A Survey of Underwater communication

Gaurav Mishra[1], Jitendra kurmi[2]

[1]Scholar, [2]Assistant Professor, Department of Computer, Science & Engg, BBAU Lucknow

---

Abstract - *This paper presents the novel idea that how we can use a loss making factor of one technology into a useful output generator for the other technique. According to the researches the variation in the calibrated values of these problem from one water medium to another water medium is due to change in the chemical and physical properties of the water medium such as temperature, salinity and density. So one of the proposed solution is to use these problems for our benefit as to calculate the value of the chemical properties of the water medium. Idea is about to achieve higher range of the data sending and receiving under the water. Basically the idea is about the effect of the chemical and physical properties of the water on the communication under it. So there can we two ways that we can have either we can rectify those losses or use those losses for our profit generation. In this paper I work over the second concept and try to come up with some new outputs and analytical data.*

Key words: Channel models, Acoustic Communication, Wireless Sensor Network, Underwater Wireless Communication System and Drones.

1. INTRODUCTION -

The research of Underwater Acoustic Networks (UANs) is attracting attention due to their important underwater applications for military and commercial purposes. The signals that are used to carry digital data via underwater channel are the acoustic waves because they can spread over long distances and the radio signals as electromagnetic waves are not used because they spread over short distances. A wireless sensor network is presented for monitoring aquatic environments such as lakes, ponds, drinking water reservoirs, or rivers. The network can be equipped with different types of sensors, enabling measurement of physical, chemical, or biological parameters of interest. Network information is collected by an uplink node floating on the surface of the water, which is then transmitted via radio waves to a host node, located on shore, which uploads network data to a computer for display and evaluation. In last several years, underwater communication network (UWCN) has found an increasing use in a widespread range of applications, such as coastal surveillance systems, environmental research, autonomous underwater vehicle (AUV) operation, oil-rig maintenance, collection of data for water monitoring, linking submarines to land, to name a few. Acoustic communications is defined as communication methods from one point to another by using acoustic signals. Acoustic signal is the only physical feasible tool that works in underwater environment. Compared with it electromagnetic wave can only travel in water with short distance due to the high attenuation and absorption effect in underwater environment[1]. A distributed and scalable UWSN provides a promising solution for efficiently exploring and observing the ocean which operates under the following constraints:

1. Unmanned underwater exploration - Unmanned underwater vehicles (UUVs) have become an integral part in helping humans do underwater explorations more efficiently and safely since these vehicles can stay underwater much longer than any human can possibly do and they require little or almost no human interaction. These vehicles are subject to dynamic and unpredictable nature of the underwater environment resulting to complexities in their navigation [2].

2. Localized and precise knowledge acquisition - Localized exploration is more precise and useful than remote exploration because underwater environmental conditions are typically localized at each venue and variable in time. Using long range SONAR or other remote sensing technology may not acquire adequate knowledge about physical events happening in the volatile underwater environment.

3. Tetherless underwater networking - The Internet is expanding to outer space and underwater. Undersea explorer Dr. Robert Ballard has used Internet to host live, interactive presentations with students and aquarium visitors from the wreck of the Titanic, which he found in 1985. However, while the current tethered technology allows constrained communication between an underwater venue and the ground infrastructure, it incurs significant cost of deployment, maintenance, and device recovery to cope with volatile undersea conditions.

Large scale underwater monitoring –

Traditional underwater exploration relies on either a single high-cost underwater device or a small-scale underwater network. Neither existing technology is suitable to applications covering a large area. Enabling a scalable underwater sensor network technology is essential for exploring a huge underwater space. Data-gathering scheme for hierarchical underwater sensor networks, where multiple Autonomous Underwater Vehicles (AUVs) are deployed over large-scale coverage areas. The deployed AUVs constitute an intermittently connected multihop network through inter-AUV synchronization for forwarding data to the designated sink. In such a scenario, the performance of the multihop communication depends upon the synchronization among the vehicles. The mobility parameters of the vehicles vary continuously because of the constantly changing underwater currents. The variations in the AUV mobility parameters reduce the inter-AUV synchronization frequency contributing to delays in the multihop communication. The proposed scheme improves the AUV synchronization frequency by permitting neighboring AUVs to share their status information via a pre-selected node called an agent-node at the static layer of the network. We evaluate the proposed scheme in terms of the AUV synchronization frequency, vertical delay (node→AUV), horizontal delay (AUV→AUV), end-to-end delay, and the packet loss ratio. Simulation results show that the proposed scheme significantly reduces the aforementioned delays without the synchronization time-out process employed in conventional works[3].

2. Theoretical Foundation:

The concept of the drone is quite fascinating and interesting for the world. When we talk about the drone there are two categories – aerial or aquatic.

Aerial Drones

Drones have helped people to take to the air in new, profound way and they have revolutionized flight. Modern drones come with outstanding capabilities and the flight is the least of these. These amazing devices enable augmented reality game playing and allow us to capture amazing aerial images. Drones are able to reach inaccessible places which are too costly or dangerous to be accessed by humans, enabling them to do much more than thought possible .It's really fascinating to see how drones have developed over the years.

In the 20th Century, military research precipitated many widely used technological innovations. Surveillance satellites enabled the GPS-system, and defence researchers developed the information swapping protocols that are fundamental to the Internet. UAVs (unmanned aerial vehicles) fall into a similar category. Designed initially for reconnaissance purposes, their para-military and commercial development was often out of sight of the public. As the technology becomes more advanced and costs fall, civilian day-today uses of UAVs are developing rapidly.

Aquatic Drone:

Unmanned underwater vehicles (**UUV**), sometimes known as underwater drones, are any vehicles that are able to operate underwater without a human occupant. These vehicles may be divided into two categories, remotely operated underwater vehicles (ROVs), which are controlled by a remote human operator, and autonomous underwater vehicles(AUVs), which operate independently of direct human input. The latter category would constitute a kind of robot.

The first AUV was developed at the Applied Physics Laboratory at the University of Washington as early as 1957 by Stan Murphy, Bob Francois and later on, Terry Ewart. The "Special Purpose Underwater Research Vehicle", or SPURV, was used to study diffusion, acoustic transmission, and submarine wakes.

3. The UUVs of Today

In the years since the Navy's first serious foray into UUVs with the NMRS and LMRS, a number of underwater drones with varying capabilities have emerged. With the release of the Unmanned Undersea Vehicle Master Plan in 2004, the Navy established nine priorities for future UUV capabilitie, ranging from anti-submarine warfare to delivery supply and even strike missions. Among the most prolific unmanned undersea drones are the Remote Environmental Monitoring UnitS (REMUS) family of UUVs. The REMUS product line was developed by Woods Hole Oceanographic Institution and Hydroid, a Massachusetts-based UUV manufacturer that is now owned by Kongsberg Maritime. During Operation Iraqi Freedom in 2003, a REMUS 100 UUV was used to help clear sea mines from the waterways around the port of Umm Qasr, marking the first time a UUV was deployed in a combat environment.

4. Related Work –

Describes explores applications and challenges for underwater sensor networks. We highlight potential applications to off-shore oilfields for seismic monitoring, equipment monitoring, and underwater robotics. We identify research directions in short-range acoustic communications, MAC, time synchronization, and localization protocols for high-latency acoustic networks, long-duration network sleeping, and application-level data scheduling. We describe our preliminary design on short-range acoustic communication hardware, and summarize results of high-latency time synchronization.

PROTOCOLS FOR HIGH-LATENCY NETWORKS

1. Latency-Tolerant MAC Protocols:

MAC protocols suitable for sensor networks can be broadly classified into two categories: scheduled protocols, e.g., TDMA, and contention protocols, e.g., CSMA. TDMA has good energy efficiency, but requires strict time synchronization and is not flexible to changes in the number of nodes. Contention-based protocols have good scalability and adaptivity to changes in the number of nodes.

2. Time Synchronization –

Without GPS, distributed time synchronization provides fundamental support for many protocols and applications. Several algorithms have been developed for radio-based sensor net-works, such as RBS and TPSN achieving the accuracy of tens of microseconds.

3. Localization

Localization is the process for each sensor node to locate its positions in the network. Localization algorithms developed for terrestrial sensor networks are either based on the signal strength or the time-of-arrival (TOA) .Signal strength only gives proximity information but not accurate locations TOA-based algorithms provide fine-grained location information, which is required by our seismic imaging application.

TOA-based algorithms estimate distances between nodes by measuring the propagation time of a signal. The basic principle is the same as radar or sonar, but is carried out in a distributed way among peering nodes. TOA measurement requires precise time synchronization between a sender and a receiver.

5. CONCLUSION

This paper has summarized our ongoing research in underwater sensor networks, including potential applications and research challenges. We presented an overview of the state of the art in underwater acoustic sensor network. We discussed characteristics of the underwater channel and outlined future research directions for the development of efficient and reliable underwater acoustic sensor networks.

6. FUTURE SCOPE

Recent advances in UUV technology and affordability and geostrategic interests are among the factors driving interest in underwater drones at home and abroad. Other countries are pursuing UUV programs in the race to develop and field unmanned systems. In 2014, the

Yomiuri Shimbun reported that Japan and the U.S. were collaborating on a 33-foot-long UUV that would be used to autonomously patrol areas using sonar. A RAND report on Chinese drones released earlier this year found that Beijing is funding at least 15 different university research programs into unmanned undersea and surface vehicles with particular emphasis on UUV projects. A Russian news broadcast in November 2015 confirmed suspicions that Russia was building a long-range UUV capable of carrying a nuclear warhead. In October 2016, the U.K. and France announced that they had awarded a $164 million contract to a group of European defense firms to develop a UUV for mine countermeasures. Unmanned submersibles could provide a low-cost alternative to manned platforms for missions that are particularly dangerous, like minesweeping, or for mission that are tedious, like patrolling. UUVs, particularly those envisioned by DARPA, could also be a way to assert military presence in an area that is difficult to reach or geopolitically contentious. Like the minesweeper concepts, UUV platforms could be built into the capabilities of existing manned platforms like the Littoral Combat Ship or submarines. Alternatively, larger UUVs may be deployed from ports and conduct missions independent from manned ships.

7. ACKNOWLEDGEMENT

We would like to express our gratitude to all those who gave us the possibility to complete this paper.

8. REFERENCES

1. Jun-Hong Cui, Jiejun Kong, Mario Gerla, Shengli Zhou, “Challenges: Building Scalable And Distributed Underwater Wireless Sensor Networks (UWSNs) for Aquatic Application”, UCONN CSE Technical Report: UbiNet-TR05-02,2005.

2. John Heidemann, Wei Ye, Jack Wills, Affan Syed, Yuan Li, “Research Challenges and Applications for Underwater Sensor Networking”, Information Sciences Institute University of Southern California, 2006.

3. Ian F. Akyildiz, Dario Pompili and Tommaso Melodia, “State-of-the-Art in Protocol Research for Underwater Acoustic Sensor Networks “,Georgia Institute of Technology Atlantic ,GA,USA ,2006.

4. Dennis Denney ,”3D,4D and Beyond “,Journal of Petroleum Technology, Jan.1998.

5. J. G. Proakis, E. M. Sozer, J. A. Rice, and M. Stojanovic, “Shallow Water Acoustic Networks”, IEEE Communications Magazine, pages 114–119, November 2001.

6. E. M. Sozer, M. Stojanovic, and J. G. Proakis, “Undersea Acoustic Networks”, IEEE Journal of Oceanic Engineering, OE-25(1):72–83, January 2000.

7. G. G. Xie and J. Gibson, “A Networking Protocol for Underwater Acoustic Networks”, Technical Report TR-CS-00-02, Department of Computer Science, Naval Postgraduate School, December 2000.

8. C. Intanagonwiwat, R. Govindan, and D. Estrin, “Directed Diffusion: A Scalable and Robust Communication Paradigm for Sensor Networks”, ACM MOBICOM, pages 56– 67, 2000.

9. W. Ye and J. Heidemann “ Medium access control in wireless sensor networks”, USC/ISI Technical Report ISI-TR-580, OCTOBER 2003.

10. W. Ye, J. Heidemann, and D. Estrin, “Medium access control with coordinated adaptive sleeping for wireless sensor networks”, ACM/IEEE Transactions on Networking, VOL 12 NO.3, JUNE 2004.

11. B. Zhang, G. S. Sukhatme, and A. A. Requicha, “Adaptive sampling for marine microorganism monitoring”, In IEEE/RSJ International Conference on Intelligent Robots and Systems, Sendai, Japan, Sept. 2004.

12. J. Elson, L. Girod, and D. Estrin, “ Fine-grained network time synchro-nization using reference broadcast”, In Proceedings of the fifth USENIX Symposium on Operating system Design and Implementation (OSDI), Boston, MA, Dec. 2002.