

An Empirical Study of Underwater Acoustic Sensor Network and Terrestrial Wireless Network

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Abstract

Two third of the earth is covered with water and there has been a growing interest in monitoring underwater medium for scientific exploration and attack protection. Underwater sensor nodes will find application in oceanographic data collection, pollution monitoring, disaster prevention and tactical surveillance application. Underwater network consist of a variable number of sensors and vehicles that are deployed to perform collaborative monitoring task over a given area. On the other hand the terrestrial wireless networks are the networks without cable and are very easy to install and offer portability and convenience which other network solutions do not offer. The terrestrial wireless networks utilized radio waves to maintain communication channels between computers. In our paper some of the fundamental key aspects of underwater acoustic communication are investigated and three different UASN architectures are discussed.

Keywords: Communication Architecture, Terrestrial Wireless Network, Underwater Acoustic Sensor Network, WWAN

1. Introduction

Underwater Acoustic Sensor Network (UASN): A collection of sensor nodes which communicates among them through the emerging underwater acoustic communication technology is known as UASN. Acoustic communication technology is the best choice when compare to the radio waves and optical waves that is why it was chosen for the communication in underwater. Underwater acoustic network gaining attention due to their importance in underwater applications for military and commercial purpose.

Some of the major applications of UASN are [1]

- I. Exploring the unpredictable underwater world.
- II. Reports Ocean related disaster like tsunanmi to coastal areas.

- III. Exchange information among nodes.
- IV. It can perform pollution monitoring in lakes and rivers e.g. Oil leakage, chemical pollution, biological pollution etc.
- V. It can also helps in detecting minerals, oil fields etc.
- VI. UAN with acoustic and optical sensors can be used to perform rapid environmental assessment and detect mine like objects. [2]

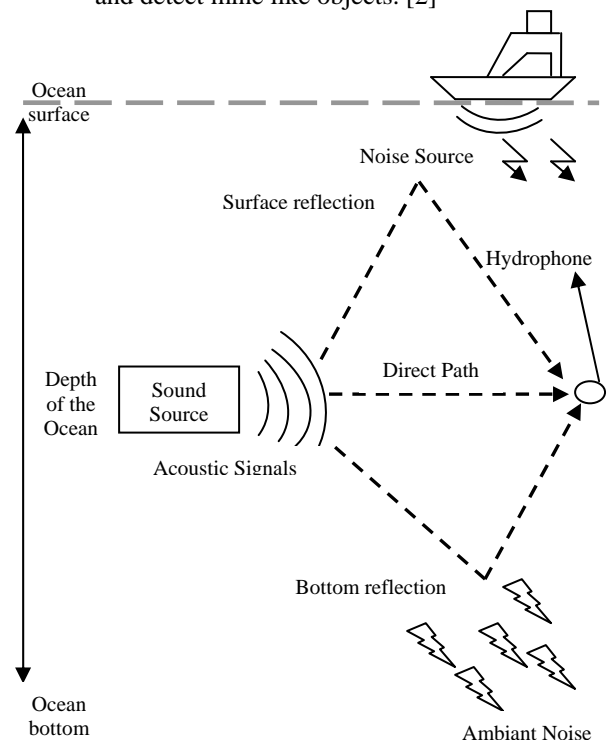


Fig. 1 Represent underwater acoustic environment

2.2 Static-Three Dimensional UASN (for Ocean Column Monitoring)

It is a collection of sensor nodes that are connected to the bottom of the ocean-bed by tethers. This technique can be used for surveillance monitoring of ocean phenomena.

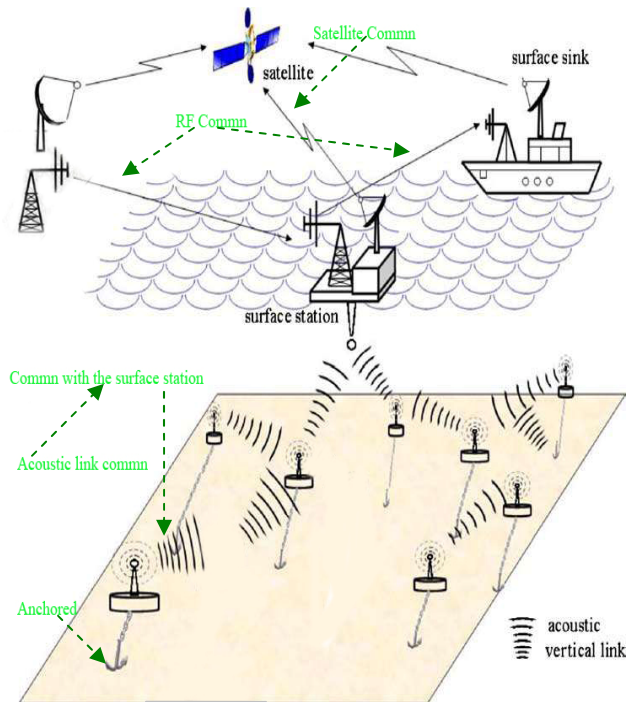


Fig. 4 Represent architecture for static 3D UASN

Some major problems presented in this architecture are [6]

- If the architecture is for military purpose than they can be easily detected by enemies.
- It can obstruct ship navigating on the surface.

2.3 Three Dimensional Networks of Autonomous Underwater Vehicle (AUV)

In this architecture a sensor node is built inside underwater vehicle and is used to enhance the whole sensor network capabilities. It is necessary for this architecture to have algorithm that guarantee the perfect coordination between AUV and the sensors. It also ensures the correct functionality of AUV and sensors in the scenario. [6]

Two distinct characteristics of AUV are

- Adaptive sampling
- Self configuration

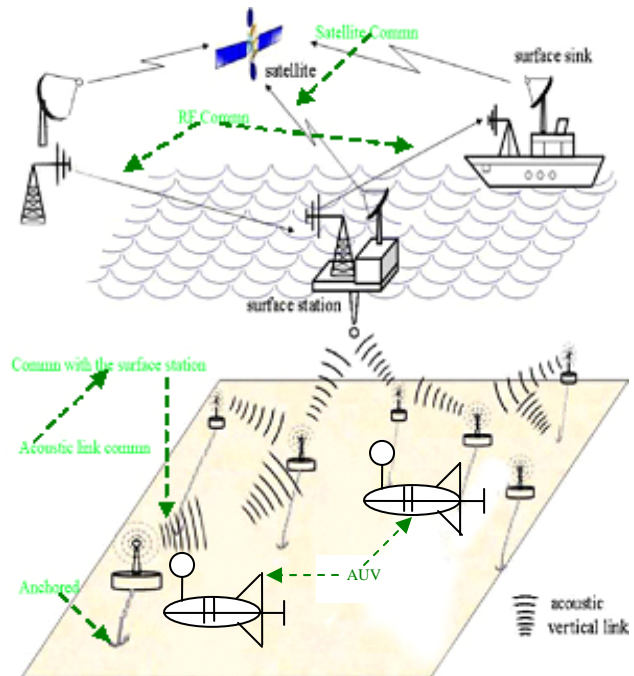


Fig. 5 Represent architecture for 3D AUV

3. Various Terrestrial Wireless Networks

The four different types of terrestrial wireless networks are described below:

3.1 Wireless Personal Area Network (WPAN)

A wireless PAN involves some one wirelessly synchronizing his/her PDA to a laptop or desktop computer; it can also provide wireless connectivity to a printer. "Plugging in" (every device in a WPAN will be able to plug in to any other devices in the same WPAN) is the key concept in the WPAN technology. When two WPAN equipped devices come into close proximity, they can communicate as if they are connected by a cable. It can also prevent the unauthorized access to information as each WPAN equipped device has ability to lock out other device selectively. Two kinds of wireless technology used in WPAN are Bluetooth and infrared. [7]

3.2 Wireless Local Area Network (WLAN)

Using a wireless distribution method i.e. linking of two or more devices over a short distance (within a building) is called WLAN. The working of WLAN depends on three main parts; they are as follows [8]

1. Infrastructure mode
2. Ad-hoc network mode
3. Mixed network mode

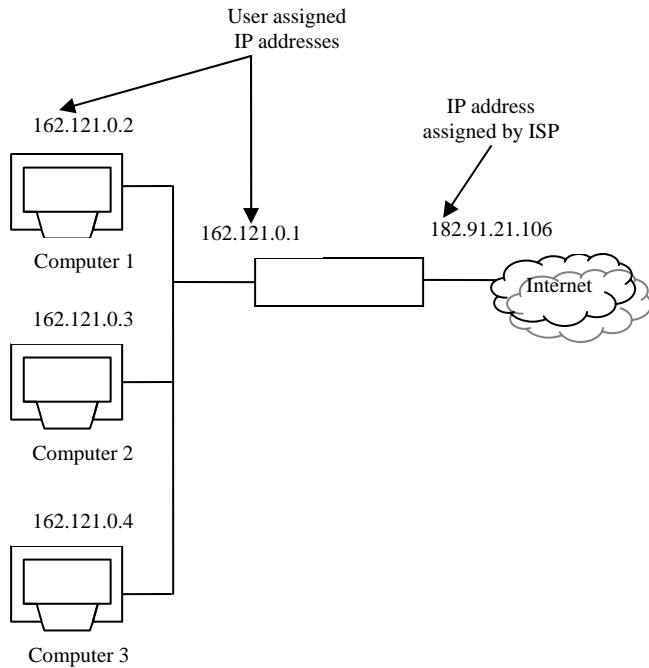


Fig. 6 Represent WLAN architecture

WLAN architecture is a technique of arranging and designing of different components in WLAN networking device in a specific way.

Three important components of WLAN architecture are

1. Access Point
2. Clients
3. Bridge

3.3 Wireless Metropolitan Area Network (WMAN)

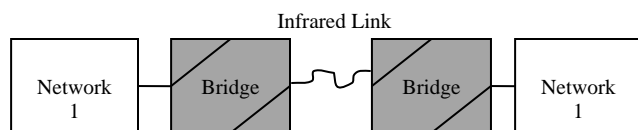


Fig. 7 Represent Wireless MAN

Wireless MANs are the type of wireless networks that connect several wireless LANs for e.g. WiMAX. Wireless MANs encompass areas of about the size of the cities and can span upto 50 kilometers. DQDB is the standard of WMAN which cover upto 48 kilometers with the speed of 34 Mbit/s to 155Mbit/s. WMAN performance varies, and the actual performance depends on the choice from the wide assortment of technologies. The technology of WMAN consists of ATM, FDDI and SMDS. WMAN

provide high speed internet access to business and thus opens the door for the success.

3.4 Wireless Wide Area Network (WWAN)

Wireless WANs covers large geographical area, such as country or continent. Data throughput rate for WWAN are a great deal slower, that is upto 170 Kbps and typical rates of about 56 Kbps. [9]

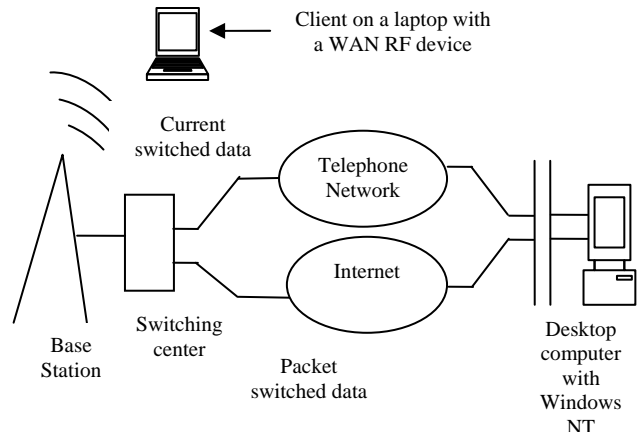


Fig. 8 Represent various components of WWAN

Various advantages of WWAN application involve user accessing internet wherever and whenever needed, stay connected while traveling, enabling users to carry on business and leisure activities form different location. With all these advantages there are certain limitations also, such as

1. Application persistence
2. Poor performance within buildings
3. Security
4. Expensive to install within buildings
5. Off-the-shelf solutions

Table 1: Comparing different terrestrial wireless networks

S.No.	Types	Coverage	Standards
1.	WPAN	Within reach of a person	Bluetooth, IEEE 802.15 and Irda
2.	WLAN	Within a campus or same building	IEEE 802.11, Wifi, Hyper LAN
3.	WMAN	Within a city	IEEE 802.16, WIMAX and proprietary
4.	WWAN	All over the world	CDPD, 2G, 3G and 3.5G

4. A Comparison between Underwater Acoustic Sensor Network and Terrestrial Wireless Network

The comparison between UASN and Terrestrial wireless network are described below: [1] [3]

1. The ground based wireless networks are expected to become increasingly expensive but the expenses for the underwater equipment i.e. the cost of manufacturing, deployment, maintenance and recovery are much higher.
2. Due to the fouling and corrosion underwater equipments can be easily damaged as compared to ground based wireless network.
3. Communication protocol used in ground based wireless network works better than underwater acoustic protocols.
4. The power needed for acoustic underwater communication is higher than ground based wireless network.
5. As compared to ground based wireless networks underwater sensors typically do not use RF communication. Acoustic communications are used instead.
6. Underwater sensors are mobile while terrestrial wireless network are fixed.
7. As compared to terrestrial wireless network underwater acoustic network typically use solar power.

5. Conclusion

Use of radio frequency technology or electromagnetic waves to transmit and received data over the air is known as wireless network. In our paper we have described four important types of wireless networks, they are as follows: WPAN, WLAN, WMAN, WWAN [5]

Whereas underwater acoustic network consist of a variable number of sensors and vehicles that are deployed to perform collaborative monitoring over a given area. There are three types of underwater acoustic networks.

1. Static 2D UASN
2. Static 3D UASN
3. 3D network for autonomous underwater vehicle

In our paper we have also explain some of the major differences between UASN and ground based wireless networks.

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