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A Study of Radio over Fiber Technology in WLAN Applications

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Abstract: ***RoF stands for Radio over frequency technology. The requirement of high bandwidth, high data transmission rate raise. To fulfill this prerequisite the concept of fiber optic was developed. RoF has attained an operative supply of wireless and baseband signal, and has also diminishes the power consumption. Here in this paper, we evaluate the different challenges that limit the conceivable aptitudes of RoF communication systems and to grasp high-performance RoF links.***
General Terms-Optical wireless communication, Radio-over-fiber
Keywords: RoF (Radio over Fiber), WLAN (wireless local area network), OFDM (orthogonal frequency division multiplexing)

I. INTRODUCTION

Fiber optics with core and cladding of suitable material is dielectric waveguide of cylinder-shaped geometry (refractive index of core > refractive index of cladding). The genuine conductor is there a plastic core or silica glass, several layers in fiber optic strand. Refractive coating which is also known as cladding is the outer part of core. This refractive coating which roots the light to travel beside the entire connection of the core provides reflective surface. The third layer is against wetness and other harm, buffer coating is used to protect also prevents light starting absconding the element might have a color coding for documentation purposes. Fiber optic strand are typically bundled into the cables. Optical Fiber is new medium, in which data (voice, Data or Video) is transmitted through plastic fiber or a glass, in the form of light. Advantages over fiber-vs.-copper:- immune to EMI (electro-magnetic interference), immune to radio over interference, smaller and more lightweight, high bandwidth, increased transmission distance, less signal degradation. With it different kinds of communication scheme such as communication over and done with different channels i.e. optical wireless communication, free space optics and optical fiber. Freshly there exist a lot of studies on FSO communication. It is a kind of new RF wireless communication technology [1]. Optical remote communication Indoor is known as remote infrared communication. For indoor tight buffer cable is used. But optical remote communication outdoor is known as free space optical (FSO) communication. For outdoor loose buffer cable is used. The OWC (optical wireless communication) scheme is not abundant dissimilar from free space optics (FSO). The dissimilarity between OWC and FSO depend in the propagation medium. To overcome the full of atmosphere tempestuousness, there is a weighty determinations study on finding weighty and detailed method model. Results in fluctuations the full of atmosphere tempestuousness at the received signal i.e. signal fading [2]. Fading with various variables is variation of the attenuation of a signal. These variables include geographical position, time and radio frequency. Wireless Local Area Networks be a multipurpose data communications scheme used as per alternative or else either such as an extension toward a conventional wired LAN. Narrowband WLANs requires the user to obtain a licence. On the other hand, wideband WLANs use the ISM frequency bands of 915MHz, 2.4GHz and 5GHz, which do not require licences [3]. WLANs must start to become extra prevalent, as a public hotspot technology, not only within homes and companies. Now days, as the technology is cheap, the simple IEEE 802.11 based networks are the reasons for the fame. It performs impartial as “wireless Ethernet”; for upper layers and applications, it is informal to use unsanctioned radio technology IEEE 802.11(a) and (g) are innovative WLAN technologies using Orthogonal Frequency Division Multiplexing (OFDM) schemes. This modulation technique has been adopted for modern wireless communications because against frequency selective it offers increased robustness. The main principle of OFDM is to fragment a high-rate data stream into a number of lower rate streams over a number of subcarriers that are transmitted at the similar time. These subcarriers are coincided with each other. In indoor atmosphere, Millimeter-wave (MMW) communication schemes work as a high-speed personal area network or wireless local area network [4, 5]. The necessity of large number of BSs, is the main drawback of mm-waves, and signifies high RF propagation losses. The fixing and sustaining the millimeter-wave scheme could be economically outrageous because of the diverse number of the essential BSs, except when the BSs are modest sufficient. The train server can be stored the fast downloaded data. Then over WLAN RoF networks the data can be strewn to mobile stations

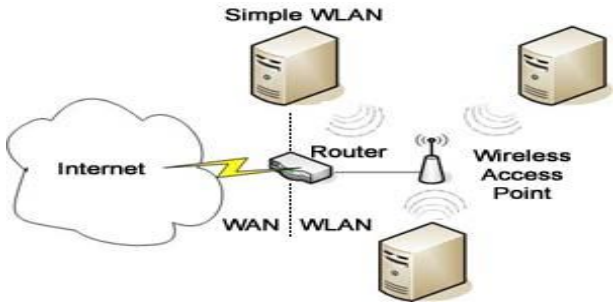

Figure 1: wireless local area network

Due to increasing popularity of the Internet and tremendous rise in the growth of mobile technology, public have become so much dependent on online services. The coverage range of recent wireless access network needs to be raised high data transmission of audio, multimedia services and video with the mobile and fixed customers. Fiber optic communication systems have the highest information-carrying capacity. Due to various restrictions such as geographical condition, resourcefully frugal, provider's stratagem and adverse situation in the case of disasters, high-speed links based on an optical fiber such as a fiber to the home cannot always be used everywhere. Therefore, a radio transmission link is considered for agglomeration large network traffics, which has preceding characteristics in system disposition, such as flexible formation for and easy installation [6, 7]. So integration of optical and wireless network is done to provide sufficient bandwidth to individual users. This network is called radio-over-fiber (RoF) technology. For communication RF technology is very old technology. For data communication, it is the wireless technology. It is used to be considered for over and above 100 years. Marconi achieved his first successful data transmission in 1901, using the RF signal from one remote station to other. Originally the very low frequency kilo Hertz to 1 GHz RF band is based. For microwave communication it can be auxiliary extended to different frequency range. RoF is an amalgamation of both optical and wireless technologies offering the benefits of high information rate and increased mobility. The notion of RoF is to transfer data over optical fiber with radio signal by modulating the light. This modulation is effete directly with intermediate frequency or the radio signal [8, 9]. There are three main RoF communication classifications (Baseband-RoF, RF-RoF and IF-RoF) relying to the frequency range of the radio signal to be transported; Figure 2 clarifies the three categories [10, 11].

a) In baseband-RoF, a information signal is used to restrain the light wave to transmission over the optical connection. As consequence, carrier signal is the light wave and the modulating signal is the message signal.

b) In-RF-RoF, a Radio Frequency signal using a high frequency is modulated with an

Optical light wave signal earlier than being transferred exceeding the optical connection. Consequently, RF signal (wireless signals) are optically appropriated to base stations straight at high frequencies and there is no requirement to any up/ down conversions, thereby a less cost system is achieved.

c) In IF-RoF, lower frequency is used by intermediate frequency radio signal is used for modulating mild earlier than being transferred through the optical link. Hence, wireless signals are transferred at intermediate frequency done with the optical.

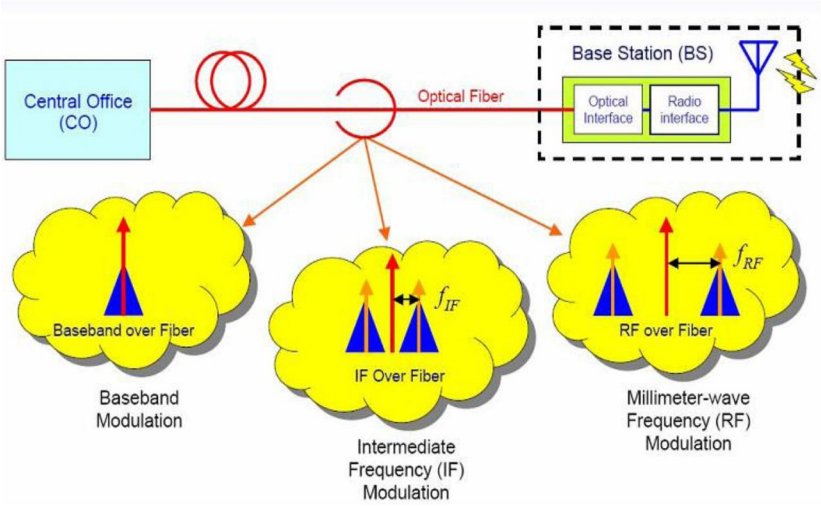

Figure 2: RoF categories

A. Benefits Of Rof Technology

Some benefits of the RoF technology are as given below:

1) Low attenuation loss
2) Dynamic resource allocation
3) Large bandwidth
4) Reduced power consumption

B. limitations of rof technology

1) Poor dynamic range
2) Device nonlinearities can be detrimental
3) Relative Intensity noise in laser source
4) Dispersion effects in the fiber

c. some applications of rof technology

1) Satellite communication
2) Mobile communication
3) Broadband access radio
4) Multipoint video distribution services (MVDS)
5) Vehicle communication

II. BACKGROUND STUDY

RoF is acquiring a huge interest because it is considered as a potential solution to meet up the growing internet bandwidth demand. RoF is an amalgamation of both optical and wireless technologies offering the benefits of high information rate and increased mobility. Some authors analyzed the effects of nonlinearities in a RoF system and proposed various methods to suppress them. The literature survey discussed below describes the contributions made by various authors in the field of optical communication:

The authors proposed a novel RoF network based on frequency quadrupling and double sideband modulation to reduce the cost of 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 [13]. The theory evaluation showed that the information signals after transmitting over fiber could be made resistant to the walk-off of signals, signal fading and the code time shift.

Another study discussed the investigated the influence of chromatic dispersion on SMF centered on mode locked laser sources [14]. The simulation results were experimentally validated for a 60GHz radio carrier delivering laser, and also for a 400 m long length which represented the length of a realistic link for in-house distribution. In addition to this, the effect of chromatic dispersion was demonstrated on signal quality for wireless local area network transmission which employed direct and external link modulation.

A novel design Terahertz frequency for RoF networks integrated with dense WDM scheme. Proposed framework supported enhanced signal security and channel capacity [15]. The wavelength enhancement in optical communication was also reviewed. The proposed system could be incorporated with the current networks in both terabit wireless and wired systems.

Another study described possible architectural approaches for an access network which was converged and based on PON for supporting business and residential services. This framework would enable the network providers to efficiently use the investment made in fiber for deploying premises centered around PON [16]. This would be done by supporting those business services which are higher value on the same infrastructure with the additional benefit of minimal incremental cost. This system reduced the cost of supporting business services and increased revenue opportunities by extending the availability of business service.

The author proposed a novel bidirectional RoF network transmitting 10Gbps DPSK downlink at central office and using ON–OFF keying remodulation scheme at BS for uplink. The proposed system utilized the same optical carrier for both downlink and uplink and so no additional source of light was required at the base station [17]. Thus, the wavelength utilization efficiency was improved and the overall cost of the system was reduced. The simulation results showed that system supported transmission over a distance of 50 km without dispersion compensation.

The execution of WDM Ethernet PON (EPON) with RoF optical link using FBG and DCF to compensate the FWM and dispersion. For compensating FWM and dispersion, two FBGs were used at a wavelength of 1550.11nm and 1552.5nm and also a DCF with dispersion value of -50 ps/nm/km was used [18]. By using FBG and DCF, the system was improved by 77.67%. Q factor, bit error rate (BER) and eye diagrams were the three parameters used for analyzing the execution of the framework.

The authors proposed and demonstrated a novel RoF network implementing optical inter-leaver and external modulator to produce dual octupling-frequency millimeter waves used for two BSs [19]. The re-modulation scheme was used to generate the uplink connection. The system was cost effective because additional laser source was not utilized for generating the two upstream signals and sharing the same laser source located at the central office. The results showed that when the uplink and downlink signals were transmitted over a SMF of length 60km, they suffer from a power penalty which was less than 0.6dB.

Another study demonstrated experimentally bidirectional RoF utilizing a 100m double-clad fiber. The double-clad fiber was used for remote antenna units (RAUs) which were optically powered. It had a multimode inner cladding and a single mode core for a RoF link [20]. The inner cladding was utilized for delivering optical power to RAU while the single mode core was used for simultaneous uplink and downlink transmissions of optical RoF information signals. The main aim of the approach was to eliminate the necessity of utilizing external power supplies, like public power lines or batteries power at the RAUs which were powered optically.

The authors introduced a method using alternative circular polarizers to alter the input pulses polarization in left and right polarized pulses prior to multiplexing leading to reduction in FWM [21-22]. Circular polarizers reduced the products of FWM without degrading the original pulses. Also, FWM could be completely eliminated by utilizing circular polarizers and by adjusting the network parameters like decrementing data rate, increasing the fiber length and increasing channel spacing.

The authors conducted an experiment to present an efficient multi wavelength generation having small wavelength spacing which was centered around FWM [23]. Dispersion flattened high nonlinear fiber (DF-HNLF) was employed along with double-pass configuration to enable an efficient multi wavelength generation. This multi wavelength generation had a 3 dB bandwidth approximately equal to 11 nm with 0.1nm spacing in wavelength. A standard SMF of length 500m, a high nonlinear fiber of length 500m and a DF-HNLF of length 500m were inserted in cavity to analyze the impact of nonlinearity and dispersion.

III. CHALLENGES FOR ROF TECHNOLOGY

In RoF network several challenges must to be addressed to increase the infiltration:

(I) For current access the addressing system and network progression in house is disposed to usage one single protocol to augmenting and take the digital information of the unlike services. To the use of RoF in the network is dissimilar this proclivity as, in this case, dissimilar protocols are used in the services are transferred visibly on their intuitive protocols and parallel as much as possible. Contrariwise, an all-IP evolution network possibly will not stand exclusively appropriate as the arrangement of traffic to retort to the increasing diversity services will be tremendously problematic to realize. By the rapidly evolving situation this is being reinforced where there is unceasing overview of new amenities, interfaces and norms each requiring their own unambiguous superiority of amenity.

(II) In access networks RoF originate from the optical infrastructure of indispensible mutualisation among the diverse network kinds which might have diverse evolutions. Using RoF over current Access Networks architectures for a consequence must be precise but, above this, RoF introduction over Metro- Access networks necessary is prepared for a consequence. By using RoF to use Wireless and Mobile access in superfluous of current optical arrangements the challenge is there to make evident the cost savings that will be realized nowadays.

(III) For RoF the lack of calibration. To inaugurate and retain the standard demanding measurement systems intended for millimeter-wave toward photonic converter as well as microwave, approximately precise pilot work has started, which are used in RoF communication schemes. The ample solutions must be identified collegially between the altered artistes in this sector (operators, system suppliers and component manufacturers) increase the utilization prospects. At present, the architectures and techniques used in RoF are very miscellaneous. So that pushes for the most adapted solutions. [24-34]

IV. CONCLUSION

In this paper the investigation of the RoF skill has been described in which some methods which used also explained. The key disadvantage of the RoF expertise is signal deterioration for example noise and distortion which ought to be rejected in the future. 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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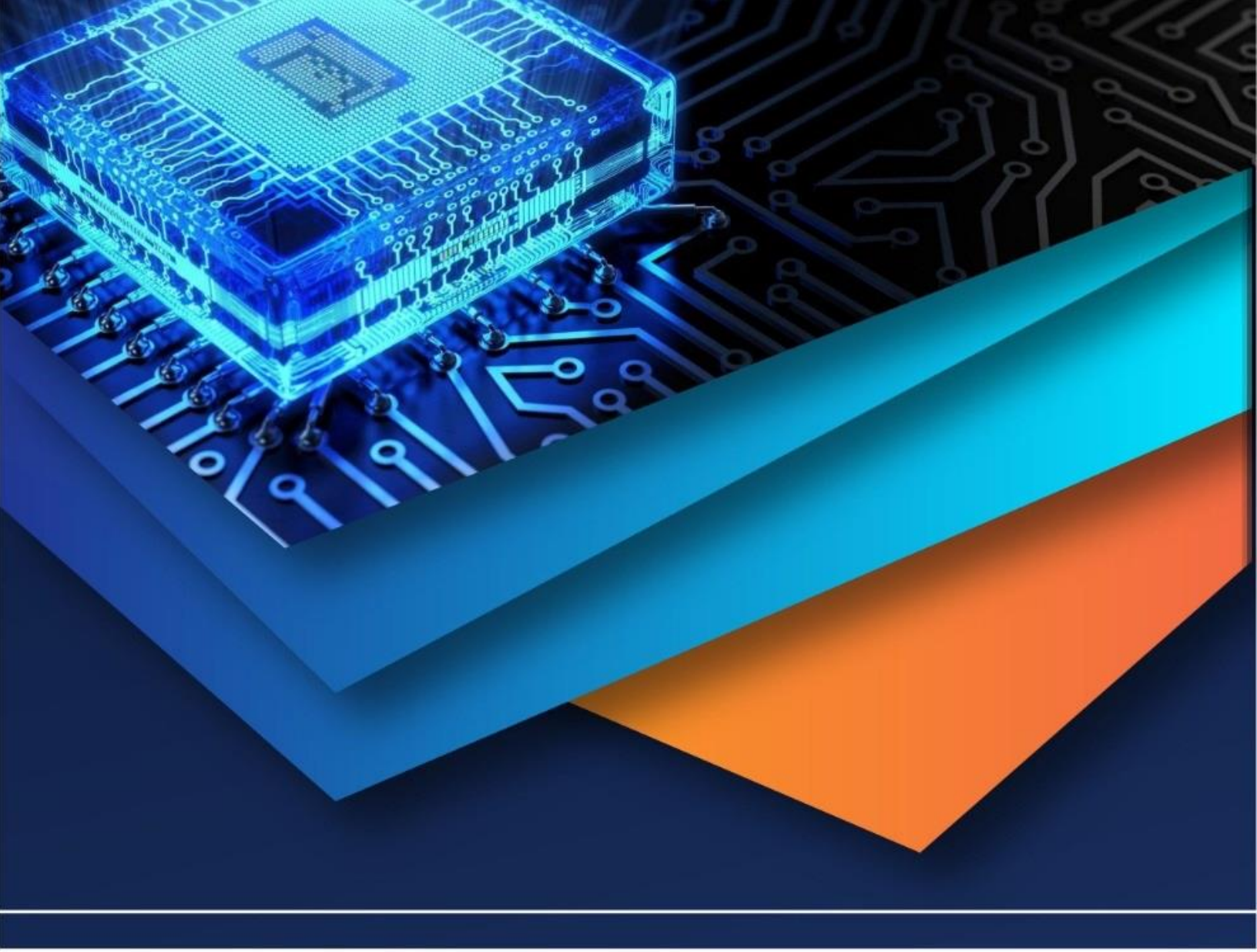

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