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Study and Comparison of Various Bit Error Rate in OFDM-RoF System Using QAM Modulation

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***Abstract*— Wireless communication nowadays adopts many new technologies in the mobile users. Every day, mobile user is increasing rapidly, but theme to rural and inaccessible area to access poor voice and data services. The recent and upcoming generation of wireless and mobile communication system support many new applications such as high bandwidth that includes High Definition Mobile TV, LTE, VoLTE, ViLTE and other multimedia services. Due to the demands, wireless and mobile communication system need to improve a high capacity for recent and next generation wireless technology. OFDM is the better solution to solve these demands multiple techniques for both wired and wireless mediums. Also the wireless and mobile broadband services the problem with low attenuation, electromagnetic interface and power consumption. To overcome these problems Radio over Fiber system (RoF) is introduced. This paper focuses the comparison of various literature studies with the combination of OFDM-RoF system. This survey takes responsive of the system relating to various problematic aspects and relevant papers. And it also analysis the merit and demerits of the existing QAM (Quadrature Amplitude Modulation) based systems.**

Keywords*— OFDM; CO-OFDM; RoF; Radio over Fiber; QAM.

I. INTRODUCTION

The field of Wireless communication has a significant development to appear anywhere in the world. It is considered the fastest growing sector of communication diligence, particularly in the mobile statement for the public region. The mobile phone has hit upon dominant devices for the humans which have been growing mentionable over the past decade. Certainly, this is also a part of the business tool of everyday life in the most number of users placed in developed and developing countries. Additionally, wireless local area network is balancing many of the wired network devices within the campus of private and public sectors etc. The government and some private concerns also provide free access to WiFi network anywhere like Railway stations, Bus terminals, Airport, Hospitals, Banks, Restaurants, Universities, Shopping malls and other government and private offices.

The explosive developments of wireless systems along with various network applications are available for personal computers and other communication devices. The recent cellular technology moves around the emerging data and internet service interconnect with Third Generation (3G) and Fourth Generation (4G) mobile communication that enables a wide range of frequency spectrum for multimedia and other internet application to access anywhere. The internet data service recently has its impacts on the many applications of mobile platforms that include a smartphone, tablet, smart notebook, and laptops. The mobile platform has significant development for radio technology, providing to a wireless network, which enables a wide range of application currently supported for fixed devices such as a wireless modem, Bluetooth, wireless Hotspot devices and Wireless HD Television. The extensive range of application on the mobile devices requires accessing instantly to more bit rates, the growth of spectrum efficiency, system capacity and efficient integration with the protocol for the radio frequency channel and that also confirms the security for the open access medium. [1, 2]

A. *Internet Users in India*

The internet and Smartphone industries have increased rapidly in the past few years. It has been observed to increase the growth of internet factors and the mobile phone industries are eventually attempting to provide high-speed internet via mobile and Smartphone, PCs, Laptops, and tablets. Recently the increasing of 4G mobile broadband and WiFi which access anywhere in the public users in India are quickly growing up and this promises to boost the member of users from the present 350 million to 600 million users in 2020. The report "Internet in India 2015-16" of December 2016 says India will have second largest internet users in the world by overtaking

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the USA. This is based on a report released in Internet and Mobile Association of India (IAMAI). [3]

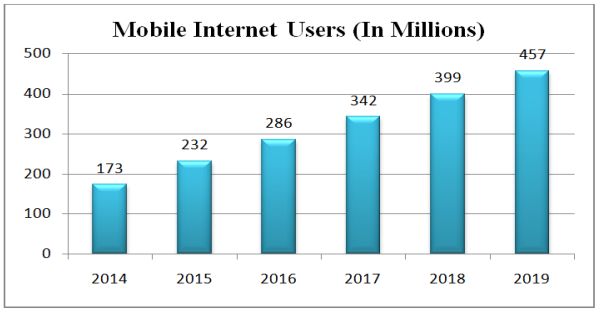

Fig. 1. Mobile Internet Users in India

According to this study, the internet user in India has reached over 27% dispersion when compared to 50% in China. Also, India is the second largest mobile phone market globally, more than one billion mobile subscribers is likely growing into 520 million users in 2020. It requires high spectrum availability in the Indian metros which is about to increase 10% of the frequency band or implement other data access technology like Optical Fiber based Network applications such as Radio over Fiber (RoF), Free Space Optical (FSO). This has caused a major difficulty in providing high-speed data services. It is the responsibility for Indian Telecom Industries of TRAI (Telecom Regulatory Authority of India). The public WiFi in India will require 8 million hotspots which are about to work. Currently they served 31,000 hotspots in the public sectors. India has seen an increase in the internet surfers from 2014 to 2019; there is a consist growth ~50 million numbers of mobile phone users annually, and the same could reach ~580 million users in India in 2019. [3]

B. Fundamentals of OFDM

Frequency Division Multiplexing (FDM) is a technology that transmits multiple signals simultaneously over a single transmission path, such as a cable or wireless system. Each signal travels within its own unique frequency range of carrier, which is modulated by the data (text, voice, video, etc.). OFDM is a technique that distributes the data over a large number of carriers that are spaced apart at precise frequencies. This spacing provides the Orthogonality in this technique which prevents the demodulators from detecting frequencies other than their own. It's sometimes referred to as multi-carrier or as discrete multi-tone modulation. Some of the benefits of OFDM are high spectral efficiency, resiliency to RF interference and lower multi-path distortion. It is high spectrum efficiency that proposed to improve the system capability for distance over optical and radio frequency domain. OFDM is a modulation technique for future broadband wireless communication. It provides for multipath spread-spectrum in the mobility system and it represents a different system design approach as a combination of modulation and multiple accesses for the communication channel. It divides the spectrum into a number of equal spread-spectrum at a part of one user. [4, 5]

The orthogonal shares the entire channel at one frequency and allows the spread spectrum that overlaps the sub channel. The Orthogonal cannot interfere with the neighboring channel. The OFDM transmission technique established itself as a popular method for overcoming the frequency selective fading in broadband wireless systems. Especially WiFi and WiMAX are recent dominating features of local area network and broadband wireless network respectively. The WiMAX standards have proposed various OFDM based methods for use in fixed and mobile environments. The various systems that use the OFDM include power line communications, digital audio and video broadcasting systems, and ultra wideband based systems for short range wireless. Some of the key concepts in the OFDM include the use of orthogonal sub-carriers for sending several data symbols in parallel resulting in better spectral efficiencies and simple equalization methods at the receivers. Figure 2.1 shows the spectrum modulation format of OFDM. [6, 7]

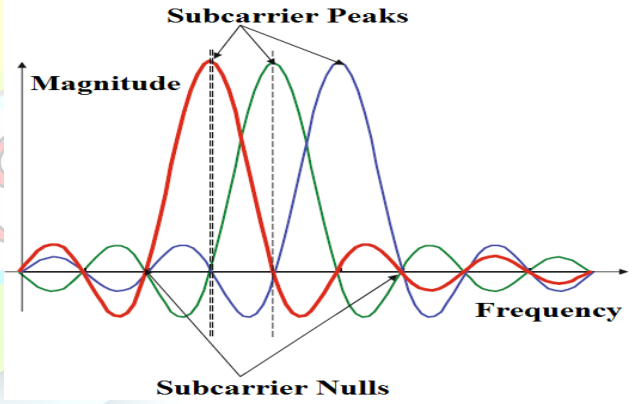

Fig. 2. OFDM Spectrum

The samples of the transmitted OFDM signal can be obtained by performing an Inverse Fast Fourier Transform (IFFT) operation on the group of data symbols that is to be sent in orthogonal sub-carriers. Similarly, the recoveries of data symbols from the orthogonal sub-carriers are accomplished using a Fast Fourier Transform (FFT) operation on a block of receiving samples. Thus, the IFFT and FFT blocks at the transmitter and the receiver, respectively, are important components in an OFDM system as shown in Figure 2.

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C. Radio over Fiber (RoF)

At present, Wireless communication networks face many difficulties in data transmission for the both fixed and mobile data network approaches. Every-day, the internet users are increasing rapidly and they have poor access to voice and data communications during the demands of internet traffic. Next generation wireless and mobile communication system includes many new applications with IPv6 network protocols and multimedia services. Radio over Fiber (RoF) or RF over Fiber (RFoF) is the best solution for the various demands of these issues. Hence it could be the best answer to solve many demands on the broadband communications. RoF refers to a technology whereby light is the modulation of a radio frequency signal and transmitted over an optical fiber link. RoF intends that single antenna can receive all radio signals (such as 4G, 5G, WiMAX and mobile broadband) carried over by a single fiber cable to a central location and then the equipment can convert their signal separately at the appropriate receiving antenna to the end user.

RoF transmits microwave and millimeter wave through the optical fiber for long and short distances. This system provides an optical link and can connect Central Office (CO) to the Base Station (BS) as well as to the different customer units through the RF using an Optical Backbone network in the RoF system. The RF signal processing such as frequency up-conversion, carrier modulation, and multiplexing has performed into the antenna. This system reduces the deployment and maintenance cost of wireless networks while providing low power consumption and large bandwidth for very attractive technique in the wireless network. The RoF system connecting Central Office (CO) to different Base Station (BS) node with millimeter wave frequency the range of 20-100GHz is shown in the following Figure. 3 [8, 9]

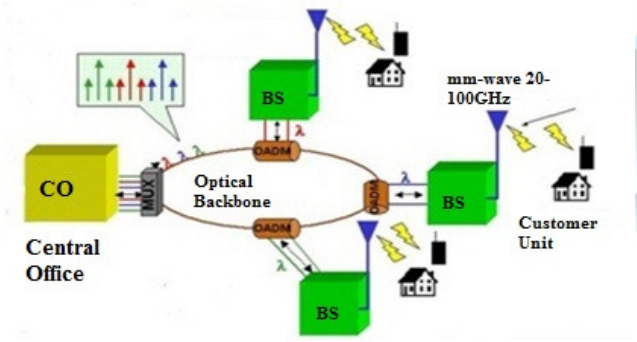

Fig.3. Radio over Fiber System

The RoF system enables techniques such as macro-diversity of handover. It is used for various features such as CATV networks, Satellite communication, millimeter and microwave communication network. At present, this system is used to successfully implement many of the broadband backbone networks and also to connect the recent 4G and 5G mobile network. The integration of RF and optical network, increases channel capacity and decreasing power consumption. The main advantages of using RoF are lower transmission losses and reduced sensitivity to noise and electromagnetic interference when compared to other electrical signal transmission. [8, 9]

D. Modulation Techniques

OFDM technology supports the combined use of ASK and PSK and formed Quadrature Amplitude Modulation (QAM) where both the amplitude and phase are changed. Depending on the weather condition, interference of the signal and the client distance, the base station dynamically allocates the modulation scheme which makes OFDM service profitable because in this case service providers are able to serve in a particular area, according to the need of the user. It supports adaptive modulation and coding which can increase the system capacity and range when necessary. Higher order modulation such as 64 QAM has a higher throughput, but a lower range of data access. On the other hand, the lower order modulation like 16 QAM has lower throughput but higher range from the same base station. [24, 25]

II. Literature Survey

The literature survey takes cognizance of the OFDM-RoF system relating to various problematic aspects and papers pertaining to these are reviewed.

R.K. Sethi et al., [10] focused on the optical OFDM using the QPSK (Quadrature Phase Shift Keying) modulation technique for high data rate transmission at 40Gb/s in OptiSystem and Matlab Simulation software. The systems performance has been analyzed and compared with the single carrier optical communication system. The various simulation results show that the system using OFDM can give dynamic compensation of dispersion by changing the various parameters of the OFDM system. The O-OFDM (Optical OFDM) QPSK can perform 1024 sub-carrier at 10, 20 and 30Gb/s data rate. It is clear that the fiber length and data rate increase the received signal that gets distorted due to the dispersion results in a higher bit error rate. This investigation shows that the acceptable BER performance can be achieved up to 150km of the length of the data rate of 10Gb/s for an optical system with OFDM.

Ayoob Alateeq et al., [11] proposed the BER (Bit Error Rate) performance in RoF-OFDM system modulated by different modulation techniques such as QAM and PSK (Phase Shift Keying). The study was under two cases – the up-converted 20 and 30 Gb/s OFDM signals on 20GHz carrier frequency over the 40km distance. And this study analyzes the BER performance of a RoF-PON scheme based on the OFDM modulation format that can be built in OptiSystem V.11. There

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are many kinds of modulation methods used in OFDM, which are based on QAM, and PSK such as 16-QAM, 8-PSK, and 16-PSK when compared the performance of BER. The two cases of the lowest BER and highest received power appeared in 16-QAM, while the highest BER occurred in 16-PSK modulation. The output 16-PSK caused a higher BER than the use of 8-PSK. The BER increase in 16-PSK might refer to the difficulty in maintaining the orthogonality in the OFDM. After increasing the bit rate 30Gb/s, the BER value in all modulation cases not clear of having received a signal with high quality.

L.A.Abdul Rahaim et al., [12] devised a CO-OFDM (Coherent OFDM) system with QPSK and QAM modulation formats with high speed at 40 and 100Gb/s bit rates and their reach at a different data rate as well. The simulation result of the input signal through the PDM with CO-OFDM with QPSK at 100Gb/s, the bandwidth of the optical signal is 25GHz. This system operates with 16-QAM and the bandwidth is 12.5GHz for the same bit rate. The PDM (Polarization Division Multiplexing) CO-OFDM QPSK signal also is of higher tolerance to non-linearity compared to CO-OFDM PDM 16-QAM. The advantage of 16-QAM modulation is that it increases spectral efficiency and the lower electrical bandwidth comes at the expense of reduced maximum reach and optimum input power. And also the author can investigate the design of PDM CO-OFDM system operating with QPSK and 16-QAM modulation formats with 100Gb/s and the bandwidth of 25GHz. This simulation result is for long-haul transmission with high data rate and high spectrum efficiency using PDM. The PDM CO-OFDM QPSK signals have a lower value of OSNR than 16-QAM for the equivalent bit rates.

Fahad Almasodi et al., [13, 14] shows that, Study of OFDM technique on RoF in Passive Optical Network (PON) over 100km, 140km, and 288km with single mode fiber by OptiSystem simulation software. This system provides for flexible cost effective and high data rate at the last mile of wireless networks of the 4-QAM modulation for 7.5GHz carrier frequency with 10Gb/s transmission bit rate for the total system which was used to simulate the OFDM-PON (OFDM Passive Optical Network) system. And this study is an expose of the use of an RF signal and the optical signal, an RF spectrum analyzer and the optical frequency analyzer. The resulting data proved the effectiveness of the RoF-OFDM-PON. The constellation diagram shows the 4-QAM modulation which clearly demonstrates that the quality of the signal is much improved after using RoF.

Veneetha Nair et al., [15] focused on the analysis of direct-detection and coherent-detection system of their BER for optical OFDM using QAM and DPSK. This system was simulated at 50Gb/s for a transmission distance of 1000km over SMF. Here the 4-QAM CO-OFDM achievement is comparable to coherent detection QAM for the same transmission data rate. The OOFDM in RoF model shows better performance when compared with QAM modulation. The simulation result shows that CO-OFDM in RoF system network which executes better performance at QAM modulation and sub-carrier increasing the BER value. The coherent detection OFDM shows that Q-Factor improvement which is about 9db when compared to direct detection. The use of polarization diversion scheme further improves the performance of CO-OFDM and it maintains the BER performance about at 10^{-5} using PDM.

Yoon-Khang Wong et al., [16] The author's attention is on the OFDM-RoF system modulation which transmits a QAM-OFDM signal over OptiSystem simulation software. The system identification technique has been working with optical and electrical signal processing for performance and improvement. This proposed model is useful to help improve the performance, quality of the RF signal and more useful in today's wireless communication network. However, this simulation model use of fiber optic distribution and optical OFDM signal provides various advantages within the microcellular systems. The modified wireless communication system can suggest an excellent cost effective for transmitting various wide band applications which avoids the complexity of the antenna technology.

Anu Sheetal et al., [17] The concept of this paper nests on the CD-OFDM system using 10Gb/s. The input power of CW laser from -5 to 9dBm and the result for Q-factor and OSNR are evaluated over the length from 40-120km. It observed that the Q-Factor increased up to a certain value which declined due to the nonlinear effects of the fiber However, for every individual channel length, OSNR increases with respect to the increase in optical input power. The result shows that the constellation points are illustrious for all the channel length and the constellation points get scattered due to the dispersion and nonlinearities. It was observed that the Q-factor increases and the low power values decreases. The constellation result of OFDM the recovery of the input signal at the receiver with effective noise up to 60km. Thus the input signal at 5dBm recovered with noise input power up to 120km.

Arun Raj et al., [18] has focused on that the combination of OFDM with Radio over Fiber system. The Orthogonal Multiplexing technique is shown satisfactorily compiling with various demands recent technology. The RoF-OFDM system was modulated using OptiSystemV.12 simulation software. The system can execute QAM sequence generator with 10GHz frequency and 10G/s data rate. The parameter which used this system 16QAM can be implemented in the OFDM-RoF system at 10-50km distances. The result of this system: As the data rate increases the output waveform of the RF spectrum analyzer, the optical spectrum analyzer is decreased. Similarly, the constellation output also shows decrease in Q-Factor leading to increase of constellation points. OFDM can be associated with RoF that efficiently merges coherent detection technique in preference to direct detection for long distance with the high-performance data value.

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M.Mahros et al., [19] The author implemented the OFDM of Radio over Fiber system. The combination of this system can execute SIMULINK tool in MATLAB simulation software. Here the bit error rate performance is analyzed by comparing the input and output signal for different fiber lengths. The simulation result for OFDM-RoF system is the performance of PSK modulation using OFDM in the LAN physical model. The number of sub-carrier is 64, the data rate of 6 Mbps and the fiber length is 8km. The result executes 64 sub-carrier of COFDM spaced equally by 0.3MHz with equivalent data rate of 6Mbps and modulated by BPSK. And also there is no significant degradation of the bit error rate performance until the fiber length becomes 12km due to the considerable OFDM model.

R.S.Asha et al., [20] investigated the coherent optical OFDM for different data rate of 1, 20 and 100Gb/s using 4-QAM OFDM at 250km distance. This system generates modulation using MZM and transmitted through the fiber for distances. At the receiver side of this system, the filtered optical signal is converted to an electrical signal and OFDM is demodulated. The result shows that the received signal has plotted constellation points of amplitude and phase in 4-QAM COOFDM with 1 and 20Gb/s. In 100Gb/s the phase noise is caused by fiber nonlinearity induced inter-carrier interference. As the data rate increases, the amplitude and phase noises of the received OFDM spectrum system are also increase.

Sinan M.Abdul Satar et al., [21] CO-OFDM system with dense WDM had analyzed to reach high data rates of 1.60Tb/s over 4500km using SMF. The WDM CO-OFDM is simulated using OptiSystem13 simulation software. The system performance is measured for Optical Signal to Noise Ratio (OSNR) of each WDM channel and to measure BER and SNR. And it is found that when BER decreases both OSNR (Optical Signal to Noise Ratio) and SNR (Signal to Noise Ratio) also increase. The result clearly shows that OSNR increases and the BER decreases. The OSNR is 11.64dB for 50Gb/s and 12.43 for 100Gb/s at BER=10^{-14}. This system has a good performance, according to the BER, OSNR, SNR values. The system shows a clear constellation diagram of 64-QAM at receiver, compared with other simulation study of O-OFDM using 64-QAM over 3600km and the obtained BER 10^{-12}. [6] discussed about Improved Particle Swarm Optimization. The fuzzy filter based on particle swarm optimization is used to remove the high density image impulse noise, which occur during the transmission, data acquisition and processing. The proposed system has a fuzzy filter which has the parallel fuzzy inference mechanism, fuzzy mean process, and a fuzzy composition process. In particular, by using no-reference Q metric, the particle swarm optimization learning is sufficient to optimize the parameter necessitated by the particle swarm optimization based fuzzy filter, therefore the proposed fuzzy filter can cope with particle situation where the assumption of existence of "ground-truth" reference does not hold. The merging of the particle swarm optimization with the fuzzy filter helps to build an auto tuning mechanism for the fuzzy filter without any prior knowledge regarding the noise and the true image. Thus the reference measures are not need for removing the noise and in restoring the image. The final output image (Restored image) confirm that the fuzzy filter based on particle swarm optimization attain the excellent quality of restored images in term of peak signal-to-noise ratio, mean absolute error and mean square error even when the noise rate is above 0.5 and without having any reference measures.

The following table 1 shows the general idea about an each paper. It analyzes the properties of Objectives, Tools, Methodology, parameter and Results of the each paper. It takes hold of the paper contents that analyzes the properties of some main issues solved and unsolved in each paper. It also used to understand the paper and that merits and demerits of the contents.

TABLE 1. COMPARISON OF VARIOUS LITERATURE SURVEY

Reference	*Objectives*	*Tools*	*Methodology*	*Parameter*	*Issues Solved*	*Unsolved & Demerits*	*Remarks*
[10]	Optical communication with OFDM for high data rate transmission at 40 Gb/s.	Opti-System and Matlab Simulation	OFDM QPSK modulation technique integration into an optical fiber.	Analysis various transmission - parameter BER, Q-Factor, SNR and Constellation diagram	BER, Q-Factor, achieve QPSK modulation up to 150km at the data rate 10Gb/s.	QPSK modulation to transmit maximum 150km at 10Gb/s.	The acceptable BER performance can be achieved even up to 150km distance for a data rate of 10Gb/s.

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Reference	Objectives	Tools	Methodology	Parameter	Issues Solved	Unsolved & Demerits	Remarks
[11]	RoF-OFDM maintains high bit rate and provides high bandwidth using OFDM as a modulation format in RoF. BER performance of OFDM using QAM and PSK modulation.	Optiwave V.11	Passive Optical Network scheme based on the OFDM modulation	16-QAM, 8-PSK and 16-PSK to up-converted at 20 and 30 Gb/s OFDM signal on 20GHz over the 40km distance. Analysis BER at the two cases.	16-QAM, 8-PSK, and 16-PSK to up-converted at 20 and 30Gb/s OFDM signal on 20GHz over the 40KM distance. Analyze BER in the two cases.	BER when 16-PSK used difficulty in maintaining the Orthogonality.	But bit rate of 30Gb/s BER value in all modulation are not clear having received signal with high quality.
[12]	OFDM modulation in the CO detection technique achieves maximum reach at the different data rate.	OptiSystem V11	The PDM CO-OFDM QPSK signal also higher tolerance to non linearity compared to CO-OFDM PDM 16-QAM.	In PDM CO-OFDM QPSK signal has lower required SNR than 16-QAM for the bit rate.	The PDM CO-OFDM QPSK signal also higher tolerance to non linearity compared to CO-OFDM PDM 16-QAM.	In PDM CO-OFDM QPSK signal has lower required SNR than 16-QAM for the bit rate.	This model the 16-QAM using addition channel of WDM decrease.
[13]	Investigates OFDM-RoF technique in PON. RoF-OFDM-PON system provides flexible for cost effective and high data rate at last mile of wireless networks. To analyze the quality of the data signal.	Optiwave V.11	4-QAM modulation for 7.5GHz carrier frequency and 10MHz bandwidth and Bitrate 10Gbit/s used.	Bit rate 10Gb/s, sequence bit length. 4-QAM, Constellation diagram	Bit rate 10Gb/s, sequence bit length. 4-QAM, Constellation diagram.	4-QAM is clearly that the quality of the signal is much improved after using SMF (RoF).	Only used 4-QAM.
[15]	Optical OFDM in RoF network at 50Gb/s data transmission distance of 1000km SMF. To perform compare and analysis BER of DD-OFDM and CO-OFDM using QAM and DPSK modulation.	Versatile Optical Simulation Software	4-QAM CO-OFDM achieved over 1000km. compared with coherent detection QAM for the same transmission and data rate.	DPSK, 4-QAM, 64-QAM, BER, and Q-Factor.	Compared with coherent detection QAM for the same transmission and data rate. 4, 64-QAM with BER Q-Factor.	CO-OFDM in RoF system network better performance achieved only data rate 50Gb/s	The CO-OFDM 4, 16QAM improving various data rate.
[16]	Performance OFDM modulation technique for RoF OFDM has different modulation format. 16QAM used.	OptiSystem 8.0/9.0	The QAM-OFDM signal over optical simulation software like Optisystem. The OFDM signal generates 7.5GHz RF from RoF system.	16QAM, 7.5GHz carrier frequency, bit rate 10Gbps, 10-50km distance. RF signal, optical fiber channel, RF power level, bit rate and modulation format used.	16QAM, 7.5GHz carrier frequency, bit rate 10Gbps, 10-50km distance. RF signal, optical fiber channel, RF power level, bit rate and modulation format used.	OFDM-RoF system model useful to improve the performance quality of the current RF signals.	OFDM-RoF system to provide various advantages in wideband cellular systems.
[17]	The performance of 10G/s CD-OFDM system evaluated using different input power at the 40 to 120km distances.	Optisystem using EDFA, SSMF and WDM analyzer.	16-QAM modulation 10Gb/s CD-OFDM.	Q-Factor and OSNR are evaluated over the SSMF from 40 to 120km. constellation diagram.	The constellation and Q-Factor illustrious for all the channel length from 40-120km.	Constellation and OSNR analysis only 10Gb/s CD-OFDM.	Constellation gets scattered while increasing input power for 120km distance.
[18]	OFDM proposed for RoF system. To increasing high-speed data rate and high capacity of bandwidth for recent advances	OptiSystem 12	16 QAM modulation OFDM-RoF system with 10GHz RF OFDM	16 QAM OFDM, RF 10GHz at 10 to 50 km. Q-factor and Constellation for	16 QAM OFDM, RF 10GHz at 10 to 50 km. At 16 QAM, data rate increasing	Similarly, constellation output decrease in Q-factor &	The coherent system has high performance than direct detection

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Refer ence	Objectives	Tools	Methodology	Parameter	Issues Solved	Unsolved & Demerits	Remarks
	broadband wireless technology.		and data bit rate 10Gbit/s.	power amplitude value.	hence the quality of the signal is decreasing.	constellation points increases.	system.
[19]	RoF-OFDM based physical performance of IEEE 802.11a using various channel model. BER analyses for OFDM BPSK and QAM modulation.	MATLAB using SIMULINK tool	Implementation RoF with OFDM at the Modulation of BPSK, 16QAM, AWGN Channel, Bandwidth 20MHz.	20 MHz channel bandwidth, BPSK, and 16QAM modulation.	20 MHz channel bandwidth, BPSK, and 16QAM modulation.	The BER increasing demand for the larger transmission bandwidth ever increases.	BER performance analyzed only 16QAM modulation with single channel bandwidth (20MHz).
[22]	Measure BER and to perform analyze COFDM based on RoFsystem. To perform 16-QAM and 16-QPSK modulation technique. And measure BER	OptiSystem Simulation Software.	Applying 16-QAM & 16-QPSK at length 2KM	16-QAM, 16-QPSK	16-QAM, 16-QPSK Result based on a comparative analysis between QAM and QPSK at the optical link. It increases same bit rate value.	Distance is drawn back. To increase more than 30km.	The optical amplification gives the better result of the modulation technique. Such as QAM.

III. Discussions and Implementation Method

The extensive literature survey in the field of OFDM and RoF system in general, and the application of these techniques in OFDM-RoF system have been analyzed as prerequisites for this paper. The literature survey takes cognizance of the OFDM-RoF system relating to various problematic aspects and relevant papers; also it understands the merit and demerit of the existing QAM based OFDM system. Additionally, the comparative literature survey is tabulated here and many parameter of survey table have been analyzed. Each parameter adopts specific goals and builds a comparison to the previous paper. Table 1 shows the general idea about each author and it takes the paper contents that relate to analysis and the properties of main issues solved and unsolved of the each paper. It also takes to understand the possibilities of merits and demerits of the each paper. The comparison of previous researches has analyzed many types of methodology. At present, there prevail different types of research execution based on the Optical-OFDM (O-OFDM) system. This work deals with implementing QAM based OFDM-RoF system using CO-OFDM. The CO-OFDM improves performance in the receiver sensitivity, spectral efficiency, and robustness of the subcarrier and its applicability in higher degree of spectral efficiency for long-haul transmission.

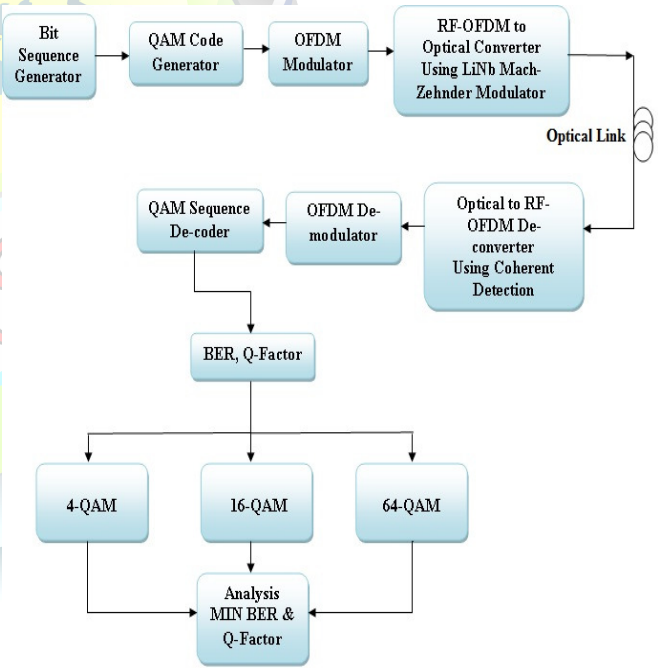

Fig.4. QAM based OFDM-RoF System

The implementation method focuses on improvement of high data rate, minimum BER and better Q-Factor (Quality Factor) for OFDM signal. An intention of this method work is to identify the minimum bit error rate and better Q-Factor for the QAM modulation. The initial execution of that system based on QAM modulation namely 4, 16, 64-QAM

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modulations and each case has various data rates, subcarriers, and their different distances are compared with the BER and Q-Factor.

IV. CONCLUSION

The study of intends to build up the overview and background of Optical Orthogonal Frequency Division Multiplexing, Radio over Fiber and their various applications. It also gives a detailed literature survey on the OFDM-RoF system based on different kinds of problems from methodology. This involves analysis of the method and facilitates to understand the merits and demerits of the existing QAM and other modulation based OFDM system. This paper also shows that detailed description about the fundamentals of OFDM and Radio over Fiber system. It also analyzes the categories of the survey tables from that the different parameters.

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