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Vulnerability Level Based Collision Avoidance in Underwater Sensor Networks

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Abstract

One of the main problems in underwater communication is the low data rate available due to the use of low frequencies. Moreover, there are many problems inherent to the medium such as reflections, refraction, energy dispersion, ect. That greatly degrades communication between devices. In some cases, wireless sensors must be placed quite close to each other in order to take more accurate measurements from the water while having high communication bandwidth. In these cases, while most researchers focus their efforts on increasing the data rate for low frequencies. We show our wireless sensor node deployment and its performance obtained from a real scenario and measures taken for different frequencies, modulations and data transfer rate. The performed test show maximum distance between sensors, the number of lost packets and the average round trip time. We compare our communication system proposal with the existing systems. Although our proposal provides short communication distances, it provides high data transfer rates. It can be used for precision monitoring in application such as contaminated ecosystems or for device communication at high depth.

Keywords: Transmission nodes,Acoustic sensor, Find the shortest path, source and Destination allocation.

INTRODUCTION

An Underwater Sensor Network (UWSN) is an emerging network paradigm which consists of a number of underwater sensor nodes and is deployed to perform collaborative monitoring and resource exploration tasks over a given area [2]. The applications of UWSNs have huge potential for monitoring the health of river and marine environments. Although there are a large number of developed network protocols for wireless sensor networks, the unique characteristics of UWSNs – such as limited bandwidth capacity, large propagation delay and node mobility, as well as high error probability – lead to considerable challenges in their design. This special issue aims to bring together a variety of advanced technologies, theory and applications in the area of UWSNs[4]. We solicit high-quality theoretical as well as practical studies on a broad range of issues important to communications, networks and applications[5].

Ocean bottom sensor nodes can be used for oceanographic data collection, pollution monitoring, offshore exploration and tactical surveillance applications[7]. Moreover, sensors will find application in exploration of natural elements under sea resources and gathering of scientific data in collaborative monitoring missions. Underwater acoustic networking is the enabling technology for these applications[9]. Underwater Networks consist of a variable number of sensors and vehicles that are deployed to perform collaborative monitoring tasks over a given area. In this paper, several fundamental key aspects of underwater acoustic communications are investigated. Different architectures for two-dimensional and three-dimensional underwater sensor networks are discussed, and the underwater channel is characterized[10].

UNDERWATER COMMUNICATION

In this section, we discuss a number of technology issues related to the design analysis, implementation and testing of underwater sensor networks. We begin at the physical layer with the challenges of acoustic communication, then proceed to communications and networking layers, followed by a discussion on applications, hardware platforms, test beds and simulation tools Outside water, the electromagnetic spectrum dominates communication, since radio or optical methods provide long-distance communication (meters to hundreds of kilometers) with high bandwidths (kHz to tens of MHz), even at low power. In contrast, water absorbs and disperses almost all electro- magnetic frequencies, making acoustic waves a preferred choice for underwater Communication beyond tens of meters.

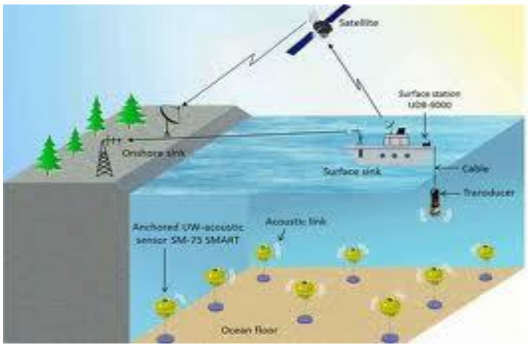


Figure 1. oceanographic system

WIRELESS SENSOR NETWORKS

Using wireless sensor networks for seismic imaging is not a new idea in the sensor network community. But all existing work is based on radio communications among sensors. Our goal is to extend sensor networking technology to underwater applications with acoustic communications. So far, virtually all platforms developed for wireless sensor networks use radio communications. One of most widely vehicles, these approaches can be very inexpensive and in many ways ideal, assuming very high latencies can be tolerated. We see our approach at moderate-distance communication as providing an important complement to data mules. Furthermore, particularly in the case of underwater operation, data mules may benefit from acoustic communication.

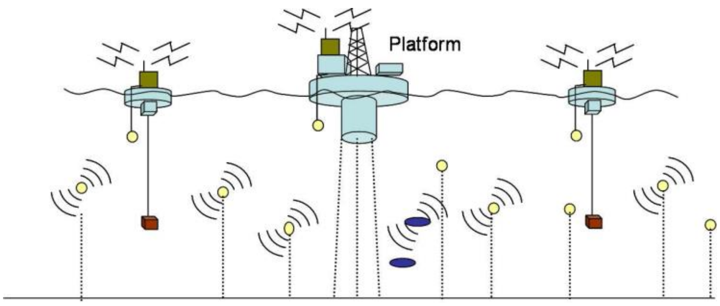


Figure 2. One possible approach to node deployment.

At the top layer are one or more control nodes with connections to the Internet, and possibly human operators. These control nodes may be positioned on an off-shore platform with power, or they may be on-shore; we expect these nodes to have a large storage capacity to buffer data, and access to ample electrical power. Control nodes will communicate with sensor nodes directly, via a relay node: a sensor node with underwater acoustic modems that is connected to the control node with a wired network.

DATA RATE

This is a trade off in the system design, based on available power, and channel bandwidth. Because acoustic communications are possible only over fairly limited bandwidths, we expect a fairly low data rate by comparison to most radios. We see a rate of currently 5kb/s and perhaps up to 20kb/s. Fortunately these rates are within an order of magnitude of RF-based sensor networks. In application such as robotic control, the ability to communicate at all (even at a low rate) is much more important than the ability to send very large amounts of data quickly. In addition, we describe how application-level techniques can be used to maximize the benefits of even limited communications rates. Support for the wired world includes Routing DV, LS, and PIM-SM.and Transport protocols: TCP and UDP for unicast and SRM for multicast. Traffic sources: web, ftp, telnet, cbr (constant bit rate), stochastic, real audio. Different types of Queues: drop-tail, RED, FQ, SFQ, and DRR. Qualities of Service are Integrated Services and Differentiated Services.

MEDIUM ACCESS CONTROL

There has been intensive recent research on MAC protocols for ad hoc and wireless terrestrial sensor networks However, due to the different nature of the underwater environment and applications, there are several drawbacks with respect to the suitability of the existing terrestrial MAC solutions in the underwater environment. In fact, channel access control in UW-ASNs poses additional challenges due to the peculiarities of the underwater channel, in particular limited bandwidth, very high and variable delay, channel asymmetry, and heavy multipath and fading phenomena. Existing MAC solutions are mainly focused on CSMA or CDMA because Frequency Division Multiple Access (FDMA) is not suitable for UW-ASN due to the narrow bandwidth in UW-A channels and the vulnerability of limited band systems to fading and multipath. Moreover, Time Division Multiple Access (TDMA) shows limited bandwidth efficiency because of the long time guards required in the UW-A channel. Furthermore, the variable delay makes it very challenging to realize a precise synchronization, with a common timing reference.

STRUCTURE OF NS2

NS2 is built using object oriented methods in C++ and OTcl (object oriented variant of Tcl.

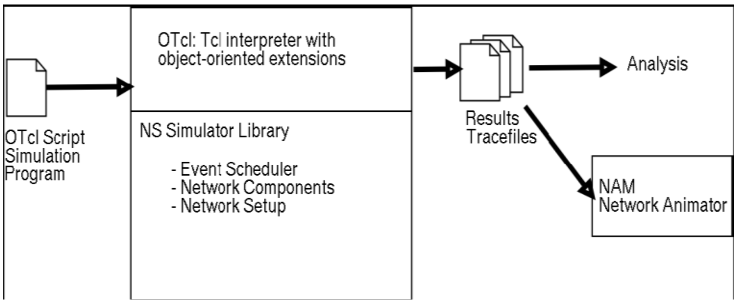


Figure 3. Simplified User's View of Ns

Can see in NS2 interpret the simulation scripts written in OTcl. A user has to set the different components (e.g. event scheduler objects, network components libraries and setup module libraries) up in the simulation environment. The user writes his simulation as a OTcl script, plumbs the network components together to the complete simulation. If he needs new network components, he is free to implement them and to set them up in his simulation as well. The event scheduler as the other major component besides network components triggers the events of the simulation (e.g. sends packets, starts and stops tracing). Some parts of NS2 are written in C++ for efficiency reasons. The data path (written in C++) is separated from the control path (written in OTcl). Data path object are compiled and then made available to the OTcl interpreter through an OTcl linkage (tclcl) which maps methods and member variables of the C++ object to methods and variables of the linked OTcl object. The C++ objects are controlled by OTcl objects. It is possible to add methods and member variables to a C++ linked OTcl object.

This fig.5 represented as schematic entry of six transistors based Static RAM design using S-Edit of TANNER version 13.0 simulator.

NETWORK COMPONENTS

Compound network components shown below a partial OTcl class hierarchy of NS, which will help understanding the basic network components.

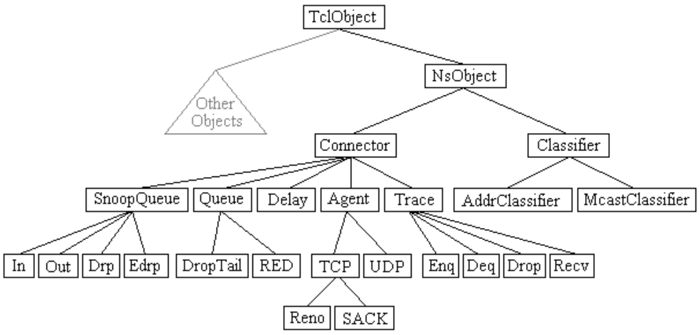


figure 4. Class Hierarchy (Partial)

SENSOR NETWORK INITIALIZED

A group of sensor nodes are anchored to the bottom of the ocean. Underwater sensor nodes are interconnected to one or more underwater gateways (uw-gateways) by means of wireless acoustic links. Uw-gateways are network devices in charge of relaying data from the ocean bottom network to a surface station. To achieve this objective, they are equipped with two acoustic transceivers, namely a vertical and a horizontal transceiver. The horizontal transceiver is used by the uw-gateway to communicate with the sensor nodes in order to: i) send commands and configuration data to the sensors (uw-gateway to sensors); ii) collect monitored data (sensors to uw-gateway). The vertical link is used by the uw-gateways to relay data to a surface station. In deep water applications, vertical transceivers must be long range transceivers.PCAP offers higher throughput than the protocols that are widely used by conventional wireless communication networks. Underwater acoustic sensor networks can be employed by a vast range of applications, retrieving accurate and up to- date information from underneath the water surface. Although widely used by radios in terrestrial sensor networks, radio frequencies do not propagate well underwater.

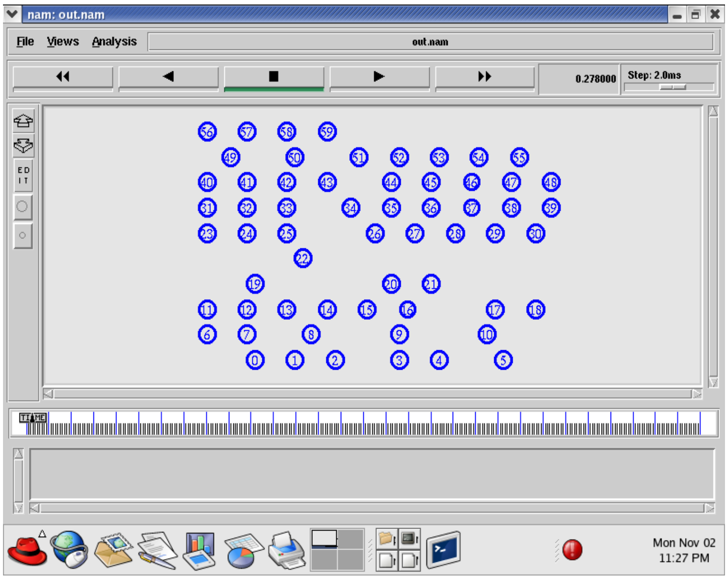


Figure 5. Sensor Network initialized diagram

SENSOR COVERAGE

Since each sensor covers a limited area, adequate coverage of a large area requires appropriate placement of sensors based on collective coverage and cost constraints. The previous research on sensor coverage mainly focuses on studying how to determine the minimum set of sensors for covering every location or certain objects (interest points) in the target field. Different coverage models and methods are surveyed

PROPOSED SYSTEM

The channel capacity, and flow assignment (CCFA) in multi channel wireless mesh networks (WMNs). CCFA involves the joint assignment of channels, distribution of wireless capacity, and determination of link flows to enhance the effectiveness of WMNs. The capacity assignment (CA) problem in WMNs(WMN-CA) which involves the distribution of wireless capacity, given the topology and the flows (i.e., traffic demand and routing).Unlike wired networks, the capacities of different wireless link in a WMN have to be carved out of the capacities of wireless nodes, Since the wireless medium is shared by various wireless nodes, interference between different wireless link constraints the distribution of the wireless capacity available at individual nodes. We formulate WMN-CA as a convex non-linear optimization problem (NLP). that are used to construct the network stack for a mobile node.

The components that are covered briefly are Channel, Network interface, Radio propagation model, MAC protocols, Interface Queue, Link layer and Address resolution protocol model (ARP).

SELECT THE ATTACKER

The attacker is normally unwanted signal from the other sources. The data is transmitted from source to destination through several nodes. Any of the nodes between source and destination can be selected as attacker. Acoustic nodes are used to form source and destination and also a attacker. CSMA method is used to indicate the presents of attacker to the user.

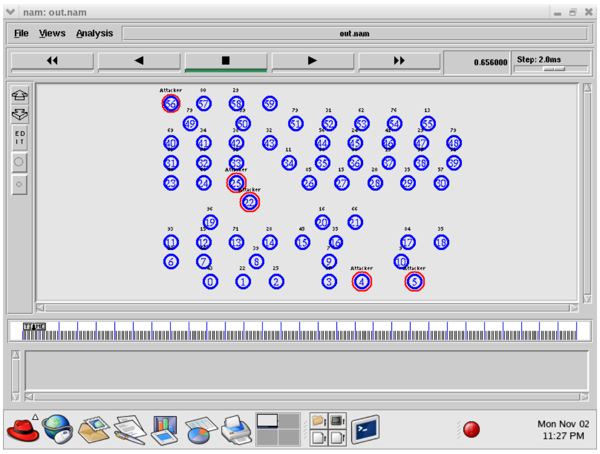


Figure 6. Select the attacker diagram

SOURCE AND DESTINATION

Underwater networks are used to detect and observe phenomena that cannot be adequately observed by means of ocean bottom sensor nodes, i.e., to perform cooperative sampling of the ocean environment. In three-dimensional underwater networks, sensor nodes float at different depths to observe a phenomenon. One possible solution is to attach each uw-sensor node to a surface buoy, by means of wires whose length can be regulated to adjust the depth of each sensor node. However, the floating buoys may obstruct ships navigating on the surface, or they can be easily detected and deactivated by enemies in military settings. Furthermore, floating buoys are vulnerable to weather, tampering, and pilfering. An alternative approach is to anchor sensor devices to the bottom of the ocean. Network Simulator (NS2) is a discrete event driven simulator developed at UC Berkeley. It is part of the VINT project. The goal of NS2 is to support networking research and education. It is suitable for designing new protocols, comparing different protocols and traffic evaluations. NS2 is developed as a collaborative environment. It is distributed freely and open source. A large amount of institutes and people in development and research use, maintain and develop NS2. This increases the confidence in it. Versions are available for FreeBSD, Linux, Solaris, Windows and Mac OS X.

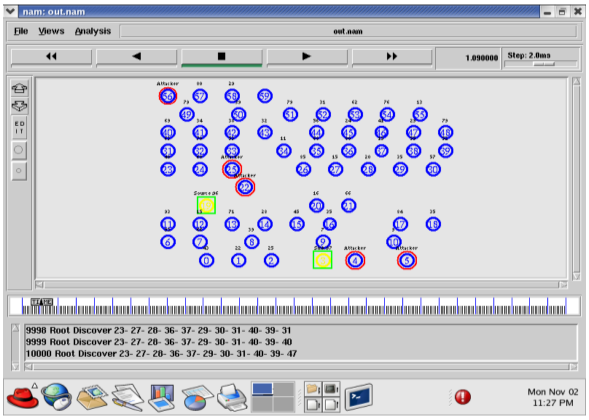


Figure 7. source and destination allocation

DATA TRANSIMISSION

After the initialization phase is complete, each node knows when it needs to wake up again to receive data from its neighbors. After this initialization, nodes follow their established schedules and begin sending data. Fig. 4 shows the structure of the data transmission packet and the listen period to listen to any potential newcomers during the data transmission phase. The transmit duration has been shaded and is followed by a listen duration. The transmit duration has three distinct parts: “missing,”“SYNC,” and “data Tx.” The “data Tx” corresponds to the part where actual data is being sent. We now explain the first two control functions.

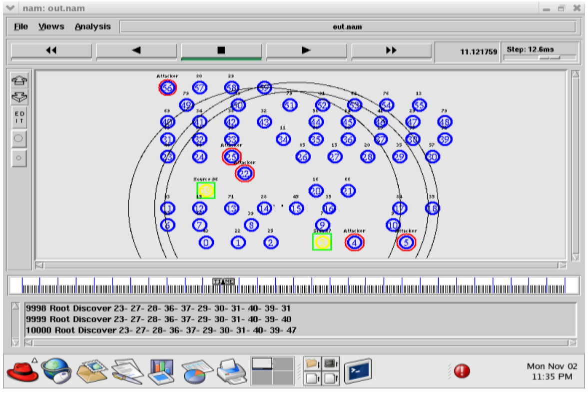
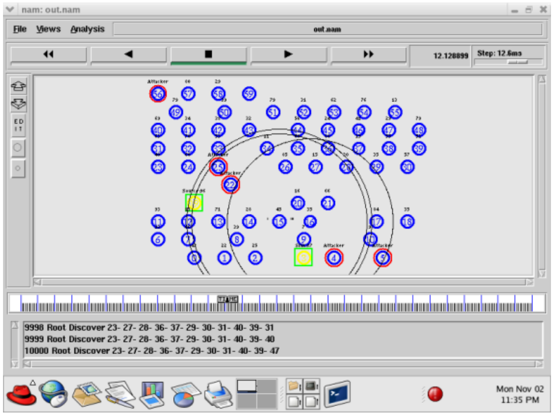


Figure 8. Data transmission

EXISTING SYSTEM

Acoustic channels are therefore employed as an alternative to support long-distance and low-power communication underwater, even though such channels suffer from long propagation delay and very limited bandwidth. In this paper, we investigate the impact of the large propagation delay on the throughput of selected classical MAC protocols and their variants.

RESULT AND DISCUSSION



CONCLUSION

We proposed an efficient multichannel Routing protocol for UWSNs in this paper required only one modem for each node utilizing cyclic quorum systems, nodes running MM-MAC are guaranteed to meet their intended receivers, which solves the missing receiver problem. The separations of control and data transmission also help reduce the collision probability of data packets. Simulation result verified that MM-MAC has better performance in that it achieves higher throughput and keeps the retransmission overhead low. We believe that the proposed scheme is a promising multichannel MAC protocol for USWNs since it achieves a great improvement over existing MAC protocol such as slotted FAMA and slotted PCAM.

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