OFDM Based Full Duplex Radio Over Fiber System

Vibhuti Sharma,Neena Gupta

Abstract— Radio over Fiber (ROF) is the recent technology in the Optical Fiber System which promotes efficient wireless communication .ROF is a combination of both RF communication system as well as the optical communication system. As the demand for high-speed wireless communications is increasing rapidly, use of OFDM in ROF has helped a lot for the same. Optical link can generate certain disadvantages like dispersion ,non linearity, attenuation which can be reduced to certain extent with the use of OFDM. To increase the capacity of our optical communication system WDM is required . In this paper complete OFDM based ROF system has been realized**.**

Index Terms— Orthogonal Frequency Division Multiplexing**(OFDM),** Radio Frequency**(RF)** Radio Over Fibre **(ROF),**Wavelength Division Multiplexing**(WDM)** Inverse Fourier Transform**(IIFT),**Fast Fourier Transform**(FFT)** Qadrature Amplitude Modulation**(QAM)**

1 INTRODUCTION

With the increasing advancements in technology ,demand of more and more bandwidth is the issue of major concern.. This demand of bandwidth can be fulfilled with the use of new medium of communication which is **optical communication** where light is used for sending and receiving data.

RoF is the technology which is the combination of RF system and Optical fiber based communication system. In this technology, light is varied with a radio signal and propagated over optical fiber. RoF has many advantages in the communication system. For example, it provides high data rates, cut down power consumption, and provides protection against electromagnetic interference .RoF is suitable for maintenance and makes setting up system simple with operational compliance.

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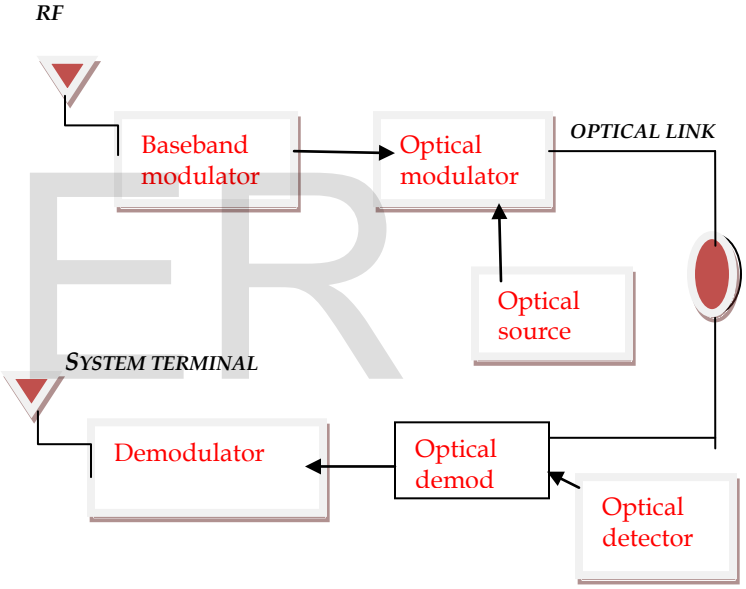

Fig.1 Block Diagram of RoF System

RoF has a central site (CS) and remote site (RS) connected to fiber optic link. It serves to transmit the RF signal downlink and uplink. Optical signal is transmitted between CS and RS in optic band passes by RoF network[2].In the Fig.1,baseband modulator has been used to modulate Radio Frequency (RF) signals ,which is then sent to optical modulator like mach-zehnder modulator where it is used to modulate carrier optical signal from laser souce.This resulted signal is then sent through optical communication link where at the receiver side it is demodulated using photodiode.

ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING

OFDM is a multi-carrier transmission technology that transmits a high-speed data stream by splitting it into multiple parallel low-speed data channels., provides an effective solution to inter-symbol interference (ISI) caused by the delay spread of wireless channels.[8]. OFDM is technique based on divid-ing a radio spectrum into certain further channels at the base station ..

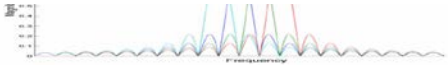

Fig 2 Orthogonal Spectrum Of OFDM

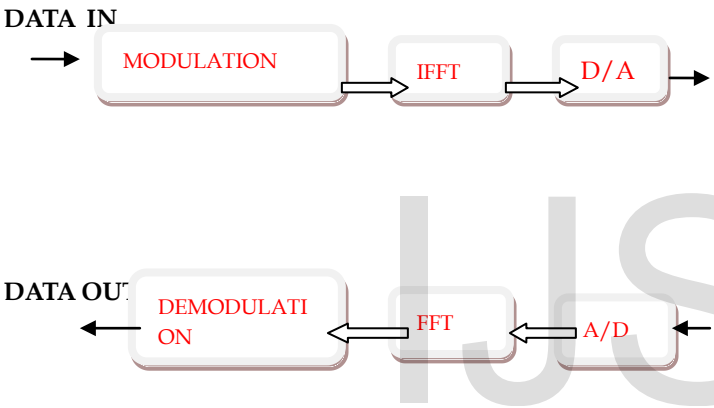

Fig 3. Block Diagram of OFDM Transmitter and Receiver

Generally, there are many different ways of modulating and demodulating an OFDM transceiver [6]. As shown in this fig 3,in block diagram of the OFDM transmitter, the data is mapped by using multilevel modulation techniques such as quadrature amplitude modulation (QAM), frequency shift keying (FSK), phase shift keying (PSK). [6]

After that, the bit stream is converted from serial to parallel and followed by the Inverse Fast Fourier Transform (IFFT). A guard interval is placed after the IFFT box to make sure no overlapping occurs between the signals The last step in the OFDM transmitter is converting the bit stream from parallel to serial and then sending the data over a channel.[6]

In the OFDM receiver, the same process as the receiver is performed, but with the opposite function[6]

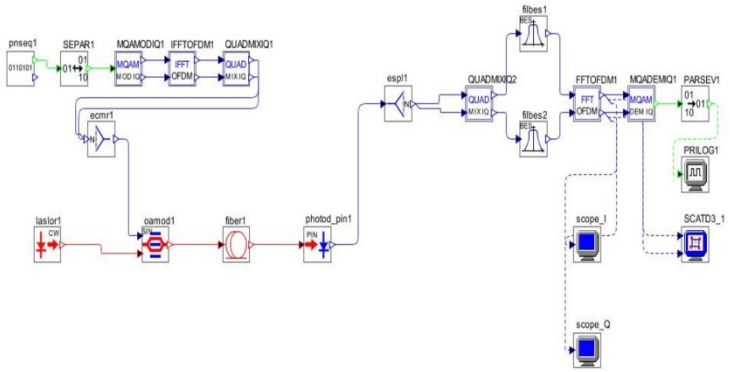

Fig 4. Model of ROF_ OFDM system IN OPTSIM VERSION 5.4

In the transmitter, a single 10 Gbit/s pseudo-random bit sequence is converted into a number of lower rate bit sequences controlled by the symbol QAM_bit_number. In fact the multiplicity of the serial-to-parallel conversion corresponds to the number of bits to encode one QAM symbol.[8]

In the OPTSIM, OFDM modulation models are different discrete blocks that can be interfaced with filters and noise sources to realize OFDM system setups. Also the signal can be monitored at each stage of the modulation process. QAM constellations are obtained at QAM modulator. Here four- QAM is used..Next the IFFT OFDM converts the QAM symbols to OFDM symbols with an IFFT operation using a number of subcarriers 64, controlled by the symbol subcarriers number, both accepting in input and returning on output baseband in-phase and in-quadrature signals.The RF signal is translated to baseband with a quadrature mixing down conversion. The replica at twice the carrier frequency originated by the down conversion process is filtered out using two 7-pole low-pass Bessel filters centered at th carrier frequency, 10 GHz [7].

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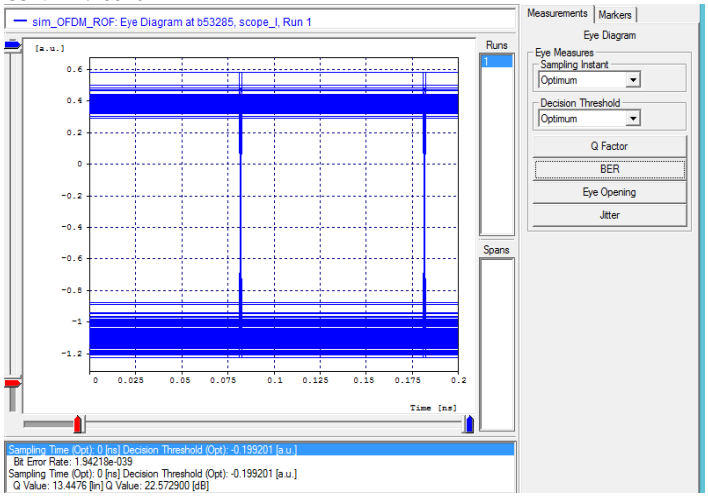

Fig. 5 Scope _q displaying quality factor 22.57 dB

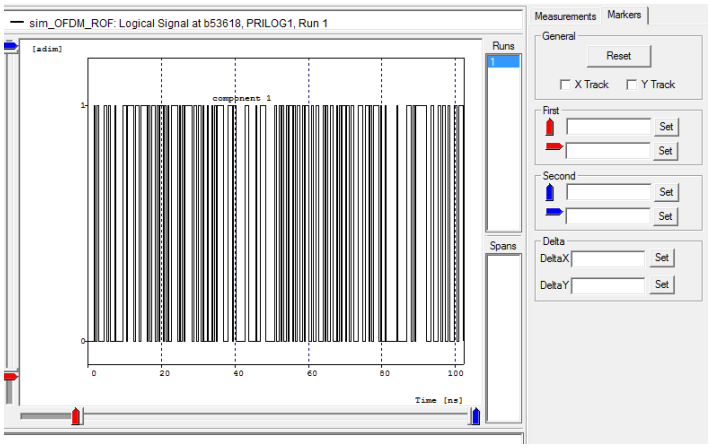

Fig. 7 Prilog output displaying logical signal at the output

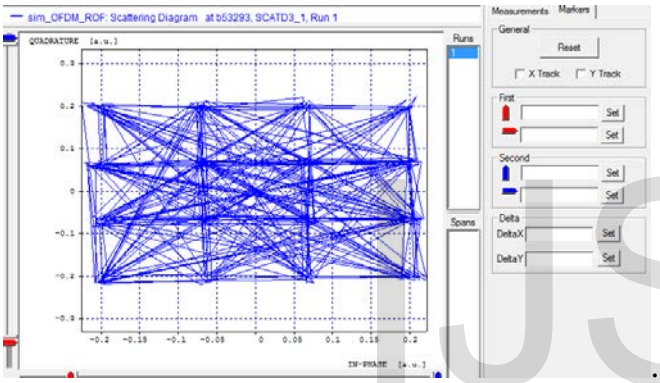

Fig. 6 Four-QAM received constellation with automatic synchronization at SCATD3_1

The system is built using 4-QAM and transmission is done for 3 km. OFDM can be built using 64-QAM, 128-QAM and the results can be observed. Also the constraints can be done for long haul communication

CONCLUSION

In this paper, first review of the the fundamentals for ROF and OFDM is done. A typical OFDM transmitter and receiver are described and the roles of the main signal processing blocks explained. OFDM based ROF system is simulated in OPTSIM version 5.4 using QAM as the modulation. As the length of fiber increases the distortion gets added to the system. Eye diagram of the system depicts quality factor of 22.57 dB and BER of 1.9 *10^-39.With the results we can predict that OFDM is helpul in reducing dispersion and high data rate signals can be send with the minimum distortion.

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