Karachi Campus
Discovering Knowledge

UNDERWATER COMMUNICATION

Underwater Acoustic Communication using OFDMA

PRESENTED BY:
BU Students

DATE:
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Agenda

Overview

OFDM is a digital transmission technique that is used in various wireless applications. The technique is used in many wireless applications such as WIFI, WiMAX, and 4G LTE. This modulation technique has also been adopted by satellite systems like DVB-S2X and DVB-RCS2..

Objectives

- Under Water Communication.
- Low cost
- Reliable

Goals

- Reliable underwater communication.

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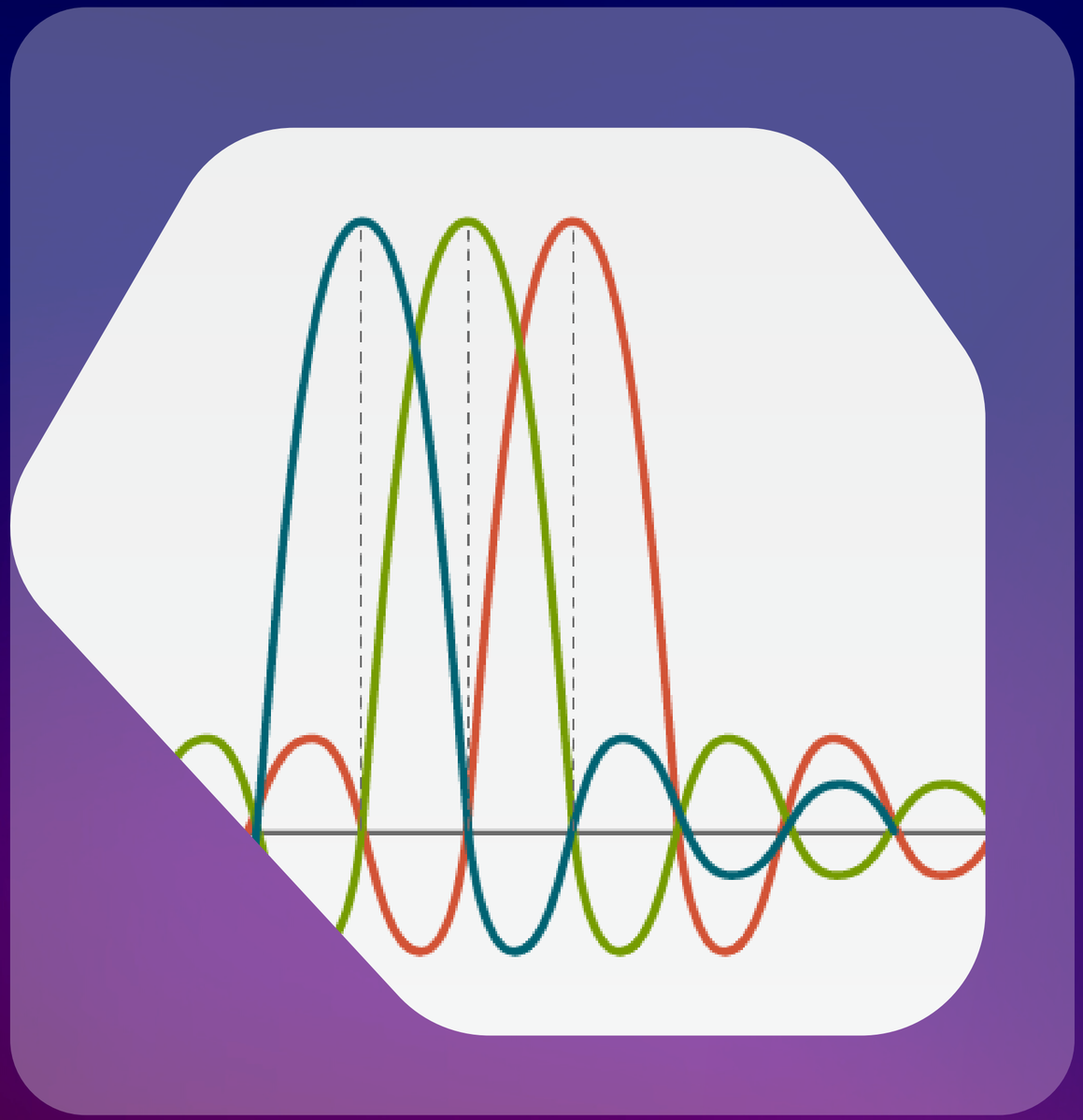
Objective

We are developing a communication protocol to install OFDM underwater to establish reliable and data communication. This will allow for immediate emergency response and evacuation in event of a natural disaster or nuclear attack. The protocol will also be used to orchestrate rescue missions and coordinate personnel.



Why OFDM?

- High Data rate.
- QAM + FDM.
- Multi-carrier.

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Channel (UWA)

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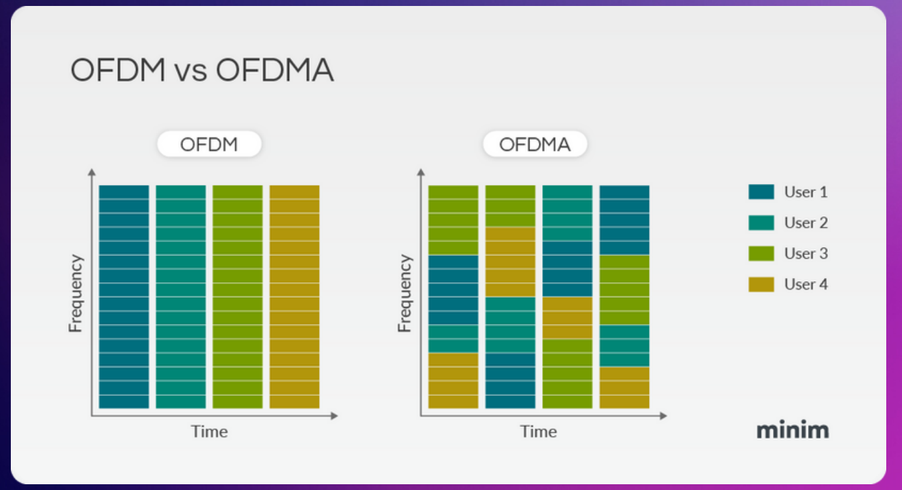
Acoustic Channel

In underwater wireless communication systems, acoustic waves are used as the primary carrier.

- *Low Absorption.*
- *Low Propagation Speed.*
- *Limited Frequency Band.*

OFDM to OFDMA

In OFDM all subcarriers of thr symbol are used to provide data to a specific user.
In OFDMA the sub-carriers of each symbol may be divided betweeen multiple users



Problems in UWA

Facing significant challenges posed by the underwater acoustic (UWA) channels.

- *Absorption*
- *Long multipath delay spreads*
- *Fast channel variations*
- *Very limited bandwidths*

These networks need carefully designed multiple access schemes

Doppler Shift

The major advantages of OFDMA systems include robustness to large multipath delay spreads, high spectral efficiencies, and the ability to exploit the multiuser and/or multipath diversity. However, intercarrier inference (ICI) and interuser inference (IUI), arise from motion-induced Doppler shift.

Doppler shift estimation method based on the autocorrelation function of the received signal

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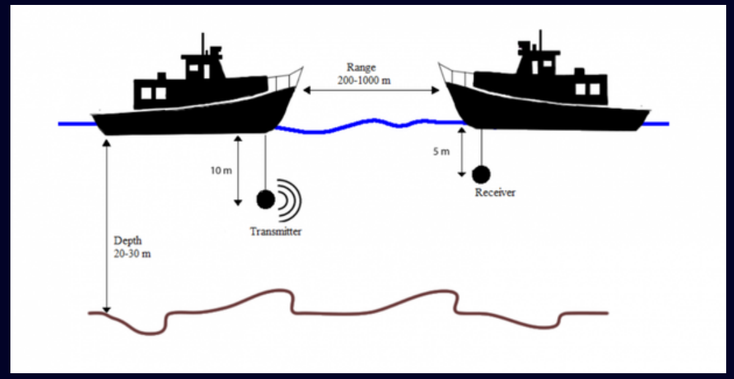
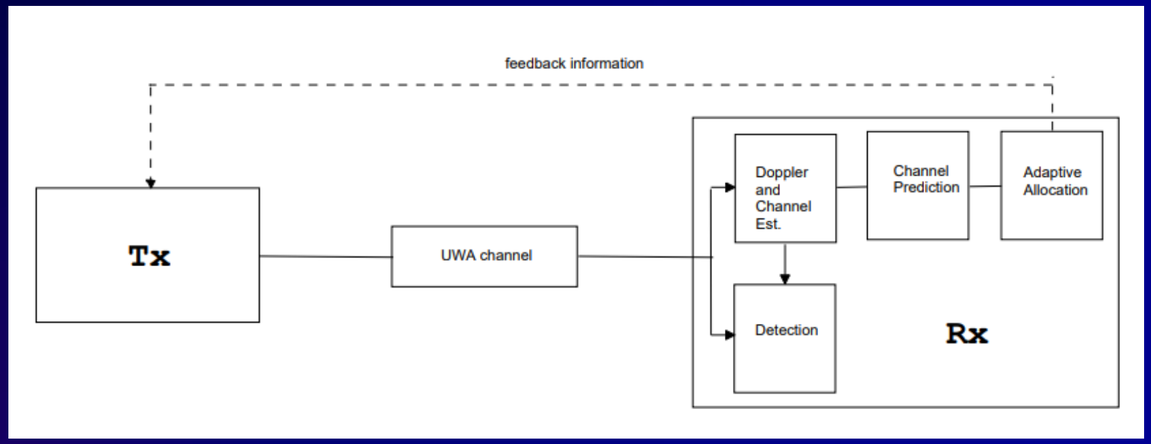
Doppler effect caused by the acceleration due to the relative motion between the transmitter and receiver. This acceleration affects the correlation behavior of the cyclic prefix and destroys the orthogonality of the sub-carriers due to the synchronization impairments.



System Design

We consider two cases. In the first case, the information about the modulation alphabet and the quantized power level for each subcarrier is computed at the receiver and fed back to the transmitter. In the second case, the quantized channel estimates are fed back, and the adaptive algorithm for bit-loading and power allocation is implemented at the transmitter



Approach

For the transmission of each OFDM block we adaptively compute the size of the modulation alphabet Mk,n and the transmission power Ck,n. The objective of our adaptive OFDM system is to maximize the throughput by maintaining a target average BER. In order to maintain the BER at a fixed value, we propose the following optimization modulation schemes

Modulation Schemes

Scheme 1

Adjusts only the modulation level and assumes a uniform power allocation

Scheme 2

Adjusts both the modulation level and the power allotted to each sub-carrier

Both schemes are based on a greedy algorithm.

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Feedback for Adaptive UWA

We assume that a limited-feedback channel is available for conveying information from the receiver back to the transmitter.

Two types of feedback information are considered

- *Modulation alphabet*
- *Quantized power levels for each sub-carrier/cluster*

We assume a feedback channel that imposes a limit on the maximum number of bits that can be conveyed to the transmitter.

Simulation

For the simulation, MatLab is used with the microcontroller Rasberry pi. In order to achieve OFDMA.

The being generated on MatLab runs on Rasberry pi.

https://www.mathworks.com/help/comm/ug/ofdm-synchronization.html

Considered Hardware

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The Given below hardware is required for the project.

- *Raspberry Pi*
- *Transceiver*
- Some other will be discussed later.

Thank You