



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJIRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**

# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 11, Issue 11, November 2022

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 8.118

9940 572 462

6381 907 438

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# Under Water Speech Signal Transmission: A Study

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**ABSTRACT:** Underwater wireless sensor network includes several components including sound system, encoders, vehicles and sensors. These sensors are deployed in specific acoustic areas to perform specific data collection tasks along with monitoring. This data can be in the form of speech signals. The network formed is used to interact with acoustic nodes and ground stations. The ground station is also known as the base station. The speech signals are converted into packets. Packets are transmitted from normal nodes to base stations. As the packets are transmitted energy is consumed. The sensor's energy once consumed, packets are dropped. This paper studies the issues and challenges that are tackled while transmitting the speech signals towards the base station. Energy conservation is the primary issue that is required to be tackled to increase the lifetime of the network. Besides, protocols commonly used in UWSN is also discussed in this literature.

**KEYWORDS:** UWSN, Lifetime, Energy, base station, speech signals

## 1. INTRODUCTION

UWSN is widely used for acoustic applications such as environmental monitoring, establishing a warning system, predicting seismic activities, etc. Nodes having the highest energy within the group of nodes is served as a cluster head. The transmission of speech is in packet form [1], [2]. Packets are collected at the cluster head. The aggregated speech signals are transmitted towards the base station based on priority. The problem arises if the energy of the cluster head completely dissipates. The speech signals aggregated at the cluster head is lost [3]. To overcome this problem, the energy conservation mechanism is required. The structure of UWSN is given in figure 1.

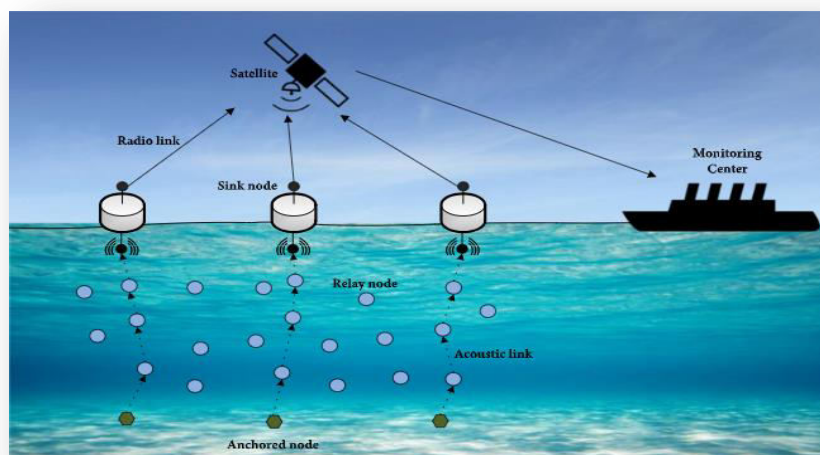


Figure 1: Architecture of UWSN



The UWSN is capable of performing multiple applications including the following

- Predicting Seismic activities
- Route monitoring
- Weather prediction
- Detecting trapped nodes
- Finding the shortest path

In addition to these applications, optimized path detection to conserve energy is the need of the hour. The protocols used for this purpose are described in the next section.

### 1. UWSN Routing Protocols for speech signal transmission

The routing protocols in UWSN follows a different mechanism than ground-based WSN since radion waves are not used in this case. Location-based UWSN is discussed as under

#### 1.1 Location-Based Routing Protocols

The Group of protocols that are based on location are discussed in [5][6][7]. VBF and HH-VBF are location-based routing protocols. In these protocols, a group of forwarding noes is combined which are directed towards the sink node. The problem arises when void nodes are encountered. Void nodes do not have direct contact with the base station thus speech signals loss occurs when speech signals are transmitted towards such as nodes[8]. To handle void nodes, reactive void handling technique is incorporated within VBF and HH-VBF.

#### 1.2 Pressure based Routing protocols

Radio waves are not used in UWS. Due to this problem, a pressure-based routing scheme is used [9][10][11]. Hydrocast is one of the pressures-driven UWSN routing protocol. This protocol consisted of two different parts. The first part includes greedy pressure based routing and second local lower depth-first recovery method. The first algorithm detects the path from normal nodes to the base station and the second algorithm detects the void nodes in advance. Using this algorithm, it is possible to transfer the speech signals to the base station at a higher rate as compared to the location-based routing protocol.

#### 1.3 Soft state Routing protocols

These protocols keep the speech signals away from the void and trapped nodes [12][13][14]. To do this, reachability information is maintained. Reachability information is maintained using the hop count mechanism. The information about the trapped nodes is conveyed quickly using this mechanism. The problem exists that recovered nodes' information is conveyed slowly as compared to other nodes' information.

**The underwater sensor network** is used in a variety of applications like river pollution discovery, monitoring ocean environment. The sound wave signals are used to transform the sensed data. These signals may be attenuated with the distance that prevents it from communicating. The underwater sensor network is limited by several constraints such as propagation delay, bandwidth so there must be efficient methods to handle these problems one of which is routing protocol [15]. The routing protocol is the one that used to find the best possible path from source to destination [16]. In WSN the routing protocol is broadly divided into two categories: proactive and reactive. The proactive protocol is the table-driven and reactive protocols are an on-demand method that provides a route for transferring speech signals [17]. The WSN and routing scheme along with routing schemes followed in underwater WSN is given in figure 2 and 3

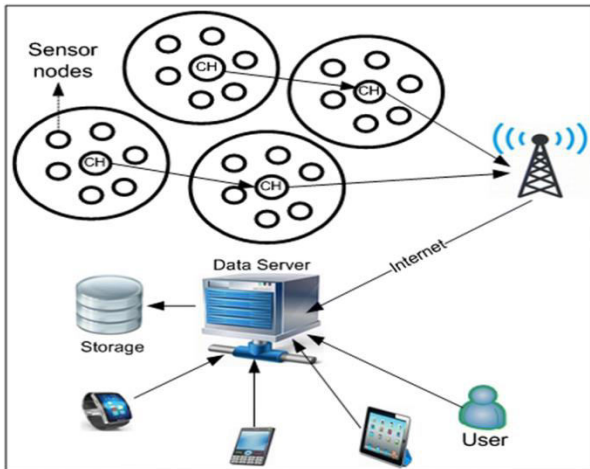


Figure 2: WSN Architecture and routing schemes

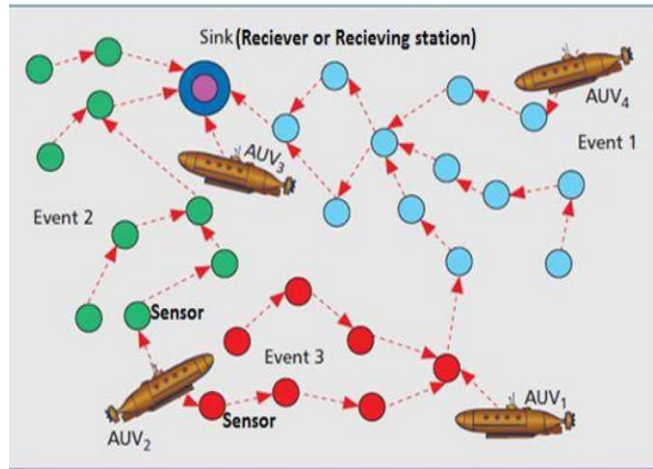


Figure 3: Underwater Wireless Communication network and routing schemes[18]

The issues and challenges corresponding to these protocols are discussed as under

## II. ISSUES AND CHALLENGES CORRESPONDING TO SPEECH SIGNAL TRANSMISSION

There is an issue corresponding to routing schemes used with UWSN. These issues hamper the performance of routing protocols.

### 1.4 Void Nodes

The Void nodes do not directly connect with the base station. The void nodes receive the data speech signals and do not direct them forward. Speech signals received from the sensor nodes will be blocked and cause congestion. Bulk messages will be lost in this case. This problem can be rectified by the use of reachability determination. Hop count is done to determine the up nodes and having a path between source and destination nodes.[19]

### 1.5 Foreshortening

The foreshortening is the mechanism where the base station looks closer due to the acoustic effect. The foreshortening could lead to misleading information and hence more energy is deprecated as compared to normal packet transmission. The projection must be accommodated to tackle the issue of foreshortening. Transformation can be used to tackle the reflective speech signals towards the destination[20].

### 1.6 Propagation Delay

The propagation delay in acoustic protocols is one of the biggest problems that causes energy from the sensor node to decay quickly and a lifetime of the network is reduced significantly[21]. The delay is primarily caused due to congestion and to this end, the threshold on bandwidth is applied and congestion is resolved. Energy efficiency is a primary target when propagation delay is encountered[22].

The features corresponding to different protocols scheme used in UWSN is given in section 4.

## III. FEATURE TABLES FOR UWSN SPEECH SIGNAL TRANSMISSION SCHEMES

This section gives the comparison of distinct features possessed by the UWSN routing schemes considered in this literature.

Feature	Location-Based	Pressure Based	Soft State
Update at	Source	Source	Source
Period of updation	Event-Based	Event-Based	Periodic
Direction	Unidirectional	Bidirectional	Bidirectional
Route Discovery	Multiple	Multiple	Single
Adaptability	Dynamic	Dynamic	Static
Overhead	High	Low	Low

Packet Drop	Low	High	Low
UnderWater Sensing	True	False	True

Table 1: Comparison of UWSN routing schemes [23]

#### IV. CONCLUSION AND FUTURE SCOPE

The location-based protocol is based on flooding within UWSN. This means speech signals are transmitted towards every visible path towards destination. Speech signals are almost guaranteed to be delivered to the destination ut high packet drop is observed. In a pressure-based mechanism, the path is dynamic and the adjacency matrix is adjusted from time to time to determine which paths are up and which links are broken. The problem of low throughput is observed in this case. The soft state-based routing scheme within UWSN, on the other hand, searches for optimal path and then speech signals are transmitted. Overhead in observing the optimal path is high. To resolve the problems of these protocols a queue can be set up at cluster head so that in case of energy depreciation speech signals drop within the queue. Speech signals can then be fetched from the queue and then transmitted. The packet drop ratio is consequently reduced and throughput increases.

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