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A REVIEW ON WLANS WITH RADIO-OVER-FIBER TECHNOLOGY

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ABSTRACT

Radio-over-fiber (RoF) provides a high-capacity, efficient and scalable 5G architecture for transporting radio signals through optical fibers. With the increase in the technology of networks and the internet, the need of the users also increases. To fulfill this need, the concept of fiber optic was developed. This form of communication is used by the users for many years, but still it requires some advancements and developments to make it more refined. This paper provides a brief to the concept of fiber communication and various modulation schemes; along with this, the developments that had been done in this work are also defined.

KEYWORDS: Optical Fiber Communication, Rof Technology

INTRODUCTION

Optical communication system is the form of communication that uses light as the transmission medium. Optical communication system has many parts like a transmitter, which encodes a message into an optical signal, it also comprises of a channel, which carries the signal to its destination and a receiver, which reproduces the message from the received optical signal. There are other types of communication system such as communication through different channels, i.e. FSO, OWC and Optical Fiber [1].

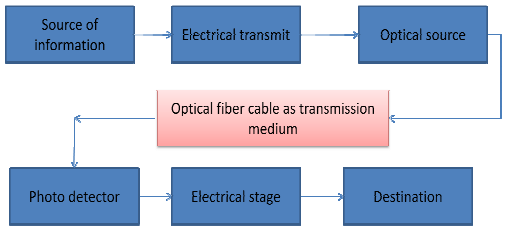

Figure 1: Block Diagram of Optical Fiber

Fiber optic communication (FOC) is a communication technology that uses light pulses to move information from one point to another point through an optical fiber. The light forms an EM carrier wave that is modulated to carry information. Narrowband WLANs requires the user to obtain a license on the other hand, wideband WLANs use the ISM frequency bands of 915 MHz, 2.4 GHZ and 5GHz, which do not require licenses. In single channel long- distance experiments, optical signals have been sent over hundreds of kilometers without amplification. Communication systems use an optical fiber, typically to manage on BER's of less than 10-11.The higher numerical aperture means, a bigger acceptance angle that allows more optical power to be coupled into the fiber. [2]

The capabilities of 5G technology are going to give tough competition to computers and laptops. It will be available in the market in 2020, at an affordable cost with more reliability than previous mobile. It must expand far further than previous generations of mobile communication. Examples of these capabilities include very high data rates, energy efficiency and acute device densities [3].

OPTICAL TRANSMISSION LINK

A general optical transmission links, shown in the below diagram in which, we assume that a digital pulse signal is transmitted over optical fiber unless otherwise specified. The optical link consists of an optical fiber transmitter, receiver and amplifier, each of which is dealt with in the subsequent subsections.

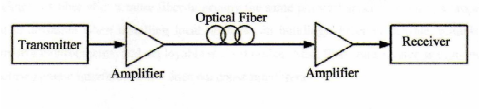

Figure 2: Optical Transmission

RADIO OVER FIBER

Now a day, there is an increasing demand for broadband services, which leads to ever growing data traffic volumes over these services. It is done to provide sufficient bandwidth to individual users. This network is called ROF technology. ROF technique has the potential to the backbone of the wireless access network. RF technology is very old technology for communication. It is the wireless technique for data communication. It is considered to be in use for more than 100 years. In 1901 Marconi achieved his first successful data transmission using the RF signal from one remote station to another. The fiber is a reliable medium with low attenuation (**0.5** dB/km at **1550** nm), confront still exists in large loss due to E/O and O/E conversion. Originally, the band of RF is based on the very low frequency of kilo hertz to GHZ. ROF is an amalgamation of both optical and wireless technologies offering the benefit of high information rate and increased mobility [4].

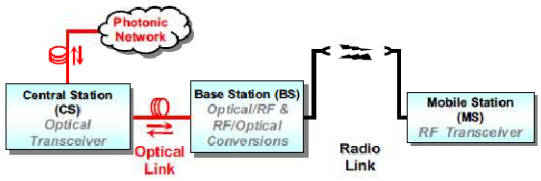

Figure 3: Basic of Radio over Fiber

4G networks are rapidly growing with more network operators around the world adopting the Long-Term Evolution (LTE) standard. The number of 4G connections globally is projected to rise 18-fold to three billion by 2019. Unlike 4G, which is built on a standardized radio access technology LTE, 5G highlights the improvement of current used techniques to optimize data capacity. 5G is speculated to transform the mobility landscape, which has increased data rates, latency, coverage and energy efficiency are still being explored. Many wireless network applications have recently adopted ROF to enhance the network performance and flexibility [5].

In a ROF, transmission links are utilized to connect a central station (CS) to a collection of remote antenna units (RAUs) to provide brilliant coverage and exclusive capacity for short-range communications in picocells, which are located in offices, malls and airports and other high-traffic areas[6]. The RAUs are spread in the streets otherwise inside the building.

LITERATURE REVIEW

ROF is acquiring a huge interest because, it is considered as a potential solution to meet up the growing internet bandwidth. The literature survey discussed below describes the contribution made by various authors in the field of optical communication.

- The authors introduced a method using alternative circular polarizer's to alter the input pulse polarization in left and right polarized pulses prior to multiplexing leading to reduction in FWM. [7]
- The authors conducted an experiment to present an efficient multi wavelength spacing, which was centered around FWM. This multi wavelength generation had a 3dB bandwidth approximately equal to 11nm with 0.1 nm spacing in wavelength. A standard SMF of length 500m, a highly nonlinear fiber of length 500m and length 500 m was inserted into the cavity to analyze the impact of non- linearity and dispersion.
- The author' study discuses the investigated the influence of chromatic dispersion on SMF centered around mode locked laser sources. The simulation results were experimentally validated for a 60 GHZ radio carrier delivering laser, and also for a 400m long length which represented the length of a realistic link for in house distribution.
- The authors proposed double side band modulation to reduce the cost of a system, both at the CS and the BS. The optical millimeter – wave's repetitive frequency was made four times the local oscillator signal frequency by biasing the intensity modulator properly.

QUALITY PARAMETER FOR ROF

Attenuation

Attenuation is a wavelength dependent parameter. Attenuation plays a major role to analyze the maximum distance at which, signal travels with minimum BER. The causes of attenuation in optical fiber are absorption, scattering and sometimes radioactive losses. Attenuation is defined as the power which is decreased exponentially with distance. The attenuation is articulated in part of decibels per kilometer (db/km). [8]

Dispersion

Dispersion is the process, in which optical pulse is widely spread over in the time domain. Dispersion occurs because optical pulses have different spectral components and it holds speed and travel all the way through different paths, hence each dispersion is named as Modal Dispersion, Polarization Mode Dispersion and Chromatic Dispersion.

BER

It is defined as the number of errors which occurs during the interval to the number of pulses transmitted during the interval.

$$\textbf{BER} = \boldsymbol{Ne/Nt}$$

Advantages of ROF Technology

- Low Attenuation Loss: high frequency radio signals electrically over long distances require expensive regenerating equipment.
- Large Bandwidth: For digital devices, the bandwidth is usually expressed in bits per second or bytes per second.

- Immunity to Radio Frequency Interference: optical Fiber communications, which is highly used for microwave transmission. This is because signals are transmitted in the form of light through the Fiber [9]
- Reduced Power Consumption: It may lead to a consequence which may result in simple RAU's with reduced equipment. RAU's is found to be considered which in time is placed in remote areas. The equipments which lead to some complexity are placed at the head end. [10]

OFDM

Orthogonal frequency division multiplexing (OFDM) is a special form of multicarrier modulation (MCM) technique that was developed in the early 1960s. OFDM has been recognized as an outstanding technique for high speed data communication systems (e.g. 4G, 5G, LTE- Advanced). [11].

Advantages of OFDM Systems

- High spectral efficiency.
- Easy coding and decoding.
- Its equalization is actually easy compared to Single-Carrier systems.
- Each sub carrier may transmit as many bits as the channels S/N at that frequency allows.
- OFDM is more flexible for single frequency network in broadcast applications. [12]

CONCLUSIONS

The increased trend of optical communication leads to the various flaws in it. The study comprises of introduction to the radio over fiber and optical communication and modulated technique. After studying the related work in this field, it is concluded that there is need to do more work on the various quality factors like increase in bandwidth, to enhance the number of users that can participate in the communication simultaneously. Hence, future enhancements can be done in order to remove their flaws from the communication system by using trendy mechanisms. The lack of capacity and limited transmission range in WLANs has restricted its usage to applications that expend relatively small bandwidth and in building coverage. Some of the challenges are listed above.

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