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Under Water Communication Using Acoustic Modem

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ABSTRACT

Underwater sensor nodes will find applications in oceanographic data collection, pollution monitoring, offshore exploration, disaster prevention, assisted navigation and tactical surveillance applications. Moreover, unmanned or autonomous underwater vehicles (UUVs, AUVs), equipped with sensors, will enable the exploration of natural undersea resources and gathering of scientific data in collaborative monitoring missions. Underwater acoustic networking is the enabling technology for these applications. 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 characteristics of the underwater channel are detailed. The main challenges for the development of efficient networking solutions posed by the underwater environment are detailed and a cross-layer approach to the integration of all communication functionalities is suggested. Furthermore, open research issues are discussed and possible solution approaches are outlined.

***Keywords :*Acoustic modem, Wireless communication, Ultrasonic transreciver.**

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I. INTRODUCTION

The knowledge about the ecosystem is increasing due to physical, chemical and biological time series data from long term sensor. Despite the substantial effort for monitoring ecological aspects of aquatic systems, the infrastructure needed for sensor networks in marine and freshwater systems without question lags far behind that available for terrestrial counterparts.Main differences between underwater acoustic network and terrestrial radio network.

Sr No.	Underwater acoustic	Terrestrial radio
1	Low bandwidth (KHz)	High bandwidth (MHz)
2	Long delay	Short delay
3	Distance dependent on bandwidth	Distance independent on bandwidth
4	Few simulation tools available	Several simulation tools available
5	Hard to experiment	Easy to experiment

Table 1. Comparison underwater acoustic network and terrestrial radio network

Now a day's interest in the design and deployment of underwater acoustic communication network. Application of underwater sensor node will be in oceanographic data collection, pollution monitoring offshore exploration, disaster prevention, assisted navigation & tactical surveillance application. (UUV, AUVs) unmanned or autonomous underwater vehicles equipped with sensor will enable to gathering of scientific data. It consists of variable number of sensor & vehicles that are deployed to perform collaborative monitoring task over give area.

Characteristics of underwater acoustic sensor network-

- Communication media: it uses acoustics waves, electromagnetic waves or optical waves.

- Transmission loss: It is related to attenuation and Geometric spreading which is proportional to distance and independent of frequency.

- Noise: It of two type's man made noise and ambient noise.
- Multipath: Multiple propagation cause to degradation of acoustic communication signal due to (ISI) Inter symbol Interference.

- Doppler spread: It causes degradation in performance of digital communication. It generates two effects: a simple frequency translation and continues spreading of frequency.

Major challenges encounter in design of underwater acoustic network are as follows.

- The available bandwidth is severely limited.
- The underwater channel is impaired because of multi-path and fading.
- Propagation delay in underwater is five orders of magnitude higher than in Radio Frequency (RF) terrestrial channels, and variable.
- High bit error rates and temporary losses of connectivity (shadow zones) can be experienced.
- Underwater sensors are characterized by high cost because of extra protective sheaths needed for sensors and also relatively small number of suppliers (i.e., not much economy of scale) is available.
- Battery power is limited and usually batteries cannot be recharged as solar energy cannot be exploited.

II. LLITERATURE SURVEY

Research Challenges and Applications for Underwater Sensor Networking, John Heidemann

The paper 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.

Survey paper on Underwater Wireless Sensor Network, Elsevier B.V.

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 characteristics of the underwater channel are detailed. The main challenges for the development of efficient networking solutions posed by the underwater environment are detailed and a cross-layer approach to the integration of all communication functionalities is suggested. Furthermore, open research issues are discussed and possible solution approaches are outlined.

III. PROPOSED SYSTEM

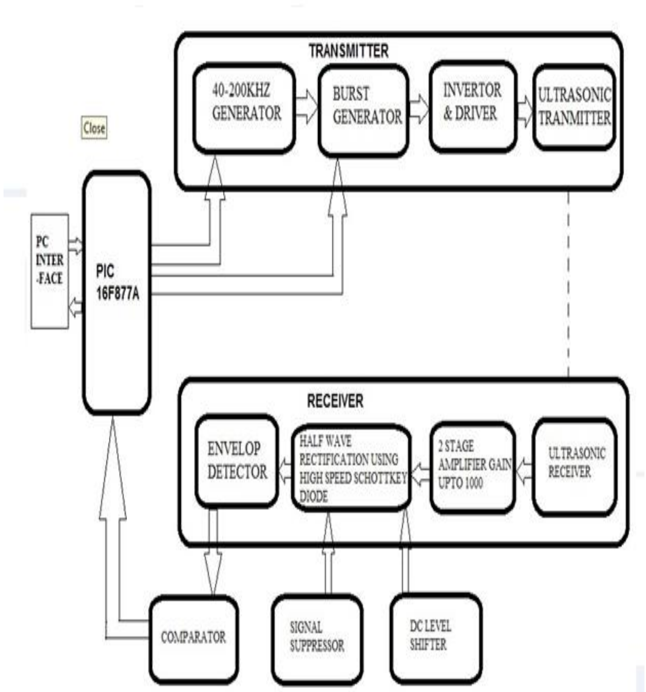

Fig 1. Block diagram

Block Diagram Description:

[A] Underwater acoustic modems consist of three main components:

(1)An underwater transducer,
(2)An analog transceiver (matching pre-amp and amplifier), and
(3)A digital platform for control and signal processing.

[B] A substantial portion of the cost of the modem is the underwater transducer; commercially available underwater omnidirectional transducers.

[C] The analog transceiver consists of a high power transmitter and a highly sensitive receiver both of which are optimized to operate in the transducer's resonance frequency range.

[D] The transmitter is responsible for amplifying the modulated signal from the digital hardware platform and sending it to the transducer so that it may be transmitted through the water.

[E] The receiver amplifies the signal that is detected by the transducer so that the digital hardware platform can effectively demodulate the signal and analyze the transmitted data.

[F] Due to its high linearity, the transmitter may be used with any modulation technique that can be programmed into the digital hardware platform.

[G] The digital transceiver is responsible for physical layer communication, i.e., implementing a suitable baseband processing scheme (including modulation, filtering, synchronization, etc.) for the application and environment of interest.

[H] There are many design choices that must be considered when designing a digital transceiver for the underwater acoustic modem including, but not limited to, the choice of modulation scheme and hardware platform for its implementation.

[I] we selected to implement frequency shift keying & ASK on a field programmable gate array (FPGA) and microcontroller for our modem prototype.

IV. RESULT

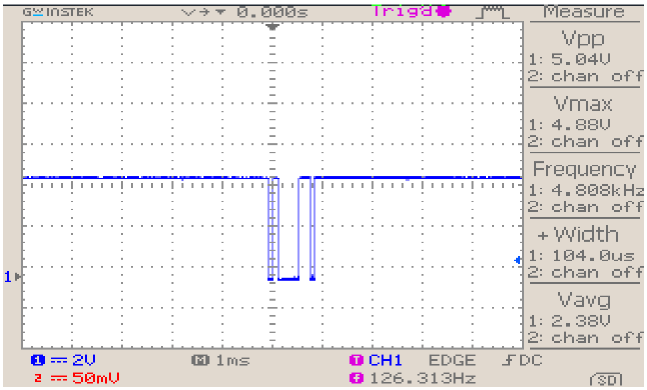

Fig 2. Serial Data for Transmitting Pc

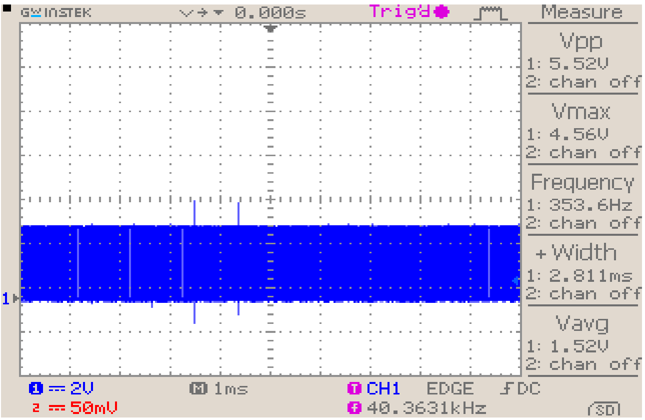

Fig 3. Carrier Generated for Pic

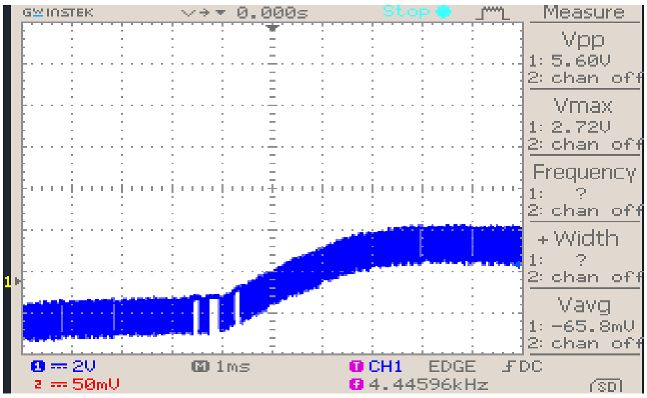

Fig 4. Transmiiter Waveform

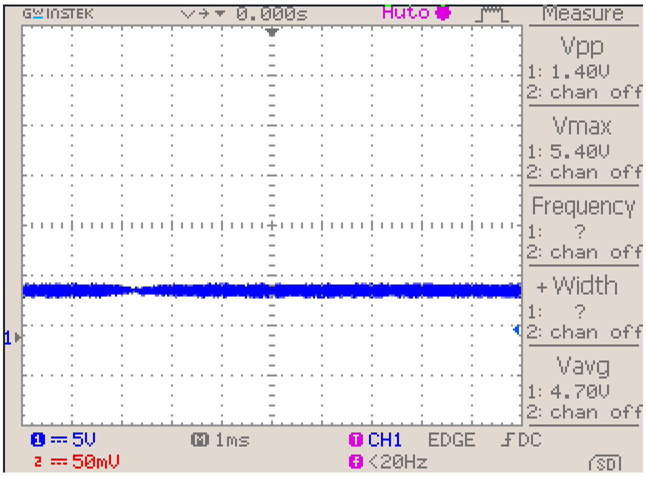

Fig 5. Receiver Waveform

V. CONCLUSION

In this paper, we presented an overview of the state of the art in underwater acoustic sensor network. We described the challenges posed by the peculiarities of the underwater channel with particular reference to monitoring applications for the ocean environment. We discussed characteristics of the underwater channel and outlined future research directions for the development of efficient and reliable underwater acoustic sensor networks. The ultimate objective of this paper is to encourage research efforts to lay down fundamental basis for the development of new advanced communication techniques for efficient underwater communication and networking for enhanced ocean monitoring and exploration applications. We strongly advocated the use of a cross-layer approach to jointly optimize the main networking functionalities in order to design communication suites that are adaptable to the variability of the characteristics of the underwater channel and optimally exploit the extremely scarce resources.

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