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AN EXAMINATION ON PROCURING UNDERWATER ACOUSTIC NETWORKS

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ABSTRACT

Wireless information transmission through the ocean is one of the enabling technologies for the development of future ocean-observation systems and sensor networks. Wireless underwater acoustic networking is the enabling technology for these applications. Underwater Acoustic Sensor Networks (UW-ASN) consist of a variable number of sensors and vehicles that are deployed to perform collaborative monitoring tasks over a given area. To achieve this objective, sensors and vehicles self-organize in an autonomous network which can adapt to the characteristics of the ocean environment. Acoustic communications are the typical physical layer technology in underwater networks. Reliable Underwater Wireless Sensor Networks (UWSNs) can supply good services for deep-water engineering applications operating in the volatile underwater environment. To integrates the AUV's dynamic path planning algorithms into the routing protocol to an AUV-aided acoustic communication protocol, namely AA-RP (AUV-Aided Routing Method Integrated Path Planning) is used. A part of sensor nodes avoid the Request/Reply mechanism and forward data.With the dynamic AUVs' path, the GNs are changing dynamically, which can balance energy consumption of the network.The simulation result shows that both End-to-End Delay and energy consumption of the proposed method can get higher performance, compared with some existing routing protocols, such as H2-DAB and the DBR. Also, the PDR of AA-RP is in an acceptable range. The method is able to prolong the lifetime of network and to handle the hot spot and zone problem.

Keywords: Underwater, UW-ASN, UWSN, Acoustic.

1. INTRODUCTION

Wireless information transmission through the ocean is one of the enabling technologies for the development of future ocean-observation systems and sensor networks. Applications of underwater sensing range from oil industry to aquaculture, and include instrument monitoring, pollution control, climate recording, and prediction of natural disturbances, search and survey missions, and study of marine life. Underwater wireless sensing systems are envisioned for stand-alone applications and control of autonomous underwater vehicles (AUVs), and as an addition to cabled systems. For example, cabled ocean observatories are being built on submarine cables to deploy an extensive fiber-optic network of sensors (cameras, wave sensors and seismometers) covering miles of ocean floor. These cables can support communication access points, very much as cellular base stations are connected to the telephone network, allowing users to move and communicate from places where cables cannot reach. Another example is cabled submersibles, also known as remotely operated vehicles (ROVs). These vehicles, which may weigh more than 10 metric tons, are connected to the mother ship by a cable that can extend over several kilometers and deliver high power to the remote end, along with high-speed communication signals. A popular example of an ROV/AUV tandem is the Alvin/Jason pair of vehicles deployed by the Woods Hole Oceanographic Institution (WHOI) in 1985 to discover Titanic. Such vehicles were also instrumental in the discovery of hydro-thermal vents, sources of extremely hot water on the bottom of Deep Ocean, which revealed forms of life different from any others previously known. The first vents were found in the late 1970s, and new ones are still being discovered.

2. LITERATURE SURVEY

Ocean bottom sensor nodes are deemed to enable applications for oceanographic data collection, pollution monitoring, offshore exploration, disaster prevention, assisted navigation and tactical surveillance applications. [2] Multiple Unmanned or Autonomous Underwater Vehicles (UUVs, AUVs), equipped with underwater sensors, will also find application in exploration of natural undersea resources and gathering of scientific data in collaborative monitoring missions. To make these applications viable, there is a need to enable underwater communications among underwater devices. Underwater sensor nodes and vehicles must possess self-configuration capabilities, i.e., they must be able to coordinate their operation by exchanging configuration, location and movement information, and to relay monitored data to an onshore station [3]. Wireless underwater acoustic networking is the enabling technology for these applications. Underwater Acoustic Sensor Networks (UW-ASN) consist of a variable number of sensors and vehicles that are deployed to perform collaborative monitoring tasks over a given area. [4] To achieve this objective, sensors and vehicles self-organize in an autonomous network which can adapt to the characteristics of the ocean environment. Underwater networking is a rather unexplored area although underwater communications have been experimented since World War II, when, in 1945, an underwater telephone was developed in the United States to communicate with submarines. Acoustic communications are the typical physical layer technology in underwater networks. [5] In fact, radio waves propagate at long distances through conductive sea water only at extra low frequencies (30-300 Hz), which require large antennae and high transmission power. Optical waves do not suffer from such high attenuation but are affected by scattering. Moreover, transmission of optical signals requires high precision in pointing the narrow laser beams. Thus, links in underwater networks are based on acoustic wireless communications. The traditional approach for ocean-bottom or ocean column monitoring is to deploy underwater sensors that record data during the monitoring mission, and then recover the instruments.

3. PROPOSED SYSTEM

AA-RP relies on two phases:

- AAR (AUV-Aided Network Routing)
- RAP (Routing Aided Path Planning).

This section presents our proposed method in detail.

This integrated communication method relies on two phases:

- AAR (AUV-Aided Network Routing)
- RAPP (Routing Aided Path Planning).

In AA-RP, AUV collects data from sensor nodes following a dynamic path, which is planned by itself at the same time.

3.1. MODULES

1) AUV has unlimited resources like power, memory and computational capability;
2) AUVs maintain synchronized time with each other;
3) AUV’s location is known.

3.2. AAR (AUV-AIDED ROUTING PROTOCOL)

AAR aims at building an energy-efficient data forwarding route between AUV and sensor nodes. In AAR, AUV is in charge of broadcasting HPs and collects data from sensor nodes when passing a zone. When sensor nodes receive HP, it checks whether the HP should be forwarded or not. If the HP could be forwarded, the sensor node updates the routing table and puts the HP into a sending buffer.

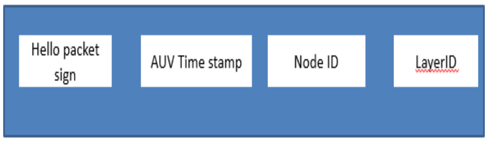


Fig 1: packet details

3.3. RAP (ROUTING AIDED PROTOCOL)

When the migration length of AUV reaches V meters, AUV broadcasts HPs and moves slowly during a Random Time. During this time, AUV broadcasts HPs at more than three different positions, and then AUV can locate the first-hop nodes easily.

3.4. ARCHITECTURAL DESIGN SPECIFICATION

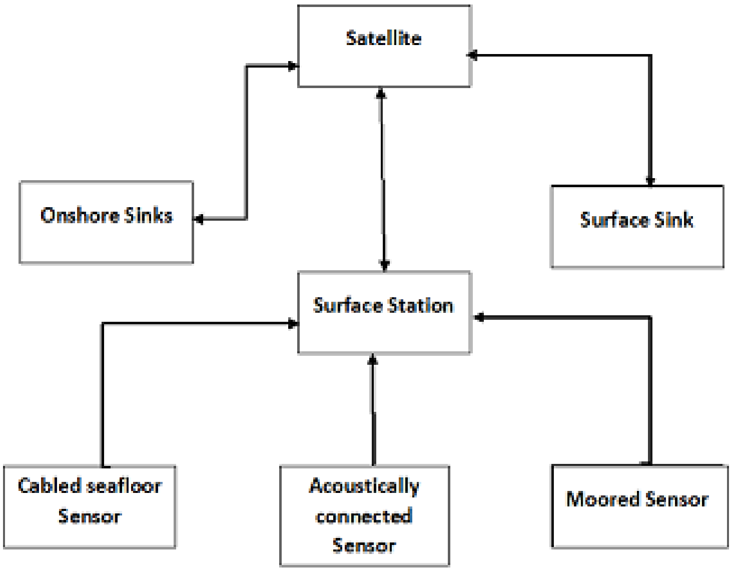


Fig 2 : Deployments can be cabled, fixed and moored wireless, mobile (on AUVs), and can have different links to shore

Underwater networks may also be mobile, with sensors attached to AUVs, low-power gliders or unpowered drifters. Mobility is useful to maximize sensor coverage with limited hardware, but it raises challenges for localization and maintaining a connected network. Energy for communications is plentiful in AUVs, but it is a concern for gliders or drifters. As with surface sensor networks, network density, coverage and number of nodes are interrelated parameters that characterize a deployment. Underwater deployments to date are generally less dense, have longer range and employ significantly fewer nodes than terrestrial sensor networks. For example, the Sea web deployment in 2000 involved 17 nodes spread over a 16 km^2 area, with a median of five neighbours per node. Finally, as with remote terrestrial networks, connectivity to the Internet is important and can be difficult. Figure shows several options, including underwater cables, point-to-point wireless and satellite.

3.5. ALGORITHM

Create the routing table

A HP is received

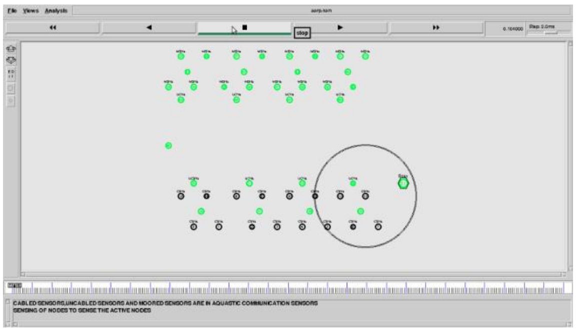
1. If packet sign ==Hello packet sign

```
2. If the layer ID not approach the threshold n
3. If the AUV time stamp is newer than the time stamp of last route entry
4. If the layer ID is HP is smaller or same compared with the last routing entry’s layer ID
5. Create new routing entry with the node Idolater ID and time stamp of the received HP
6. Refresh HP: node ID is replaced with this node, layer ID pluses one
7. Put the HP into send queue
8. Else go to step 10
9. Else
10. If the node ID are recorded in routing table
11. Discard the HP
12. Else if the node ID is recorded in neighbour node list
13. Else if
14. Else discard the HP
15. End If
```

3.6. ALGORITHM FOR FORWARDING THE DATA PACKET DEPENDING ON ROUTING TABLE

```
DATA PACKET IS READY TO SEND (either own generated or received)
1. If packet sign=data sign
2. If there are recorded entry in routing table
3. Choose a next-hop node with the newest AUV time stamp
4. If layer ID of the next-hop node in routing table =1// the node is first-hop node
5. Send a DRP //detect AUV’s
6. Wait a time
7. If node receive DRPS from AUV’s
8. Choose the first replying AUV as destination
9. Else if node receives DRPs from GN
10. Choose the first replying GN as destination.
11. Else if node didn’t receive DRPR
12. Store data in itself
13. Endif
14. Else\\the node is not first hop node
15. Send data to chosen next-hop node directly
16. Endif
17. Else
18. If the last time of this situation without routing table<=AU
19. Wait until receive a layer or over AUV data collecting c
20. Else
21. Else
22. Ask for layered neighbors
23. If there are layered neighbors
24. Send data to neighbour with the smallest layer ID
25. Else go to step 19
26. Endif
27. Endif
28. Endif
```

RESULT AND ANALYSIS



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CABLED SENSORS,UNCABLED SENSORS AND MOORED SENSORS ARE IN AQUASTIC COMMUNICATION SENSORS
SENSING OF NODES TO SENSE THE ACTIVE NODES
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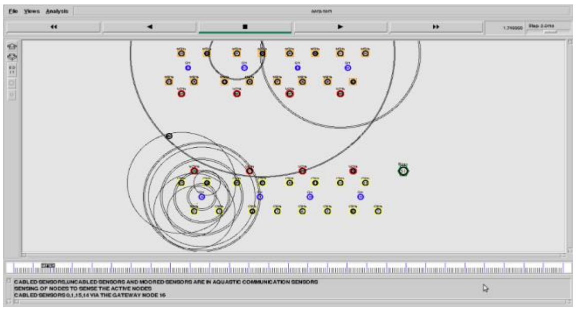
Fig 3: Sensing of Active Nodes



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CABLED SENSORS,UNCABLED SENSORS AND MOORED SENSORS ARE IN AQUASTIC COMMUNICATION SENSORS
SENSING OF NODES TO SENSE THE ACTIVE NODES
CABLED SENSORS 0,1,15,14 VIA THE GATEWAY NODE 16
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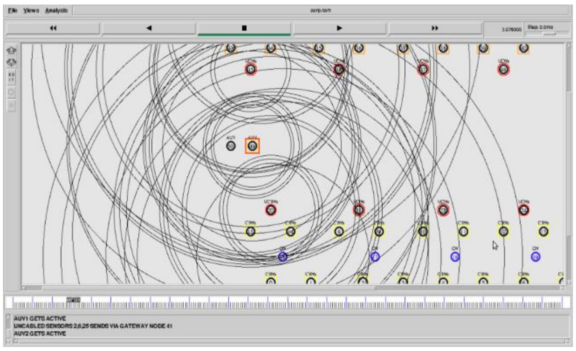
Fig 4: Sending Packets via Gateway Nodes



```
AUV1 GETS ACTIVE
UNCABLED SENSORS 2,6,25 SENDS VIA GATEWAY NODE 41
AUV2 GETS ACTIVE
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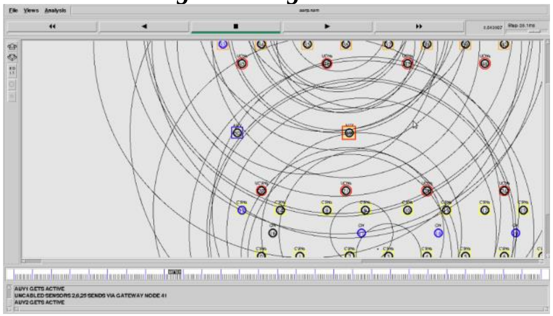
Fig 5: AUV gets active



```
AUV1 GETS ACTIVE
UNCABLED SENSORS 2,6,25 SENDS VIA GATEWAY NODE 41
AUV2 GETS ACTIVE
```

Fig6: AUV2 gets active

CONCLUSION

In AA-RP, a part of sensor nodes avoid the Request/Reply mechanism and forward data directly, which can reduce the energy consumption of the network. With the dynamic AUVs' path, the GNs are changing dynamically, which can balance energy consumption of the network. In turn, the variation of dynamic GNs influences AUV's forward path. The simulation result shows that both End-to-End Delay and energy consumption of the proposed method can get higher performance, compared with some existing routine protocols, such as H2-DAB and the DBR. Also, the PDR of AA-RP is in an acceptable range. The method is able to prolong the lifetime of network and to handle the hot spot and zone problem. It is suitable for the data collection in deep-sea engineering application, where data gather in a narrow depth range. A successful routing protocol is not only able to react to topology changes and choose the highest throughput routes in scalable simulation experiments, but also it should show good performance in practical application. We will adjust our method depending on our sea trial in the future work.

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