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A Review on Free Space Optical Communication System

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KEYWORDS

Optical, substantially, turbulence

ABSTRACT:

Optical wireless solutions are becoming increasingly popular. Due to the turbulent atmosphere, when the signal is received in the channel, the performance may be substantially reduced. The goal of this research is to examine the best modulation approach for FSO systems operating in an FSO channel. Without atmospheric turbulence, the energy efficiencies, bandwidth efficiencies, BER, and SNR for the 4 modulation schemes On-Off keying (OOK), Binary Phase Shift Keying (BPSK), Differential Phase Shift Keying (DPSK), and Quadrature Phase Shift Keying (QPSK) were explored and compared. In terms of BER performance and power consumption, numerical studies have shown that BPSK and QPSK schemes outperform other schemes. When using Gamma-Gamma turbulence channel for intensity scintillation, the BER performances of the BPSK and QPSK schemes are nearly identical. BPSK is resistant to turbulence. As a result, freespace optical communication systems can use the BPSK technique.

Introduction

Due to its unique qualities, such as exceptionally high capacity, easy implementation, tariff-free available bandwidth, and lower power consumption, WOC communication is described the next barrier for high-speed broadband service. FSO connectivity is ideal for densely inhabited urban regions where road digging is inconvenient. Terrestrial FSO lines can be utilised for short-range (a few metres) or long-range (a few kilometres) communication . Short-range links connect lans sections that are located within the site or in multiple buildings of the organisation to give social connections to end users.

Long-range FSO networking devices connect wireless systems to existing metropolitan area fibre rings or expand up to existing metro area fibre rings. These connections do not reach end users, but they do provide services to underlying infrastructure. Indoor WOC systems are FSO communication systems that can be placed within a building. With the expansion of technology including portable devices, such as computers, personal digital assistants, mobile telephonic gadgets, and etc, this short-range interior WOC system is becoming more popular.

Indoor WOC links allow for flexible connecting within a facility where establishing a physical cable connection is difficult. The transmitter is made up of lasers or light-emitting leds, and the reception is made up of photodetectors. When contrasted to communication equipment or copper wires wires, these devices and their drive pathways are far less expensive. Furthermore, unlike electromagnetic radiation, which can cause disruptions, indoor WOC is fundamentally safe technology, as photons can not permeate walls and so give a high level of protection against spying. These optical wavelengths either belong to the visible spectrum of light or to the infrared spectrum, which has a very wide (THz) bandwidth. These gadgets are also useful for mobile terminals systems because they require extremely little power.

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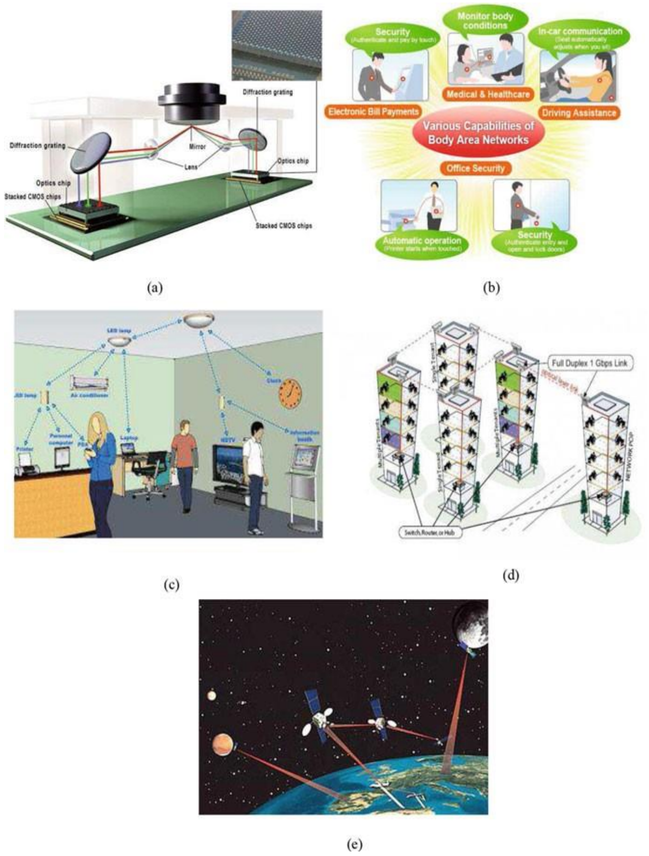

Fig.1. WOC applications include (a) chip-to-chip communication, (b) wireless body area networks, and (c) wireless sensor networks.

LinkConfigurationsTypes

An indoor optical link's categorization is determined by two key factors: I the broadcaster beam direction, or degree of directional cues, and (ii) the detector's FOV, or whether the recipient's view is broad or narrow. Directional LOS, quasi LOS, dispersed, and multi-beam quasi diluted links are the four basic types of link configurations based on this.

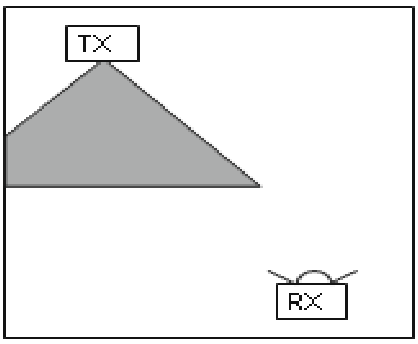

Fig.1.5LOS link with many beams that is not directed [14]

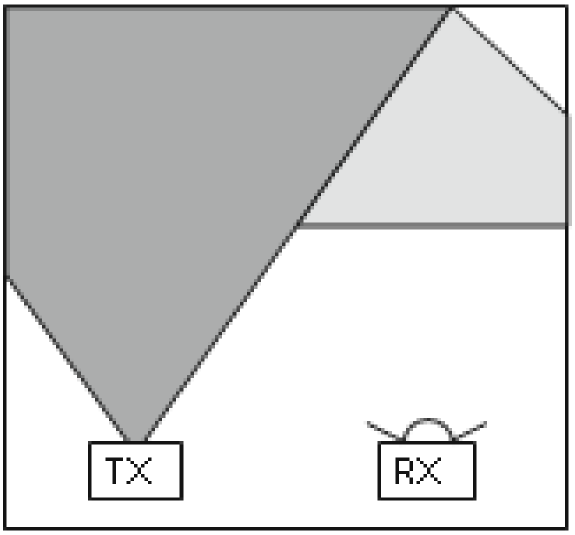

Fig.1.6Diffusedlink[14]

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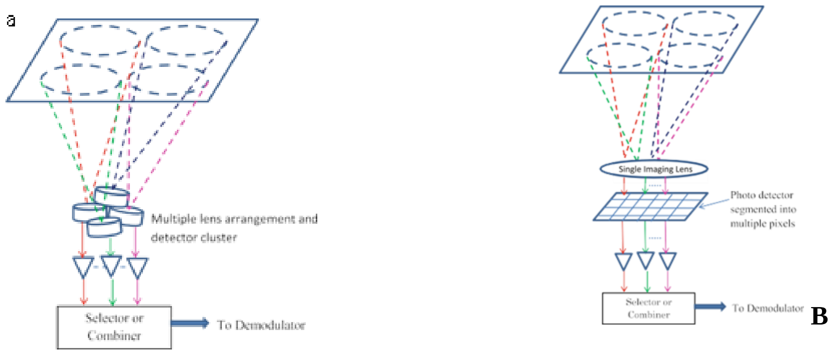

1.7Links with several quasi-diffused beams. (a) A receiver with a multi-lens setup. (b) Transmitter with a single lens configuration

Table1Indoor WOC and Wi-Fi systems are compared.

Property	Spectrum licensing		Penetration through walls		Multipath fading	Multipath dispersion
Wi-Fi radio	Yes		Yes		Yes	Yes
IR/VLC	No		No		No	Yes
Implication for IR/VLC	Approval not required	World wide compatibility	Inherently secure	Carrier reuse in adjacent rooms	Simple link design	Problematic at high data rates

1.1.1 Outdoor FSOCommunication

For data to be transmitted from one place to another, FSO communication needs a line-of-sight link between the sender and receiver. The message signal from the source is modified on the optical signal, which is then permitted to propagate toward the reception over the atmospheric route or space available rather than directed optical fibres. The transmission of a laser system through the air and into free space is involved in ground-to-satellite and satellite-to-ground communications. As a result, these connections are a mix of earthly and interplanetary linkages. The main applications of FSO links are depicted in Figure 1.8.

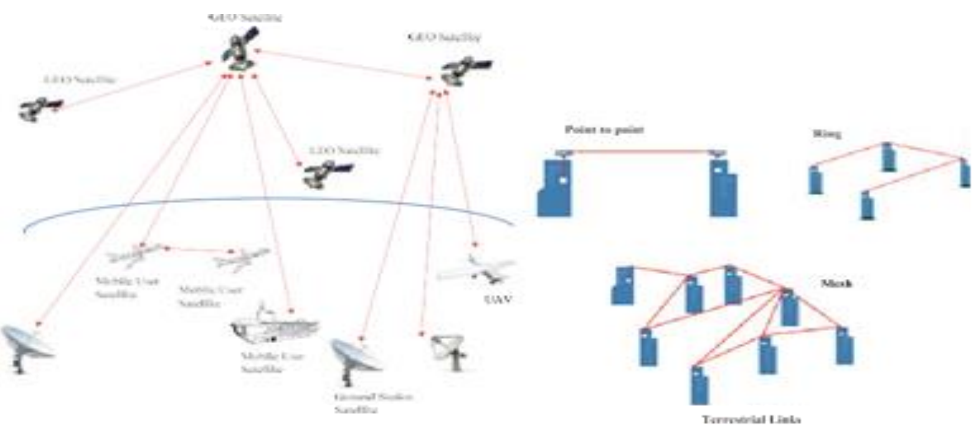

Fig. 1.8FSOcommunicationlinksApplications

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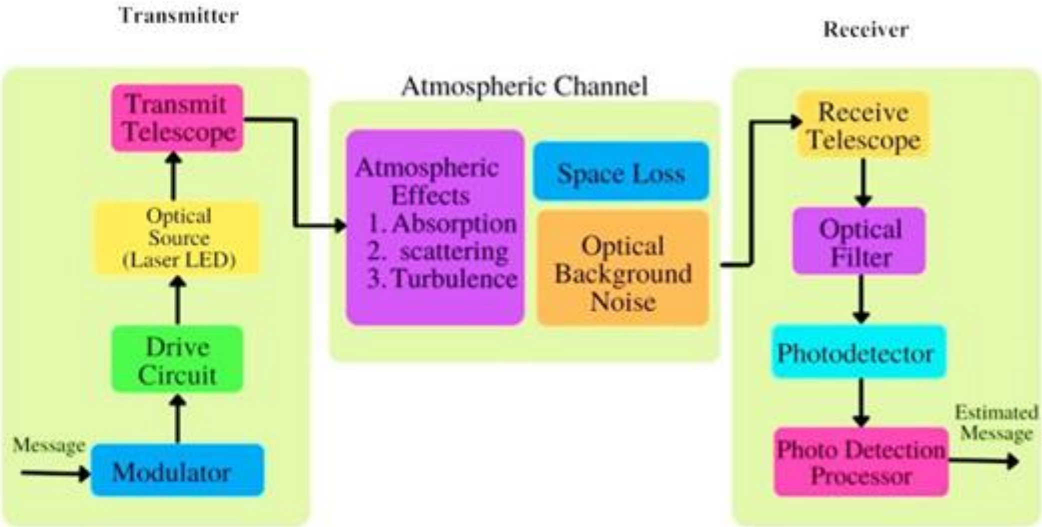

Fig.1.9FSOcommunicationlinkBlockdiagram

2.1. SubcarrierModulation

Unlike the OOK system, it does not need a thresholding technique, and it uses less bandwidth than the PPM technique. Because optical SIM inherits the advantages of a more established RF technology, it simplifies the implementation procedure. Simultaneous transfer of several data streams across an optical link is possible using the SIM technology. Subcarrier multiplexing is accomplished by employing frequency-division multiplexing (FDM) to combine different modulating electric subcarrier signals, which are then utilised to control the intensity of a steady light beam that functions as the optical signal. The SIM objective lens for the FSO link is depicted in Figure 1.16. The drawback of this multiplex system is the receiver's tight synchronisation and design intricacy.

Figure 1.17 depicts the most frequently used modulator techniques in FSO systems. The selection of an appropriate modulation technique

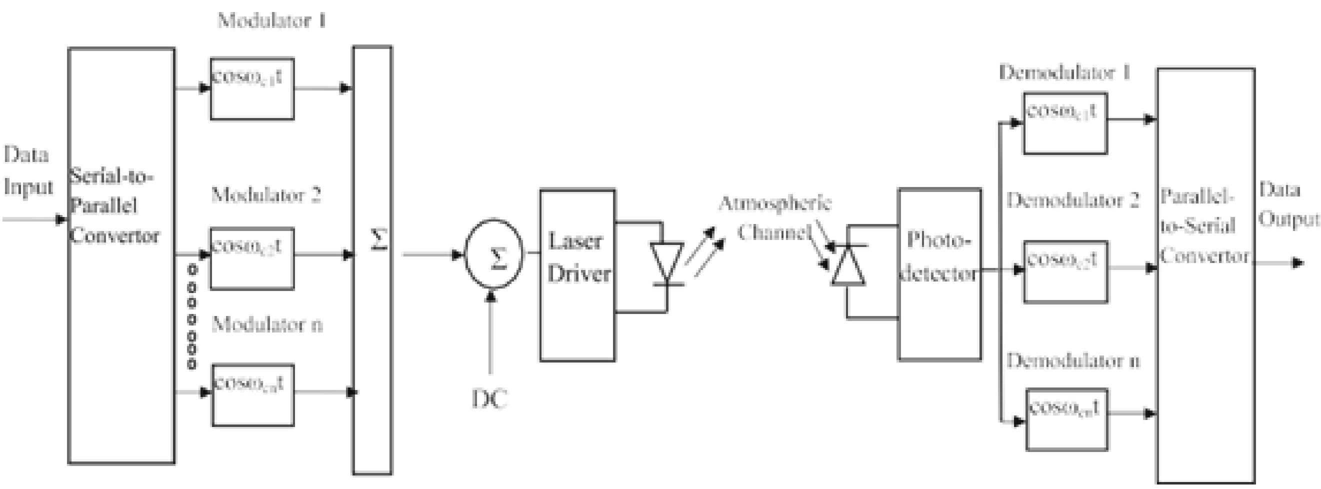

Fig.1.16SIMforFSOlink

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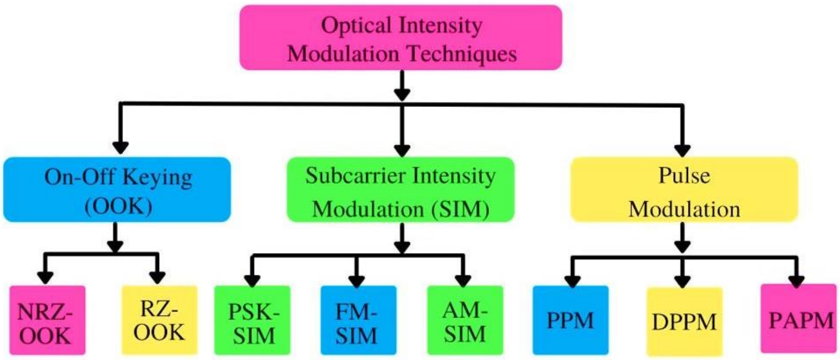

Fig.1.17In the FSO system, there are several modulation techniques.

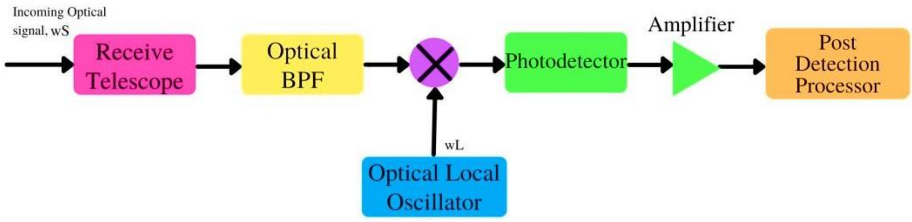

Fig.1.18Coherent optical communication system block diagram

2.1.1. Coherent Detection

The incoming signal is combined with a locally produced coherent carrier wave from a specific frequency in an efficient detection receiver . The photodetector amplifies and turns the optical signal to electrical signal by combining the incoming weak light beam with the strong LO signal.

Conclusions:

As a response, the BPSK has changed. In this situation, the evaluation of the above-mentioned modulating scheme evaluation was finished successfully. Even when atmospheric interruptions are taken into consideration, BPSK and QPSK modulating perform much better in terms of BER than OOK and DPSK modulation, according to both analytical and empirical investigations. After account for atmospheric variations, the mean BER efficiency of the modulation techniques indicates a direct decrease. In both low and high turbulence, the BER performance of the BPSK and QPSK versions is almost identical. Experiments have shown that BPSK has good turbulent resistance in a variety of turbulence conditions. QPSK surpasses the competition by a factor of 2 in terms of spectrum efficiency.

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