The article "Underwater Acoustic Sensor Networks: a Survey on MAC and Routing Protocols" covers pages 1-8. The article "Issues in Underwater Acoustic Sensor Networks" by Manjula B. and Sunilkumar S. Manvi was published in February 2011 in Volume 3, pages 101–110. 5. In the February 2013 issue of the International Journal of Computer Science & Engineering Technology (IJCSET), Rakesh V S and colleagues published "A Survey on Underwater Sensor Network Architecture and Protocols." 6. "Efficient multipath communication for time-critical application for underwater acoustic sensor networks" by Zhong Zhou, Zheng Peng, and Jun-Hong Cui 9. The 2011 February issue of the IEEE/ACM Transactions on Networking, volume 19, issue 1.