International Journal of Electrical and Electronics Engineers
Vol. No.8 Issue 01, January-June 2016
www.arresearchpublication.com
IJEEE ISSN 2321 - 2055

# ANALYSIS OF WIRELESS OPTICAL COMMUNICATION FOR UNDERWATER APPLICATIONS: A REVIEW

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## ABSTRACT

*Wireless Optical Communication (WOC) technology is now established as an alternative or complement to radiofrequency for indoor and outdoortransmissions. Wireless Optical Communicationcan be given as an different to acoustic modems for schemes where moderate distance, less complex communication system, high speed and lower power are want.Wireless communication is much more possibleanswer to the problem of communicating with robotic vehicles. In this paper, the underwater criteria for wireless optical communication is analysed and designed. The focus of the paper is to build light emitting diode based links at faster data rate of 1Mbps with low cost, wirelessly under the water. The choice of using LEDs instead of Lasers was largely economic.*

***Keywords: Moderate Distance, Wireless Optical Communication, Super Bright Blue LED***

## I. INTRODUCTION

Our planet is covered by water more than 70%. Demands for underwater communication systems are increasing due to the on-going expansion of human activities in underwater environments such as environmental monitoring, underwater exploration, and offshore oil field exploration. Underwater world holds ideas and resources that will boost up the next generation sciences and business. To perform the underwater tasks since1950's services provided by such robots as underwater Remotely Operated Vehicles (ROV's) and Automatic underwater Vehicles(AUV's). To easily communicate with a robot is through a wired connection such as a copper or fibre optic tether. It allows efficient and high speed communication, a tether provides manyfunctional challenges when handling with a mobile robot,restricting the range of vehicle, management of links. In underwater, radio waves do notreproduce more, acoustics will be hard to provide sufficient bandwidth at the same time and have difficulty in stinging the water. This convey that high bandwidth, short range underwater wireless optical communications [1], [2] have high potential to improve acoustic communication methods.

## II. BLOCK DIAGRAM

A wireless optical communication system is built up of optical transmitter and receiver. The signal transmitted to pass through the transmission medium (water) and it is received up by the receiver. The receiver detects the optical signal, converts into an electrical signal and passes that data back to the respective system [3].

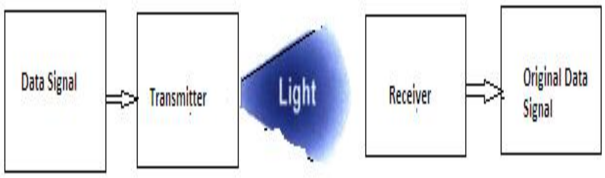


**Figure 2.1. Wireless Optical Communication System**

The simplest way to carry the data is called On-Off Keying (OOK) [4]. This means that the transmitter read the binary data either ON (for binary digit 1) and OFF (for binary digit 0), quickly and correctly change the state of the optical component accordingly. On the other end, the receiver use a photo detector whichdetermine if the light is ON or OFF and outputs accordingly as the input signal. The speed and dependabilityof the system is determined by how fast the transmitter can switch the state of the optical component and how quickly and accurately the receiver can determine the state of the light.

## III. OPTICAL TRANSMITTER

The optical transmitter converts electrical signal into optical signal and pass that optical signal through transmission channel. It consists of photon source, which acts as electro optical convertor systems required to operate. Figure 3.1 shows the typical optical transmitter.

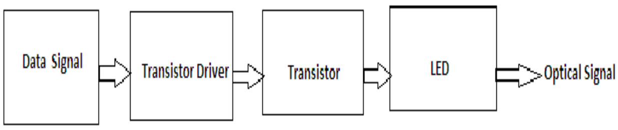


**Figure 3.1 Optical Transmitter**

**Table 1. Comparison of LEDs and LASER Diodes**

| Characteristics | LASER | LED |
|---|---|---|
| **Modulation Bandwidth** | >1GHz | <200MHz |
| **Temperature Dependency** | Temperature Dependent | Little |
| **Optical Spectral Width** | 0.01-5nm | 25-100nm |
| **Minimum Output Beam Divergence** | Narrow(0.01 degree) | Wide(about 0.5 degree) |
| **Cost** | More | Less |
| **Coherence** | Coherent | Incoherent |

| | | |
|---|---|---|
| **Special Circuitry Required** | Threshold and temperature compensation circuit | None |
| **Lifetime** | Medium | Long |
| **Ease of Operation** | More Difficult | Easier |
| **Reliability** | Moderate | High |

### 3.1 Photon Source

The design of optical transmitter drives by photon source.Any photon source should be used either light emitting diodes (LED) or laser diodes (LD) have satisfies the trade-off between system cost, system complexity and switching speed. The choice between LEDs and LASER diodes is shown in the table. The maximum amount of optical power is required to transmit the signal by choosing super bright LEDs and also by using number of LEDs. When we maximize the output light it required more LEDs but this must be balanced by limiting the power which is placed in the system.

### 3.2 LED Driver

The transmitter used LED as source. To control the operation of LED, a LED driver is required, but it work with lower speed switching applications. In this situation, we use transistor to start and stop the flow of current through the LEDs which indicate turning them ON and OFF. A metal oxide semiconductor field effect transistor (MOSFET) is best suited for this application because it provides constant voltage and the flow of current through LED limits. For this reason, MOSFET that require to switch high power loads very quickly and employs a MOSFET driver. MOSFET Driver takes the source current and the input signal to MOSFET gate.

## IV. OPTICAL RECEIVER

The Optical receiver receives the optical signal which is transmitted by Optical transmitter and converts it into an electrical signal. It consists of photo detector which converts the optical signal into an electrical signal. Now this signal can be amplified and recover the signal. Finally the resultant signal can be displayed. Figure 4.1 shows the optical receiver design.

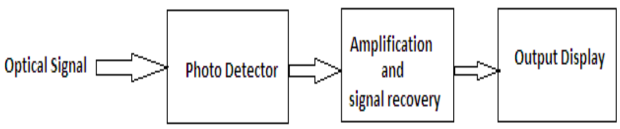


**Figure 4.1. Optical Receiver**

### 4.1 Photo Detectors

Photo Detectors can be used as an opto-electrical device which will answer quickly to all the incident photons transmitted by transmitter. In the applications first priority for a photon detector is switching speed additionally it would be cheap, small, power efficient and robust.Many photo detectors such as photodiodes, photomultipliers and photo transistors. Photodiodes should work very fastly with temperate power consumption. Photodiodes is more suitable for underwater wireless optical communication for the wavelength of 420nm whichiswavelength of blue color is highly responsive. P-N Photodiodes is optimized for the efficient detection of light at a given wavelength. It does not required high bias voltage and the cost is not high. Its NEP (Noise Equivalent Power) is 3.2x10^-14 because of this it is better to use than another photodiodes. Spectral response of various photo diodes is shown in figure 4.2

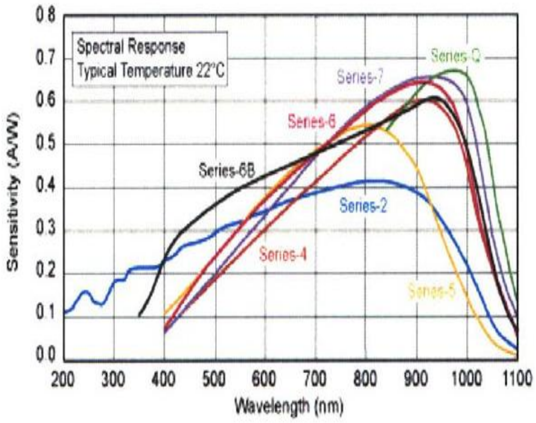


**Figure 4.2 Spectral Response of Various Photodiodes**

### 4.2 Signal Processing

Photodiodes acts as a current source device for this purpose there are two methods to convert the current signal coming from photodiodes to voltage signal. To convert the current signal into proportional voltage a resistor is put across the current source and transimpedance amplifier improves the current to voltage converter. Signal processing add an inverting voltage amplifier which changes the negative voltage into positive voltage and amplifies it. Finally converts the data signal into voltage levels accepted by receiving system.

## V. CONCLUSION

Receiver Signal is similar as Transmitted Signal. When the received signal is dropped off then transmitter again transmit the signal. If the received signal strength is low for long distances then we use amplification and signal recovery stages for successful transmission. For underwater application wireless optical communication is highly reliable and analyzed.

## VI. ACKNOWLEGEMENT

I would like to thank Prof. Satish Kumar and my parents for their patience, understanding and support. All my research paper work would not have been possible without their constant encouragement and support. They and my younger brother help me in searching the new ideas and review points.

***"Special Thanks"***

WG CDR Dr.Anil Kumar (Director) of Amity School of Engineering and Technology Department and Prof. (Dr.) O.P. Singh (Head of Department of Electronics and Communication Engineering) for their valuable help and guidance for the successful completion of the paper.

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