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Future Technology of Communication RoF (Radio over Fiber) and Fi-Wi (Fiber-Wireless)

Kavita Bhatnagar[1]

[1] *Assistant professor (ECE) in Jamia Millia Islamia, New Delhi, India*

Abstract-*In this paper we focus on different aspects of optical fiber wireless (Fi-Wi) network. It is a technology of present researchers. Fi-Wi is a combination of optical fiber based network and wireless network. The Fi-Wi is very advance technology for network. It often mixed up with (Wi-Fi) but it can be included in (Fi-Wi). Actually Wi-Fi and Fi-Wi pronounced similar sound so many students and academics and other practitioners are not able to differentiate between both. In this paper we analyze to overcome the various problems of implementing (Fi-Wi) in practical and we provide the researchers to find future direction and to general readers to understand the matter in a better way.*

Keywords: RoF, Quality Parameter, fiber wireless

I. Introduction

The use of (Fi-Wi) or optical wireless is combined use of optical fiber and wireless (radio frequency) for communication to provide telecommunication services in bulk for distant or remote areas. This combination (PONS) Passive Optical Network and (WMS) Wireless Mess Networks is designed to provide network in very far and remote areas. The high capacity optical fiber used to provide cheap wireless link to carry the signal to the last user. The Fi-Wi can be used various types of communication such as upstream, downstream, peer to peer communication.

Fi-Wi network consists of a wireless-sub network as the front and back end. A WMN consist of multi connections to the internet and a group of wireless routers. PON in FiWi network can provide up to 1.25 gbps EPON (Ethernet PON) and GPON (Gibit PON) supporting 2.498 gbps in the downstream and 1.244 gbps in the upstream which are very high facilities but wireless communication network still experiences effects of interferences which causes excessive reduction in the network throughput in wireless sub network or Fi-Wi network which becomes a main point IEEE 802.11 standard for WMNS [3] when P2P (Peer to Peer) communication used in Fi-Wi. The network can be increased by increasing traffic for each P2P communication provide more demand of network to increase overall throughput. But it can be delayed in P2P to reduce in the PON network will be faster than in the multi hop wireless network part. These issues will be discussed later in this paper.

II. RoF (Radio-over-Fiber)

In RoF Wi-Fi networks radio frequencies carried over optical fiber links to central office and multiple antenna. RoF network is useful to provide transparency against modulation techniques and also useful to support various digital formats and wireless standards in a low cost manner. The network use optical fiber as an analogue transmission medium between central control office and one or more RAYS. The CO is manager of controlling access to both optical and wireless media. But use of optical distribution system in wireless network may be a negative impact on the performance of medium access control (MAC). The extra propagation delay can exceed certain time out of wireless. MAC protocol and network performance can become very bad. The fig. show the sample ROF Wi-Fi architecture may be used a Fi-Wi network.

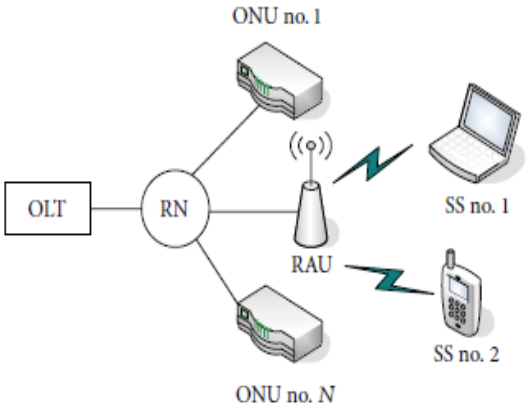

Figure 1: RoF Wi-Fi access network architecture: PON and its wireless extension RAU

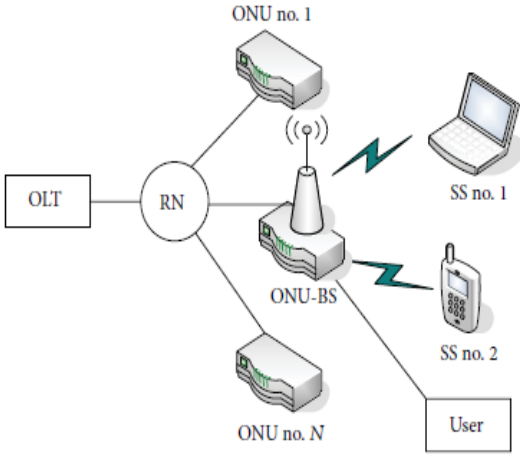

Figure 2: R&F Wi-Fi access network architecture: PON and its wireless extension ONU-BS

III. Fi-Wi Description

In the previous few years Fi-Wi network structures are used extensively by researchers and many other areas. Also, some researchers are going to find out the solution of issues like optimal placement to maximize the network. Through put by reconfiguration of PON structure and routing algorithms in wireless sub network. The strategies of network throughput and gateway deployment play significant roles. On these aspects many papers published but we are going to discuss for better understanding of the topic. Reference [10] presents an idea how to protect Fi-Wi from multiple segment failures. The term is RPMF (Ring based protection considering multiple failures) in this system a backup ONU is installed in each segment of the network. All segments are combined in the network then in each cluster the author cluster back up fibers among the backup ONUs in different segments for building a protection ring. This system guarantees that in each cluster has sufficient residual capacity to carry the interruption of traffic in the worst failure. Scheme such that the network can tolerate the failures of multiple segments, if a segment fails then scheme transfer the traffic to other segment along the protection ring hence this system can tolerate failures of any one segment and its backup.

ONU-BS: Optical Wireless unit base station
SS: Subscriber station
RAU: Remote antenna unit

IV. R & F

Two different MAC protocols are used in RFF Wi-Fi network separately to access PON and WMN. An appropriate optical wireless device is used to translate protocol at the interface of optical and wireless segment such as optical network unit base station (ONU-BS). In this case, MAC is not able to travel along the optical fiber to central control office but it traverse their associated point and remain working. WLAN based R & F done inside the wireless network without central office so it is able to avoid negative impact of fiber propagation delay. On the network throughput and reduce interferences in wireless sub network. R&F is best to build WLAN based Fi-Wi to cover extended network. Fig2 provide a sample and Wi-Fi can be used as Fi-Wi.

V. Quality Parameter

A: Attenuation

In the design of optical communication system attenuation of optical signal is an important consideration for radio over fiber simple mode fiber is very suitable but there in not much fiber simple mode fiber dispersion is not required for low frequency is (10 GHz) Actually attenuation is a parameter depend on wave length at present modern fibers offers as 0.2 db/km loss at 1.5um. All optical issues including fiber attenuation, connector less and splices loss can be calculated as follow

$$OL = 2(NL_c + ML_{sp} + \alpha L_p)\ \text{dB} \qquad (1)$$

Where NLc is the connector loss with N connectors; MLsp is the splicing loss with M splices, and α is the fiber attenuation in dB/km. The OL is very large with every time the power split can be computed as follows:

$$OL = 2(NL_c + ML_{sp} + SL_{split} + \alpha L_p)\text{dB} \qquad (2)$$

In this case S splitters each with loss L split.

B: Scattering

(SBS) stimulated Brilloun scattering is one of the most severe non linear impairment. Both the amount of back scattered optical power and generated noise quickly increases with the input power. If the input power into a fiber reaches a critical value known as (SBS) threshold. SBS create limitation on an amount of optical power launched into the fiber without degrading signal quality. At present there are many investigation taken place on post system for radio signal distribution that target 3G cellular and wi MAX service distribution since. SBC is the key limiting factor to stimulate Brilloun scattering in Radio-over-fiber transmission may be strongly suppressed with single mode optical fiber.

C: Dispersion

For analog optical links ROF builds broadband wireless and wired connectivity is a promising application If we applied microwave and Micrometer-wave bends the performance will be improved by the chromatic distance for long reach radio-over-fiber links chromatic dispersion compensation scheme used parallel electro – optic phase. Modulators also suitable for long reach radio-over-fiber links. Wide operating bandwidth of 0-18GHz over a 34km single mode fiber. The powers fading around by the dispersion suitably compensated properly adjust. The optical power and time delay between two modulated signals. Optical fiber is optimized for less chromatic dispersion to minimize the pulse spreading in the proposed system

D: Bit Error Rate

Transmission channel noise, interference, distortion bit synchronization problems may be affected by BER. But BER can be improved by using strong signal strength or slow and robot modulation scheme by deep study it is found that the length of fiber but decrease after some time. It is found that BER is less compare to analog ROF.BER Of BPSK is less than QPSK and 16QAM is better choice for digital link

It is found that digital Radio over fiber shows improved performance over analog link.

E: Carrier to Noise Ratio

Mach Zehnder (MZ) modulators and optical amplifier will be used for a variety of application such as antenna remoting in ROF net works. Also fiber amplifiers may be used to increase the RF gain and dynamic range and improve the noise figure. To increase the CNR modulator bias control in narrow band links can be used odd-order non-linear tie which are Affected narrow band signals used in 802.11 a/g systems. In such a link, because the CNR improvement is maximum, if link CNR is limited by laser intensity noise or by saturation of the detector, the optical power over the fiber can be high enough to excite nonlinear effects including Stimulated

Brillouin Scattering. SBS is a serious impairment for signals with narrow optical spectrum: it limits the power that can be transmitted on a single-mode fiber. Optical carrier by controlling the modulator bias can lead to simultaneous optimization of RF gain and suppression of SBS-induced noise. This translates into improvement of the CNR, even for SBS noise limited links, without the complexity of an additional phase modulation.

Table 1: Comparison of parameter of wireless RoF

Parameter	SCM	WDM	OFM
Attenuation	Moderate	Low	Low
Scattering	SBS	FWM & SBS	SBS
Dispersion	PMD & Chromatic	Chromatic	Chromatic
BER	LESS	More	More
CNR	LESS	More	More

VI). Challenges of Fi-Wi

1. In different devices use of digital data in length protocol in house network. This is different because different protocols are used in parallel. The Services are provided accurately on their original protocol on the other hand. There is different realization of all IP network because it is not entirely desirable to increases the service There is specific quality of disturbance to introduce new evolved situation.

2. RoF is comes from optical infrastructure between different network evolution. A scheme for using RoF over current access network architectures must be explained but first of all a scheme for introduction of RoF over metro-access network should be prepared. There is another challenge to demonstrate the cost saving which is realized today by using RoF to utilize mobile and wireless access over optical infrastructure.

3. There is lack of Standardization for RoF in primary work to display and maintain the standard specifying methods for microwave and millimeter wave to photonic converter used in RoF systems. Recently there is very diverse and adequate solution in RoF techniques and architecture between different operator systems supplied and manufactures. We have to increase opportunities of establish more and more to find better solution.

VII). Quality of Service issues

QOS (quality service) service is very important to run various multimedia application over Fi-Wi network because QOS technique are very essential to measure hand width to process network for implementation over other available alternative QOS technology can be used to process traffic for sensitive application such as voice video and to control these there is a requirement for quick change in the variability of wireless channel condition for better service at present various QOS technique have been developed for Fi-Wi network. It can be a achieved by layering for hybrid Fi-Wi several technique are going to be used to provide QOS better services for and users in[1] many scheduling approaches were being examined for EPON and WIMAX. The result show better and improved network throughout for different QOS demands. In [2] the integrated QOS aware dynamic handle width allocation (DBA) scenario is proposed. It supports fairness at the ONU-BS interface which sends optical band width request to the optical live segment (OLT) the result show improved network It is importer maximum network throughput to use key QOS metric such as packet less bandwidth delay fitter and packer error ratio

another mean improve QOS is to design better routing algorithm.

VIII: Future prospectus of Research

There are certain areas where huge scope of research is there to achieve the optimum and the maximize outputs. Some of the parameter are as follows

- Performance
- Routing
- Architectural issues
- Energy Consumption
- Throughput
- Smart Grid integration.

a). Performance

The performance of Fi-Wi network relates the design of gateway nodes (ONUS) is very important in Fi-Wi integration but bandwidth allocation, routing and link scheduling are also important, functions in the network design. In the shared wireless medium link scheduling is used guarantee interference free transmission performance of these networks uplink can be degrade significantly by using multipath dispersion introduced by the wireless link and the non-linear distortion. Caused by the radio-over-fiber (ROF) link [4] to explain optical fibers multipath dispersion occurs in a wide core due to light travelling along the axis of the core travels a shorter distance parameter of a fiber than light repeatedly under goes total internal reflections A pulse of light become longer than its range if too long it may be merge with next pulse. This creates multipath disturbance.non linear disturbance means the phenomenon of non linear relationship between the input and output signals of electronics device (which is sending signals) receiver side cannot be measure these issues. Therefore channel equalization is puzzling task in Wi-Fi network. For better performance its needs to adjust the balance between of frequency component within an electronic signal for smooth operation of net work. There are some work [4, 5] to improve performance regarding this issue an optimal solution applicable in various schemes is always an open challenge.

b). Routing

Routing is very important link other network in fi-wi network because multi hopping create a great impact on network performance degradation in WMN, Routing algorithm persist paper [6] intensive research work on upstream scheduling algorithm for PON or related system are contributed the traffic flows via wireless upstream links may lead to signal attenuation reducing interference and noise .Therefore existing algorithm adopted by investigating features of wireless links.

c). Architectural Issues

There are several researches who have suggested may net work architecture which combine optical and wireless communication to gain maximum network throughout put some of them [7] are independent and ratio-over-fiber.(ROF)

The ONU is directed connected in the independent architecture with base station (BS) through a common standardized interface MO direct wireless link between ONU and the clients, the main benefit of this architecture is the independent deployment of the two access network But communication between ONU and BS is unavoidable due to separate domains. So, control signaling messages can suffer a delay and cause traffic overhead. There are an open challenge of reducing delays in both parts of Fi-Wi services like video –on-demand (VOD) live streaming video conferencing and other multimedia delivery is considered [8,9].

Architecture consist of a central office (CO) and a remote antenna unit connected by an optical fiber link on which microwave signals are distributed in radio-over-fiber (ROF) for low attenuation loss it is advantageous of ROF architecture intensity to radio frequency interference and reduced power consumption . The signal impairments such as noise and disturbance become serious issue to handle for analog modulation and analog signal transmission.

d). Energy consumption

It is a major issue of the Fi-Wi network implementation. There are many parts supported by constant energy supply. Therefore saving energy or energy cost is severe issue to make it more economic over other available technologies. As we are going towards green Information Technology (IT) or green computing age, it is very important to know how to reduce energy consumption in Fi-Wi network. It is hope full to use widely Fi-Wi network in competitive advancement technologies in electronics applications in future.

e). Throughput

For internet traffic it is necessary for each router should able to reach at least one (ONU) for the internet access. Shortest path with minimal hop count to ONUs must be calculated in each wireless node and select one ONU as a primary gateway for internet access. When the traffic is only directed for the internal access. The network throughput will be high on the other hand the network throughput could decrease when the traffic demand increases peer-to-peer communication due to the interferences will be increased in the wireless network. The network throughput may be less when nod degrees are increased in the wireless network. By applying more traffic demand for each flow of the network we can increase the network throughput in Fi-Wi network and in WMN.

***f).* Smart grid integration**

There is very interesting area for further investigation would be joining Fi-Wi network with smart grid. The Fi-Wi could work as a backbone for faster operation of smart grid. Also, we can take an area of cloud infrastructure with Fi-Wi support. There is a major issue to reduce time in many commercial and business computing applications.

IX). Conclusion

To conclude the complete contribution of this paper , the RoF and Fi-Wi network architecture and their performance quality parameters are discussed based on different research already been conducted. Numerous aspects of the RoF and Fi-Wi have been investigated to get the insight of the technology. This paper contribution is that we have foreseen various future research areas for doing further brief study and some of the points we have mentioned where we have proposed the possibility of pairing the Fi-Wi technology with the mainstream networking research. In particular, Fi-Wi networks are good platform for the long distance communication. It can provide high-bandwidth communications as well for the future innovative different applications and services. Therefore, In spite of mentioning several issues, many more other network architectural issues are yet to be explored in future with more details.

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