CSE1004 – NETWORK AND COMMUNICATION

UNDERWATER WIRELESS SENSOR NETWORKS

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SLOT: **D2**

Introduction

The 75% of earth's surface is covered with water in the form of rivers, canals, seas, and oceans. Plenty of precious resources lie underwater which are required to be explored. The key to successful explorations has always been technology dependent. Recent advances in technologies have led the possibilities to do the underwater explorations using sensors at all levels which were not possible previously.

Underwater sensor network (UWSN) is emerging as an enabling technology for underwater explorations. UWSN is a fusion of wireless technology with extremely small micromechanical sensor technology having smart sensing, intelligent computing, and communication capabilities.

What is an UNDER WATER SENSOR NETWORK (UWSN)?

UWSN is a network of autonomous sensor nodes which are spatially distributed underwater to sense the water-related properties such as quality, temperature, and pressure. The sensed data can be utilized by variety of applications that can be used for the benefit of humans. The sensor nodes, stationary or mobile, are connected wirelessly via communication modules to transfer various events of interest.

We simulate this network by a network simulator named **AQUA SIM.**

Aqua-Sim is a underwater network simulator which supports a vast amount of protocols and features. Originally developed on the basis of NS-2, Aqua-Sim can effectively simulate acoustic signal attenuation and packet collisions in underwater sensor networks (UWSN).

Architecture and implementation

Aqua-Sim follows the object-oriented design style of NS- 2, and all Compost Bin network entities are implemented as classes in C++. Currently, Aqua-Sim is organized into four folders, uw-common, uw-mac, uw-routing and uw-tcl. The codes simulating underwater sensor nodes and traffic are grouped in folder uw-common; the codes simulating acoustic channels and MAC protocols are organized in the folder of uw-mac. The folder uw-routing contains all routing protocols. The folder uw-tcl includes all Otcl script examples to validate Aqua-Sim. It is implemented using Aqua Sim as the main simulator but the coding is developed in Network Simulator 2(NS2). The Aqua Sim runs on the TCL script.

Aqua sim follows some basic protocols for different layers.

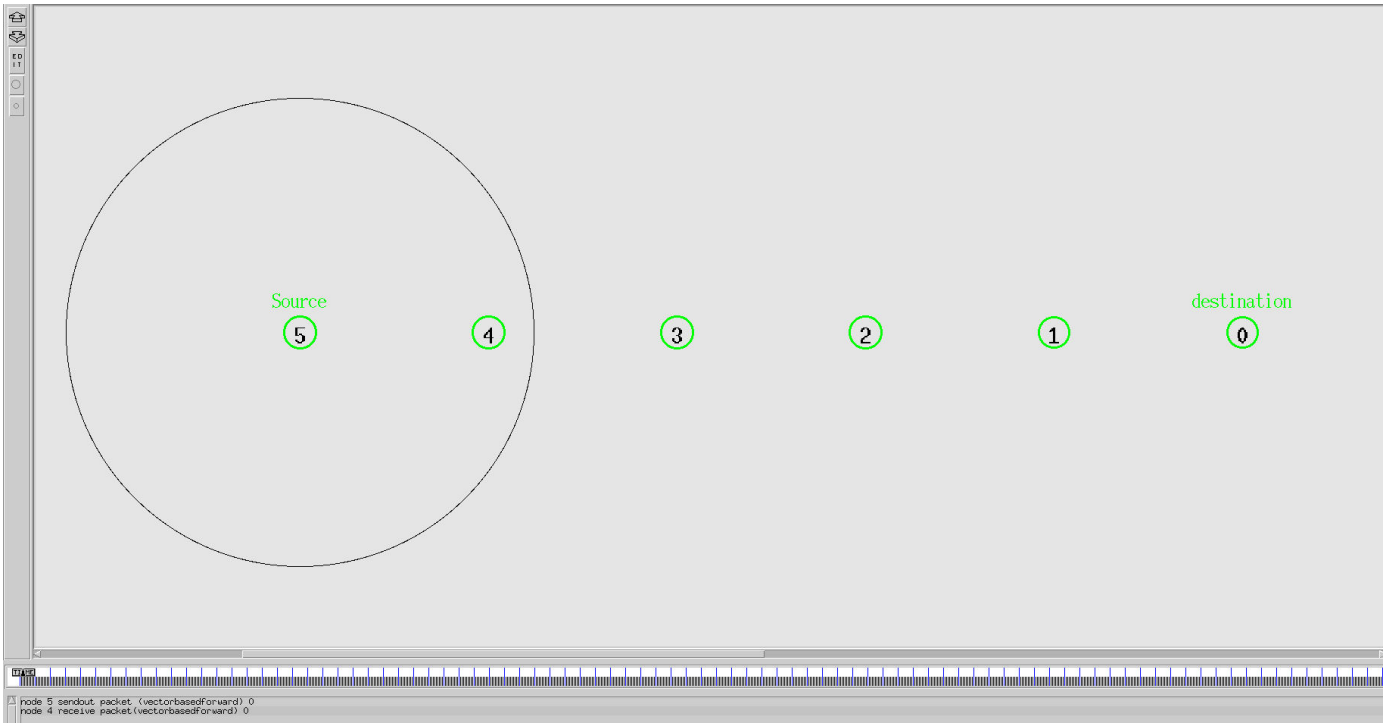
Current protcol support includes:

(MAC layer:) BroadcastMAC, Underwater ALOHA, CopeMAC, Underwater FAMA

(Routing Layer:) DBR, Static, Dynamic, Flooding, VBF, and VBVA.

Features

- In parallel with CMU wireless extension
- Object Oriented Design: extensible and flexible
- Open Architecture: easily import new protocols
- Three Basic Classes: Entities, Interfaces, Functions
- Simulates acoustic signal attenuation and packet collisions in underwater sensor networks.
- Supports 3D deployment.
- Can be easily integrated with existing codes of ns-2.
- Independent of CMU wireless simulation package of ns-2.
- Changes in either of them do not affect the other packages.



Screen shots from the implementation

Figure1

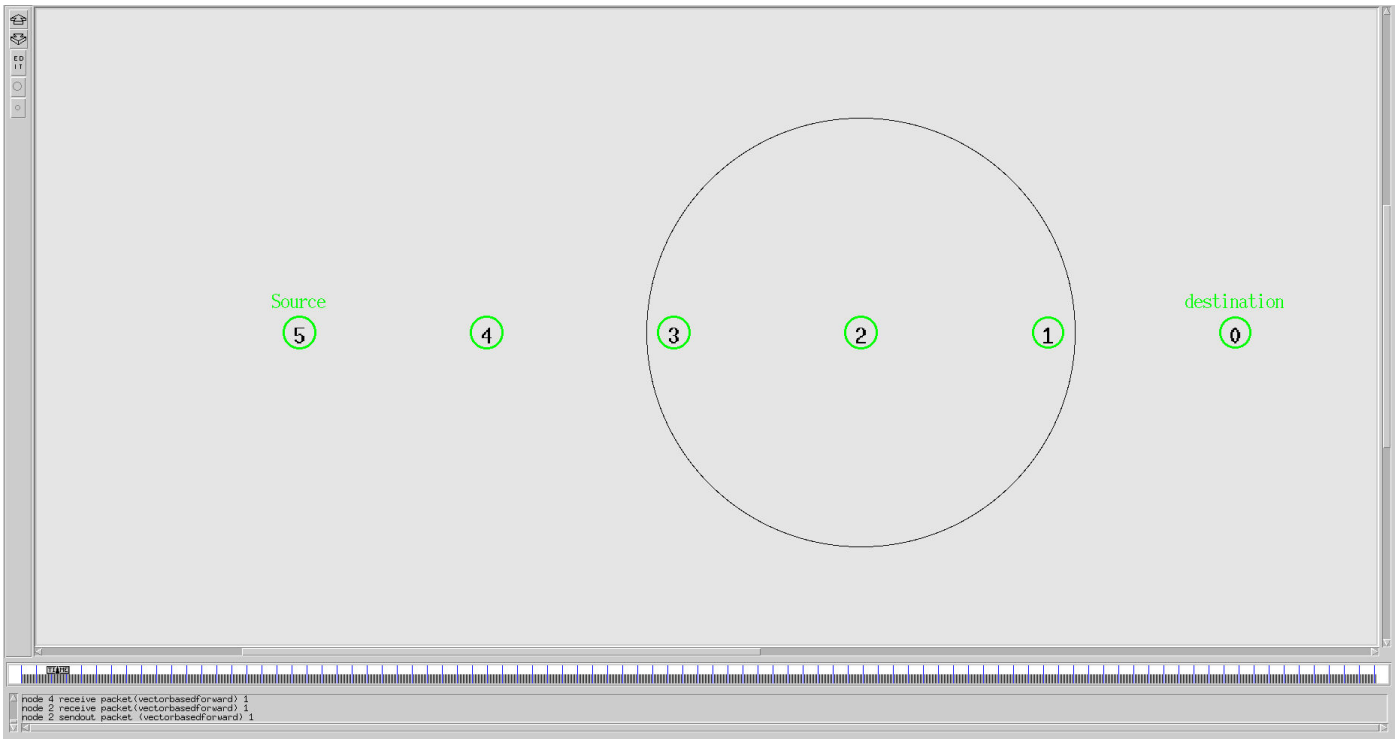

Source
destination
5
4
3
2
1
0
node 4 receive packet(vectorbasedforward) 1
node 2 receive packet(vectorbasedforward) 1
node 2 sendout packet (vectorbasedforward) 1

Figure 2

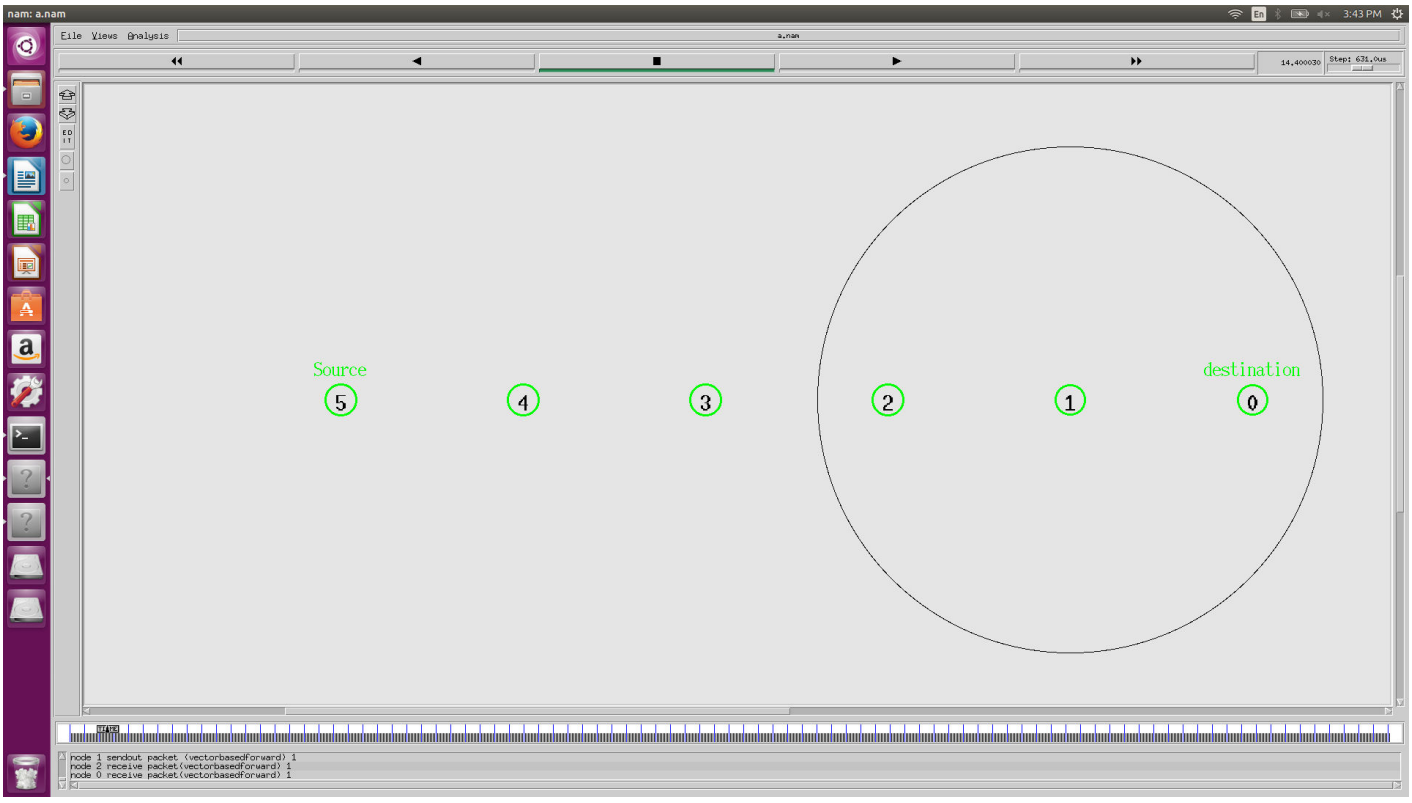

nam: a.nam
File Views Analysis
Source
destination
5
4
3
2
1
0
node 1 sendout packet (vectorbasedforward) 1
node 2 receive packet(vectorbasedforward) 1
node 0 receive packet(vectorbasedforward) 1

Figure 3.

Explanation

As you can observe in the above , the source being node 5 is broadcasting the signal which is captured by the next node(here, node 4), and so on to node 2 which broadcasts to node 1 which then broadcasts to node 0 which is the destination node. The destination node receives the data or information sent by the source node.

Proposed application

This concept can be implemented when suppose if there is a war going on and all the communication modes are down due so some problem. So now the base will not be able to know if any enemy is coming at them or not. So the base can send a small aircraft carrier with couple of wireless sensor nodes and as the aircraft passes by the sea, it can deploy the sensors in the ocean dropping the source node at the border line and the destination node at the base. So if any enemy is on its way towards the base to attack, the source can broadcast the signal to the base and they can be prepared and take necessary action.

This can be further improved by putting the sensors in all directions around the base so that they would know where the enemies are coming from.

Other applicaitions.

UWSN applications are rapidly gaining popularity for enabling advances in the area of ocean monitoring and observatory systems, deep sea surveillance, tracking of various entities of the aquatic environment, and unearthing resources. UWSNs find their application in fields like offshore oil and gas extraction, oil spills, military surveillance and reconnaissance, mine detection, pollution monitoring, natural calamities like tsunami and hurricane forecast, coral reef and habitat monitoring of marine life, and fish farming. UWSN offers a promising solution to ever demanding applications.

Marine life monitoring

It can be used to find how may fishes live in a specific region. It can be used to check if any harmful substance is there in the water causing pollution.

Water Quality

Water is precious resource and is premier factor for survival of living things under or above the water surface. Therefore, it is important to monitor the quality of water. The underwater quality monitoring applications vary from monitoring water quality of canals to oceans

Underwater Exploration

There are large number of minerals present underwater which is required to be explored such as oil and gas.

A comprehensive classification of potential UWSN applications is shown in Figure4:

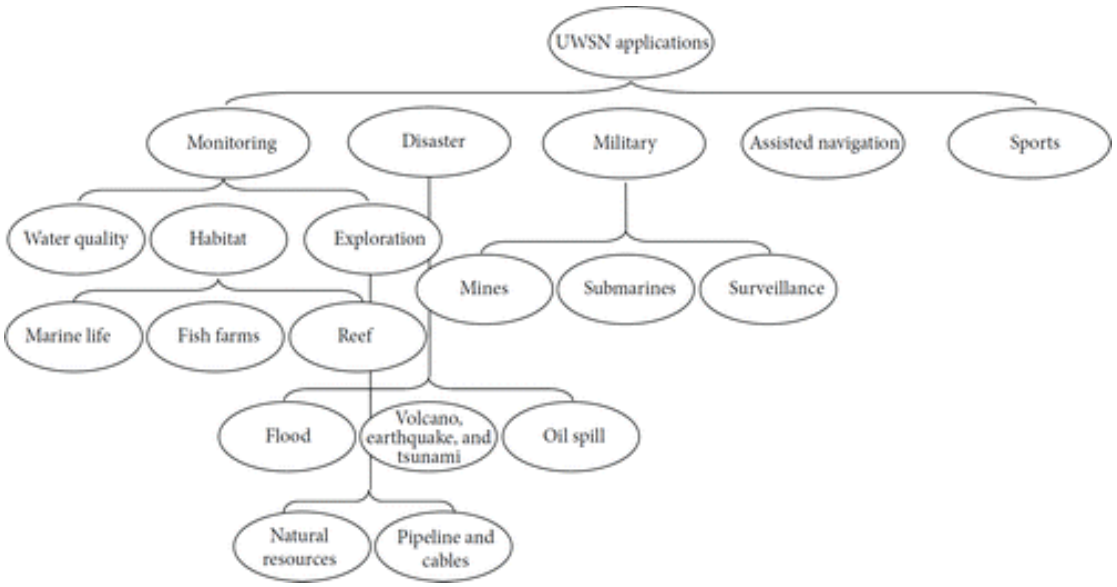


Figure 4. classifications of Underwater Wireless Sensor Networks

Advantages of Aqua-Sim

- Discrete-event driven network simulator
- Support 3D networks and mobile networks
- Simulate underwater acoustic channels with high fidelity
- Implement a complete protocol stack from physical layer to application layer

Future work

Aqua sim is in constant work to improve its performance and capabilities. It can be further supported in NS3 architecture.

Enhanced Channel Models

Supporting additional propagation models such as Bellhop ray tracing model for acoustic communications. The goal here is to depict better accuracy to real world scenarios in our simulation results.

Conclusion

Aqua-Sim can effectively simulate acoustic signal attenuation and packet collisions in underwater sensor networks. Moreover, Aqua-Sim supports three-dimensional deployment. Further, Aqua-Sim can easily be integrated with the existing codes in NS-2. Aqua-Sim is in parallel with the CMU wireless simulation package.

This underwater wireless sensor networks proves to be really effective and reliable in many cases and it can be incorporated in various applications in broadscale.