

# Underwater Communication in 2.4 Ghz ISM Frequency Band for Submarines

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**ABSTRACT:** One of the main problems in under water communications 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, etc., that greatly degrade 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 propose the use of the 2.4 GHz ISM frequency band in these special cases. In this paper, 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 rates. The performed tests show the maximum distance between sensors, the number of lost packets and the average round trip time. Based on our measurements, we provide some experimental models of underwater communication in fresh water using EM waves in the 2.4 GHz ISM frequency band. Finally, 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 applications such as contaminated ecosystems or for device communicate at high depth.

## I. INTRODUCTION

The aim of this project is to develop under water wireless communication system using the ZigBee protocol stack. This is very useful to find out any problem in caves and mines. An embedded system is a special purpose system in which the compute is completely encapsulated by or dedicated to the device or system it controls Personal digital assistants (PDAs) or handheld computers are generally considered embedded devices because of the nature of their hardware design, even though they are more expandable in software terms.

### HALFDUPLEX:

A *half-duplex* (HDX) system provides communication in both directions, but only one direction at a time (not simultaneously). Typically, once a party begins receiving a signal, it must wait for the transmitter to stop transmitting, before replying.

An example of a half-duplex system is a two-party system such as a walkie-talkie, wherein one must use "over" or another previously designated keyword to indicate the end of transmission, and ensure that only one party transmits at a time, because both parties transmit and receive on the same frequency. A good analogy for a half-duplex system would be a one-lane road with traffic controllers at each end, such as a two-lane bridge under reconstruction. Traffic can flow in both directions, but only one direction at a time, regulated by the traffic controllers.

Half-duplex systems are usually used to conserve bandwidth, since only a single communication channel is needed, which is shared alternately between the two directions. For example, a walkie-talkie requires only a

single frequency for bidirectional communication, while a cell phone, which is a full-duplex device, requires two frequencies to carry the two simultaneous voice channels, one in each direction.

In automatically run communications systems, such as two-way data-links, the time allocations for communications in a half-duplex system can be firmly controlled by the hardware. Thus, there is no waste of the channel for switching. For example, station A on one end of the data link could be allowed to transmit for exactly one second, then station B on the other end could be allowed to transmit for exactly one second, and then the cycle repeats.

In half-duplex systems, if more than one party transmits at the same time, a collision occurs, resulting in lost messages.

#### **FULL DUPLEX:**

A simple illustration of a full-duplex communication system. Full-duplex is not common in handheld radios as shown here due to the cost and complexity of common duplexing methods, but is used in telephones, cellphones and cordless phones.

A *full-duplex* (FDX) system, or sometimes called *double-duplex*, allows communication in both directions, and, unlike half-duplex, allows this to happen simultaneously. Land-line telephone networks are full-duplex, since they allow both callers to speak and be heard at the same time, with the transition from four to two wires being achieved by a hybrid coil in a telephone hybrid. Modern cell phones are also full-duplex.<sup>[1]</sup>

Two-way radios can be designed as full-duplex systems, transmitting on one frequency and receiving on another; this is also called frequency-division duplex. Frequency-division duplex systems can extend their range by using sets of simple repeater stations because the communications transmitted on any single frequency always travel in the same direction.

Full-duplex Ethernet connections work by making simultaneous use of two physical twisted pairs inside the same jacket, which are directly connected to each networked device: one pair is for receiving packets, while the other pair is for sending packets. Some types of Ethernet, for example Gigabit Ethernet, use two twisted pairs per direction. This effectively makes the cable itself a collision-free environment and doubles the maximum total transmission capacity supported by each Ethernet connection.

Full-duplex has also several benefits over the use of half-duplex. First, there are no collisions so time is not wasted by having to retransmit frames. Second, full transmission capacity is available in both directions because the send and receive functions are separate. Third, since there is only one transmitter on each twisted pair, stations (nodes) do not need to wait for others to complete their transmissions.

#### **Echo cancellation**

Full-duplex audio systems like telephones can create echo, which needs to be removed. Echo occurs when the sound coming out of the speaker, originating from the far end, re-enters the microphone and is sent back to the far end. The sound then reappears at the original source end, but delayed.

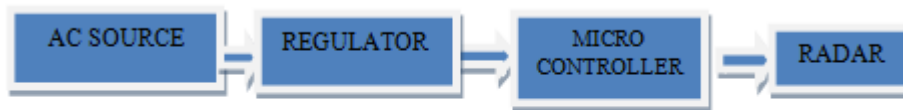
## **II. SYSTEM MODEL**

### **2.1 EXISTING SYSTEM :**

Radio waves do not propagate well in underwater due to high energy absorption of water. Therefore underwater communication are based on acoustic links characterized by large propagation delays, the propagation speed of acoustic signals in water (typically 1500m/s). Acoustic channels have low bandwidth as a result, the bit error rates of acoustic links often high, and losses of connectivity arise. It cannot rely on Global Positioning System (GPS) because it uses radar waves in the 1.5GHz band that do not propagate in water. The

above mentioned characteristics are of underwater wireless communication network's have several security implications.

**BLOCK DIGRAM:**



**Figure-2.1: Existing Method of Underwater communication**

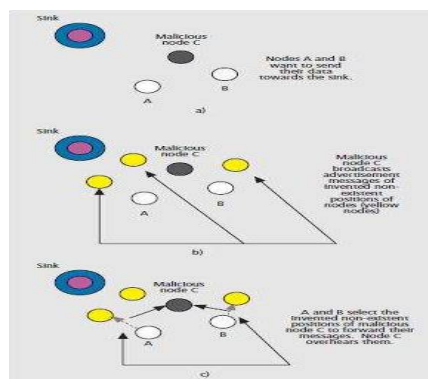
**2.2 .ATTACKS ON UWCNS AND COUNTER MEASURES**

**Jamming Attack:**

A jamming attack consists of interfering with the physical channel by putting up carriers on the frequencies nei ghbour nodes use to communicate. Since underwater acoustic frequency bands are narrow, UWCNs are vulnerable to narrowband jamming. Localization is affected by the replay attack when the attacker jams the communication between a sender and a receiver, and later replays the same message with stale information posing as the sender. Spread spectrum is the most common defence against jamming.

**Sybil Attack:**

An attacker with multiple identities can pretend to be in many places at once. Geographic routing protocols are also misled because an adversary with multiple identities can claim to be in multiple places at once Authentication and position verification are methods against this attack, although position verification in UWCNs is problematic due to mobility.



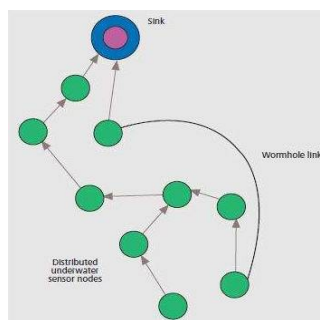
**Fig 2.2: Sybil attack**

**Wormhole Attack:**

A wormhole is an out-of-band connection created by the adversary between two physical locations in a network with lower delay and higher bandwidth than ordinary connections. In a wormhole attack the malicious node

transfers some selected packets received at one end of the wormhole to the other end using the out-of-band connection

The effect is that false neighbor relationships are created, because two nodes out of each other's range can erroneously conclude that they are in proximity of one another due to the wormhole's presence [3]. This attack is devastating.



**Figure-2.3: Underwater network with a wormhole link**

### **2.3.Sinkhole Attack:**

In a sinkhole attack, a malicious node attempts to attract traffic from a particular area toward it; for example, the malicious node can announce a high-quality route. Geographic routing and authentication of nodes exchanging routing information are possible defences against this attack, but geographic routing is still an open research topic in UWCNs

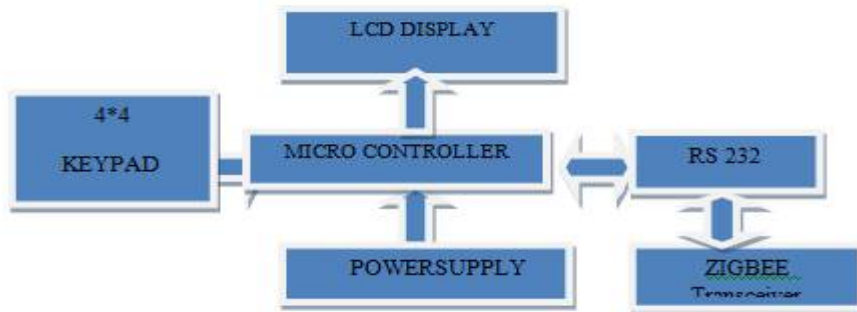
### **Selective Forwarding:**

Malicious nodes drop certain messages instead of forwarding them to hinder routing. In UWCNs it should be verified that a receiver is not getting the information due to this attack and not because it is located in a shadow zone. Multipath routing and authentication can be used to counter this attack, but multipath routing increases communication overhead.

### **2.4 PROPOSED SYSTEMS**

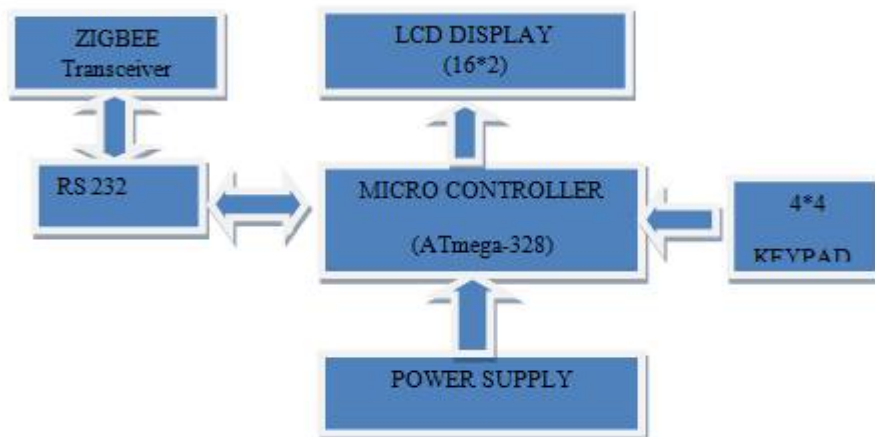
In the proposed system we are implementing high frequency RF transmission using acoustic algorithm. So in this method it is possible to send the digital and analogue data in water for high speed. Acoustic algorithm supports to send data between submarine with high efficiency without losses and in this method we can communicate data in full duplex so possible transfer and receive data at a same time in both places.

**BLOCK DIAGRAM OF TRANSMITTER:**



**Fig 2.4 Block diagram of Transmitter**

**BLOCK DIAGRAM FOR RECEIVER**



**Fig 2.5 Block diagram of Receiver**

**2.5 PRINCIPLE OF OPERATION:**

1. In the transmitter Section, The digital or analogue input signal/data is given to the microcontroller through 4\*4 keypad.
2. The microcontroller performs the process and control the input signal/data using acoustic algorithm and also display the input signal/data into the LCD display.
3. After that the microcontroller output signal is given into RS232 Serial cable, The RS232 Serial cable converts the microcontroller output signal into Serial data input to the ZIGBEE Transceiver.
4. ZIGBEE Transceiver transmits the signal/data into the 2.4 GHz ISM frequency range.
5. In the receiver section, ZIGBEE Transceiver receives the transmitted signal/data in the frequency range of 2.4 GHz.

6. The ZIGBEE Transceiver sends the received signal/data into the microcontroller through RS232 serial cable. Microcontroller displays the received signal/data into the LCD display.
7. In the receiver end, at the time of reception the receiver simultaneously sends the reply signal/data to the transmitter, The digital or analogue input signal/data is given to the microcontroller through 4\*4 keypad.
8. The microcontroller performs the process and control the input signal/data using acoustic algorithm and also display the input signal/data into the LCD display.
9. After that the microcontroller output signal/data is given into RS232 Serial cable, The RS232 Serial cable converts the microcontroller output signal into serial data input to ZIGBEE Transceiver. ZIGBEE Transceiver transmits the signal/data into transmitter section.
10. Finally we can communicate data in FULL DUPLEX mode, so possible to transfer and receive data at a same time in both places.

### III. RESULTS AND DISCUSSION

**Underwater acoustic communication** is a technique of sending and receiving message below water There are several ways of employing such communication but the most common is using hydrophones. Under water communication is difficult due to factors like multi-path propagation, time variations of the channel, small available bandwidth and strong signal attenuation, especially over long ranges

**Transmitter and receiver window:**

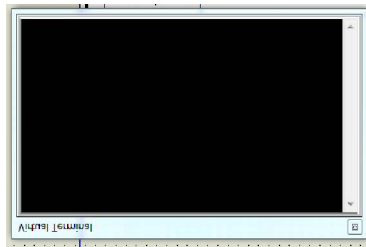


Figure 3.1: output in transmitter side

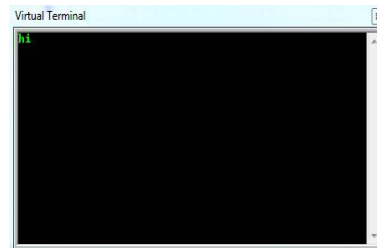


Figure 3.2: output in receiver side

The virtual terminal shown in figure 3.2 will be taken as an output in transmitter end. The message which needs to be sent were typed here.

**Proposed output:.**

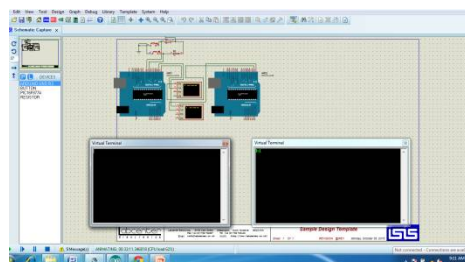


Figure 3.3: output of the data transmission

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In the proposed system we implementing high frequency RF transmission using acoustic algorithm so in this method it is possible to send the digital and analogue data in water for high speed. acoustic algorithm supports to send data between submarine with high efficiency without losses and in this method we can communicate data in full duplex so possible transfer and receive data at a same time in both place This project is used to transfer data in submarines in high frequency RF transceiver using aquatics algorithm in FULL duplex so that the data transfer and receive in same time

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