

# A Review on Radio over Fiber Technology with Its Benefits and Limitations

Neeraj Singh<sup>1</sup>, Harmanjit Kaur<sup>2</sup>M.Tech Student, Dept. of EEE, Arni University, Himachal Pradesh, India<sup>1</sup>Assistant Professor, Dept. of ECE, Arni University, Himachal Pradesh, India<sup>2</sup>

**ABSTRACT:** RoF stands for Radio over frequency technology. As today's era is the era of networks. Therefore whole data travels over the internet. So there is a chance of data traffic over the network due to excess of data to be transmitted. RoF is a technology which provides the access to the bandwidth of the channel. Hence it is used to control the traffic over network in case of wireless networks. There are many advantages of RoF like it provides the facility of low attenuation. It is easy to install and cheap which leads to the less maintenance cost. In this all the equipments are located at the central end and all other networks or channels have access of these equipments or devices. There are some disadvantages of RoF such as sometimes it is must to use the costly equipments or devices.

**KEYWORDS:** RoF (Radio over Fiber); RAU; Radio Frequency; Radio Fiber; Base Stations; MU (Mobile Units); Antenna units

## I. INTRODUCTION

In today's era the data travelled over network so this leads to an increment in Data traffic over the internet. It is necessary to control this data traffic in order to timely delivery of data. ROF is Radio over Fiber technology which is widely used to control the data traffic. Optical wireless approach is used for network connectivity in ROF. To increase the broadband range is quite difficult in ROF. It is because the Radio Frequency Spectrum is congested. In order to set high speed multimedia facilities in optical wireless networking extensive bandwidth is used by the mobile terminals [1]. Radio over Fiber is a technology which is used to transfer the data over the wireless network by making variations in signals. In variation of signals light signals are modulated with radio signals [3].

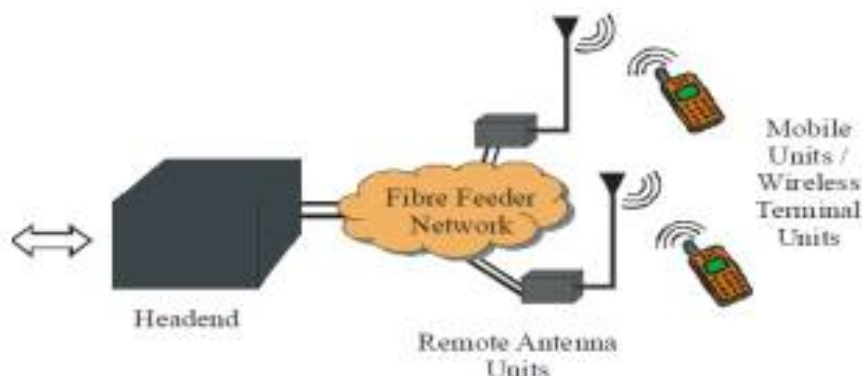


Figure. 1. Concept of Radio over fiber System

The signal modulation can perform directly by using radio signals or intermediate frequency can also used for modulations. Higher operating frequency i.e. above 6 GHz is needed in order to increase the capacity of the per unit area. The signals are transmitted from base stations by using linear optical Fiber links. In RAU only conversion devices are used like optoelectronic and amplifiers [4]. All the techniques used for ROF are efficient because provides low loss of data and a higher range of bandwidth in order to transmission of data. The maintenance and installation cost of such systems are quiet high. To reduce the cost of the system one should use simple radio antenna units. The signals are

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combined with centralized head to minimize the cost of the system. The signals and centralized head are combined by using ROF technology [2][5].

Following figure shows the concept of Radio over Fiber diagrammatically.

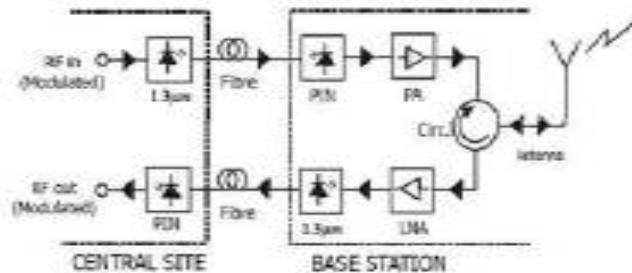


Figure 2. Basic of RoF system

Radio over Fiber technology preferred a single shared location to centralize the RF signal processing. In this optical fiber links are used to dispense the Rf signals to RAUs or Base stations. In case of network architecture, switching, routing and all other OAM i.e. Operation Administration Maintenance is done by CS. For wireless distribution antennas are interconnected. The main operation performed by the BS is it processes the optical signals to wireless signals [6].

## II. ADVANTAGES AND DISADVANTAGES

As we know each and every technology has some advantages and disadvantages. Similarly, RoF has some advantages and lacking points as follows:

### A. Advantages of ROF Technology

Some of the advantages and benefits of the RoF technology are discussed follow:

- Low Attenuation Loss
- Large Bandwidth
- Immunity to radio frequency interference
- Easy installation and maintenance
- Multi-Operators and multiservice operations

#### (i) Low Attenuation Loss:

It is difficult and expensive to disperse the electrical signals with high frequency. Thus in order to transmit the signals of high frequency requires expensive equipment which supports the transmission over a long distance.

#### (ii) Large Bandwidth:

Radio over fiber uses the optical fibers to transmit the data in wireless network. There is an advantage of using optical fiber that they provide high rate of bandwidth.

#### (iii) Immunity to Radio Frequency Interference:

The main feature of optical fiber is that it provides the facility of EMI i.e. Electromagnetic Interference. In case of optical fiber data travels in the form of light and by using fibers. For this fiber cables are mostly preferable even in short distance also [3].

#### (iv) Easy Installation and Maintenance:

It is easy to implement and maintain a RoF system. Because in this head end is occupied with complex and expensive equipments. Hence it makes RAU much simpler. For example in case of a photo detector the RF amplifiers and antennas are used in the system. Various RAU shares the modulation and switching devices which are located at the head end. Such systems can perform faster as compare to other systems. Due to all arrangements of the system the maintenance and installation of the system becomes easy.



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(v) Multi-Operator and Multi-Service Operation:

Each RoF systems facilitate the operational flexibility. In case of microwave generation technique, system is created of signal format transparent. It is one of the advantages of the RoF system [3].

## B. LIMITATIONS OF ROF TECHNOLOGY:

RoF system is an analogue transmission system. It detects light and modulate the analogue signals. Hence like any analogue system signal impairments like distortion and noise in the signals are vital in RoF also. These impairments are used to bounds a limit on Noise Figure and Dynamic Range NF and DR respectively. DR stands for dynamic range and plays an important role in mobile systems [7] like GSM because the power at Base station which comes from MUs fluctuates continuously. It refers that the power received from MU which is located nearest to the base station may be higher as compare to that one which is located far away from the Base station but within in the range of same cell.

## III. RELATED WORK

**Pooja [3] et al**, In this paper author explains that radio over fiber technology is a combination of two techniques wireless and fiber optic networks. It is a preferable and important technology used to access broadband in case of wireless networking systems applications of RoF system is last mile solutions, existing radio coverage and capacity etc. In this paper pros and cons of RoF system is explained by author. Various techniques which are used to transfer the Radio signals by using fiber is also define in this. Idea behind the usage of radio over frequency technology is also given by the author.

**Naresh Kumar [2], et al**, In this paper author defines that radio over fiber is a technology which is used to control the traffic over the wireless communication networking system. It is a technique which is created by using two techniques collectively. The techniques which are used for creating RoF are fiber optic and wireless. Hence it transfers the data in the form of light by using fiber optic cables as a medium of transmission. In this advantage along with disadvantages of the radio over fiber system is explained. Author also represents some techniques which are used in RoF for data transmission. Some applications of radio over fiber technology is also described like RoF is used in backhaul etc.

**D.Wake, [7] et al**, In this author represents a scenario of RoF in which low cost optoelectronic components are used for distributing data over various antennas. Whereas in RoF systems complex and costly equipments are used to transfer the data over the wireless network. In this various design issue regarding RoF system is discussed along with another parameters like bandwidth supported by the channel, modulation frequency of the channel and sub carriers in OFDM. Hence it is proved that noise introduced in the signals does not effects much more on range of the signals in wireless network. From the cost point of view RoF is best technology to be used as compare to other technologies. It also best in performance parameters as others are not that much better.

**Ali Hussein Radhi [8] et al** in this paper author describes that to reducing the Bit Error rate of lowest power penalty in case of RoF system is quite a major problem. In this paper performance of WFDMA system which poses the 5 Gbps OOK signals and 5 base stations in 6 km area is evaluated. In this paper it is shown by the author that the proposed technique has less BER and is much efficient as compare to other techniques. The value received of BER in proposed technique is negotiable in case of multimedia and real time application.

**Sreenesh Shashidharan [9] et al**, In this it is explained that two techniques are combined in Radio over frequency technology which is makes it much efficient from performance point of view. RoF is a technology which is used to access or control the bandwidth of the wireless system. It is used to control the data traffic over the wireless networking system. It is used in real time multimedia applications because it provides the high capacity multimedia services. The RoF system is designed by using Optisystem 10 is a integrated system which uses both radio frequency wireless and optical fiber, there is a central node or base station, remote access unit and a link which is made up of optical fiber.

**Arya Mohan [10]** RoF is a technique in which signals are transformed in the form of light. The media uses for transmission is fiber optic cable. In RoF full duplex communication is done by using WDM i.e. Wavelength Division Multiplexing and Optical Add Drop Multiplexer. WDM is used for the purpose of transferring various signals over a



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single mode fiber media whereas OADM is used for data transfer in both cases such as down link and up link. In this author uses different line coding technique. The simulation of the technique is done by using Optisystem 12.0 by Optiwave.

**Virendra kumar [11] et al.** this paper focuses on the optimal transmission over the single fiber having linear and non-linear dispersion. Consequently, these parameters are of great concern because it pulls down overall efficiency of the system. Another term used in this paper is loop control which is an important component in optical transmission system. Loop control is basically used to increase the length of the optical fiber as it has a multiplier for this purpose. Erbium Doped Fiber Amplifier which is used to enhance the efficiency of the signals over the channel. The basic idea of this paper is to analyze RZ and NRZ modulation schemes. Both schemes has been used to avoid crosstalk between the signals over the optical fiber at the time if transmission. Thus each modulation scheme consists of various merits and demerits according to conditions of particular channel. Accordingly both schemes have been evaluated and their performance is checked respectively. Lastly comparison performs on the basis of Q factor BER, eye diagrams and average input power so to establish pros and cons of RZ modulation scheme.

## IV. CONCLUSION

In this paper the review of the ROF technology has been explained in which some techniques which use radio over fiber technology are also explained. The main advantages of the ROF technology are low attenuation loss, large bandwidth and easy installation and maintenance. The main drawback of the ROF technology is signal impairments such as noise and distortion which should be eliminated in the future.

## REFERENCES

1. Ajay Kumar Vyas, Dr. Navneet Agrawal, "Radio over Fiber: Future Technology of Communication", IJETCS, Volume 1, Issue 2, 2012.
2. Vandana Ydav, A.K. Jaiswal, Mukesh Kumar, "Radio over Fiber Technology", IOSR-JECE, Volume 9, Issue 3, Ver. I, PP 83-8, 2014.
3. Pooja, "Advantages and Limitation of Radio over Fiber System", IJCSMC, Vol. 4, Issue. 5, 2015.
4. Naresh Kumar, "A Review Paper on Radio Over Fiber Technology", IJAER, Vol.7 No.11, 2012.
5. Subodh Ku. Gond, Sai Prasad A, "Green Antenna and Radio over Fiber Technology for a Cellular Wireless", IJEIT, Volume 2, Issue 1, 2012.
6. Lu Hai-Han et al, "A Full-Duplex Radio-on-Photonic Crystal Fiber Transport System", IEEE Photonics Technology Letters, vol. 19, No. 11, 2007.
7. D.Wake, "Radio over Fiber Systems for Mobile Applications", Radio over Fiber Technologies for Mobile Communications Networks, H. Al-Raweshidy, and S. Komaki, ed. Artech House, Inc, USA, 2002.
8. Ali Hussein Radhi, "Performance Analysis of Radio over Fiber System with Ook Based Dwdm for Fiber to Home Network", IEEE, Volume 8, Issue 5, PP 26-29, 2013.
9. Sreenesh Shashidharan , "Design and Simulation of Radio Over Fiber System and its Performance Analysis using RZ coding", International Conference on Electrical, Electronics, Signals, Communication and Optimization (EESCO), 2015.
10. Arya Mohan, "Full Duplex Transmission in RoF System using WDM and OADM Technology", IJERT Vol. 4 - Issue 01, 2015.
11. Virendra kumar, "Design and Performance Analysis of Optical Transmission System", IOSR Journal of Engineering (IOSRJEN), Vol. 04, Issue 05, PP 22-26, 2014.