# Analysis of Delay in Underwater Communication

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**Abstract***:* Subject to this paper is the comprehensive survey of underwater communication. Underwater communication is a technique of sending and receiving message below water. Beneath water transmission catch that application in aquatic. Injection monitoring, data assemblage, shipping, tactical inspection and mine exploration. In underwater communication there are low data rates compared to terrestrial communication, since underwater common uses acoustic waves instead of electromagnetic waves. The enabling technology for these applications is acoustic wireless networking .A major challenge for the deployment of UW-ASN is the development of a Multiple Access technique and modulation technique tailored for the underwater environment. Typical frequency 1 Hz to 1 MHz so there is a low data rates.

***Keywords:*** UW-A, OFDM (orthogonal frequency division multiplexing), CDMA.

## I INTRODUCTION

The underwater covers 70% water of our planet, through research of oceans to investigate reliability of underwater acoustic (UWA).This channel is more complex of the encountered for the transmission of data. For underwater acoustic application underwater acoustic is frequently used
These applications include wireless networked sensor telemetry in coast areas range, governing of mine fields and associate of surface vessels, submarines, Unmanned Underwater Vehicles (UUVs) and divers. Designing one such system, which can effectively withstand the adverse effects of the channel but still provide adequate data rate? For this purpose, an in depth study of the underwater communication channel was carried out and the findings are analyzed. Major constraint underwater medium is the extremely complex and continuously varying nature of the sea.

While wireless communication technology today has become part of our daily life, the idea of wireless undersea communications may still seem far-fetched. Although such systems remain indispensable if high-speed communication link is to exists between the remote end and the surface, it is natural to wonder what one could accomplish without the burden (and cost) of heavy cables. Hence the motivation and our interest in wireless underwater communications. Together with sensor technology and vehicular technology, wireless communications will enable new applications ranging from environmental monitoring to gathering of search for rescue mission, aquatic data, and excavation. The signals that are used to carry digital information through an underwater channel are not radio waves inseminate over small waves, Instead of acoustic waves are used, which can propagate over long distances of about– 1500 m/sec, speed of sound in air 340 m/sec.

## II ADVANCE TECHNOLOGY IN UNDERWATER COMMUNICATION

With advances in acoustic modem technology, sensor technology and vehicular technology, ocean engineering today is moving towards integration of these components into autonomous underwater networks. While current applications include supervisory control of individual AUVs, and telemetry of oceanographic data from bottom-mounted instruments, the vision of future is that of a "digital ocean" in which integrated networks of instruments, sensors, robots and vehicles will operate together in a variety of underwater environments. Examples of emerging applications include fleets of AUVs deployed on collaborative search missions, and ad hoc deployable sensor networks for environmental monitoring [1], Figure 1. Underwater sensor network are envisioned to enable applications for oceanographic data collection, pollution, monitoring, offshore exploration. Multipath unmanned or Autonomous underwater vehicles (UUVs, AUVs), equipped with underwater sensors, there is a need to enable underwater communication 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, movement information and to relay monitored data to an onshore station [2] .Underwater Acoustic sensor network consist of a variable number of sensors and vehicles that are deployed to perform collaborative monitoring tasks over a given volume of matter. To achieve this objective sensors and vehicles self organize in an autonomous network, which can adopt to the characteristics of ocean environment.

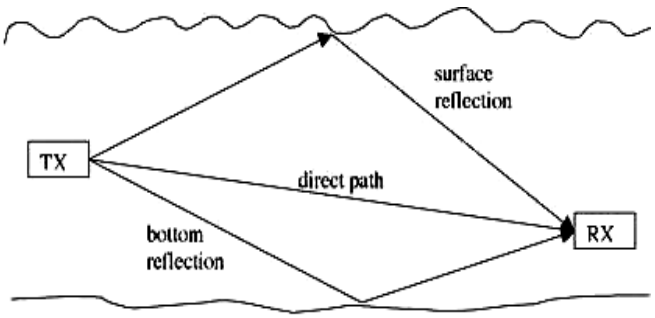


**Figure 1: Shallow water multipath propagation: in addition to the direct path, the signal propagates via reflections from the surface and bottom.**

## III BROAD RANGE OF ACOUSTIC NETWORK

- Underwater Acoustic Sensor Network can perform pollution monitoring (Water quality in-Situ analysis) [3].
- Underwater Sensor network can help detecting oilfields or reservoirs and assist in exploration for valuable minerals.
- Study the effect of submarine earthquake and tsunami warnings to coastal areas [2].
- Seismic monitoring great important in oil extraction from underwater field to asses field performance.
- Sensors can be used to identity dangerous rocks in shallow water.
- Underwater Sensor network can reach a higher accuracy and enable detection.

## IV FACTORS AFFECTING UNDERWATER ACOUSTIC COMMUNICATION

1. **High delay and delay fluctuation** –The generation speed of underwater channel is lower than radio channel is of five orders. This large generation truncated the system for adequate protocol design high generation delay is very adverse. The round trip time protocol is used for common communication protocol

2. **Doppler dispersion –**The importance of Doppler frequency is underwater-A channel causing of reduction in the performance of digital communication transmission at high data rates can occur many adjoining symbols at the receivers.

3. **Path Loss** – The path loss cause due to disturbing in attenuation by consumption caused by consuming audio energy into heat. Path loss is mainly occur due to heat and reverberation.
4. **Geometric dispersion**–There are two common kinds of geometric spreading Spherical (unidirectional point source) which characterize deep water communication and cylindrical (Horizontal radiation only) which characterize shallow water communication.

5. **Noise**- Man made, Ambient Noise.

   **Ambient Noise-** It is caused by the movement of wind, noise current storms and to seismic and biological phenomena. In [6] boat noise and snapping shrimps have been found to be the primary sources of noise in shallow water by means of measurement experiment on the ocean bottom.

6. **Multipath** – Reduction of audio signal produce multipath geometry depends on vertical channels because it produce short multipath. To overcome these effects different types of modulation and multiple access technique are used.

## V UNDERWTAER MODULATION TECHNIQUES

Use of a modulation technique depends on the application for which it is used and the environment it is operated.

**a)** **FSK modulation**-The relies energy does not require phase tracking, it is very difficult task because Doppler's dispersion in the underwater channel-A. By inserting a time guard between many pulses it suppressed the multipath effect.

**b)** **Non-coherent modulation-** Low bandwidth efficiency makes the power efficiency unsuitable, and high bandwidth efficiency makes the power efficiency suitable.

**c)** **Coherent modulation technique**-Fully coherent modulation technique such as PSK, QAM is used because of availability of powerful digital processing [7].

**d)** **DPSK** is an median solution between Incoherent and fully coherent system in terms of Bandwidth ability [8].

**OFDM** –OFDM transmit over many subcarriers due to it associate of a multi carrier modulation. In particular sub carrier which experience higher Signal to Noise ratio are allotted with a higher number of its whereas less bits are allotted to sub carrier. Experiencing attenuation which requires channel estimation. Since the symbol duration for each individual carrier increase [7].

## UNDERWATER MULTIPLE ACCESS

Additional challenges for limited Bandwidth and high variable delay.

**a)** **FDMA: -** Not suitable for underwater ASN due to narrow Bandwidth in underwater-A channel.

**b)** **TDMA: -** Shows a limited Bandwidth efficiency because of long time guard required in UWA channel. In fact, long time guard must be designed to account for the large propagation delay and delay variance of the underwater channel, to minimize packet collision from adjacent time slot. Variable delay to realize a precise synchronization, with a common timing reference, which is required for TDMA.

**c)** **CDMA: -** CDMA is quite strong to frequency selective fading caused by underwater means of PN noise codes that are used for spreading the user signal over the entire available band. Rake filters at the receiver used These filters are designed to match pulse spreading, pulse shape

and channel impulse response, compensate for the effect of multipath [5].

**CDMA** allows reducing the number of packets retransmission, which results in decreased battery consumption and increased network throughput.

Two code division spread – spectrum access technique are compared in shallow water 1) DSSS and 2) FHSS.

**FHSS** is more prone to the Doppler shift effect, Since the transmission takes place in narrow bands the scheme is more strong to multiple access interference (MAI) than DSSS**.**

**FHSS** is shown to lead to higher bit error rate than DSSS, it results in simple receiver and provides robustness to near far problem, thus potentially simplifying the power control functionality.

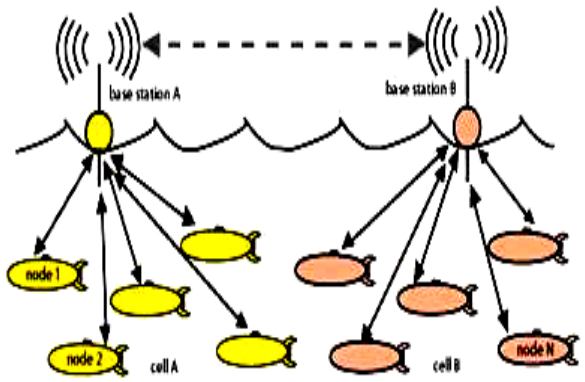


**Figure 2: Communication channel procedure.**

Another recent technique underwater combines multicarrier transmission with the DSSS. CDMA [4], as it may offer higher spectral efficiency. Increase the flexibility to support integrated high data rate application with different quality of service requirement. The main idea is to spread each data symbol in the frequency domain by transmitting all the chips of a spread symbol at the same time into a large number of narrow sub channel , this way to high data rate can be supported using the duration of each symbol reduce ISI.

| Distance | **Range (Km)** | **Bandwidth (KHz)** |
|---|---|---|
| Very Long | 1000 | <1 |
| Long | 10-100 | 2-5 |
| Medium | 1-10 | 10 |
| Short | 0.1-1 | 20-50 |
| Very Short | <0.1 | >100 |

**Table 1: Available Bandwidth for different ranges in UW Channel.**

**CDMA** is promising multiple access technique for underwater acoustic network, in shallow water where multipath and Doppler spreading plays a key role in communication performance.

**TDMA** is used with long band guards to overcome the effect of propagation delay in underwater. TDMA not highly inefficient since vehicles in the same cluster are close to one another effect of propagation delay is limited.

## CHALLENGES

- Battery power is sufficient and cannot be recharged because solar energy never is end.
- The available bandwidth is severely limited.
- Channel characteristics, including long and variable propagation delays, multipath and fading problems.
- High bit error rates.
- Underwater sensors are prone to failures because of fouling, corrosion etc.
- The ocean can be as deep as 10 km.
- A unique importance of underwater network is that the environment is constantly mobile, naturally causing the node passive mobility.

## CONCLUSION

In conclusion although the high delay spread that characterizes the horizontal link in underwater channel makes it difficult to maintain synchronization among the station, when especially OFDM used [6]. CDMA System is best for Underwater Communication.

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