Performance Analysis of WDM-RoF System with CO-OFDM for Long Distance Communication

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ABSTRACT
Orthogonal Frequency Division Multiplexing (OFDM) is an multicarrier modulation Format that can be easily adopted by different telecommunication standards such as LTE, LTE-A, Wi-Fi & WiMAX etc, now getting used in optical fiber communication. Chromatic dispersion arises due to Inter Symbol Interference (ISI) and it is serious issue in long-distance communication. The performance of CO-OFDM / WDM-RoF System has been analyzed for long distance communication by measuring the Q-factor and Bit Error Rate (BER).

Keywords
Wavelength Division Multiplexing (WDM), Radio over Fiber (RoF), Coherent-Optical-Orthogonal-Frequency- Division Multiplexing (CO-OFDM), Bit Error Rate (BER), Quality Factor (Q-Factor).

1. INTRODUCTION
WDM is a technique of multiplexing more than one optical carrier signals of different wavelength over a single fiber by using different wavelength of laser to carry different signals, and it can achieve a greater capacity, higher data rate and good flexibility at relatively low cost and system can be easily upgraded [1][2]. Rof (Radio Over Fiber) is an integrated system means radio frequency over the fiber that can facilitate to the wireless network, where the Rof system can be increased the channel flexibility and mobility of application system due to larger bandwidth by using optical fiber and at the same time it decreases the cost and power consumption for wireless network [3]. OFDM (Orthogonal frequency division multiplexing) is modulation technique based on an approach as combination of modulation and multipath access for future broadband wireless communication. CO-OFDM system is nothing but a combination of basic 5 components like OFDM Transmitter, RF to Optical (RTO) or Up Converter, Optical Link, Optical to RF (OTR) or Down Converter and OFDM Receiver.

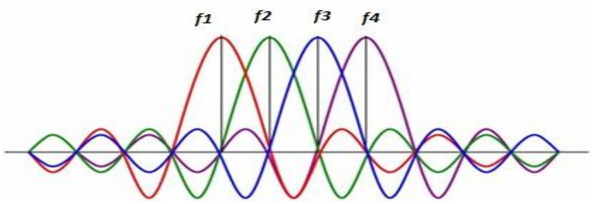

Fig-1 OFDM Spectrum

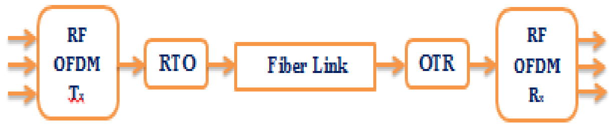

Fig. 2. CO-OFDM communication system

2. SYSTEM DESCRIPTION
The system consists of 5 RF signals transmitted over single mode optical fiber at a distance 60 km and received by 5 remote stations. In transmitter side RF signal is modulated by QAM-OFDM. Li-Nb Mach-Zehnder is used to modulate the OFDM signal into optical carrier. Here, laser is used having frequency of 193.05, 193.1, 193.15, 193.20 & 193.25 THz as an optical source. QAM modulate the RF signal at the rate of 2 bit/symbol. The QAM signal is then connected to OFDM modulator with 512 subcarriers and 1025 FFT point [4]. The in phase and quadrature signal from OFDM modulator is transmitted to optical modulator. The 5 optical signals from different sources are then multiplexed by 5x1 WDM to transmit the optical signal over single fiber simultaneously. In channel side two optical gains are used with 60km optical fiber having gain of 13 dB. At receiver side 1x5 WDM de-multiplexer is used to transmit the signal to 5 different remote stations [5]. At remote station coherent detection is used here for dispersion compensation. Coherent detector consists of local oscillator having wavelength equivalent to laser in transmitter side. Each coherent detector consists of 2 PIN diodes and 2 couplers [6][7]. After detecting the signal the signal is send to OFDM demodulator [8]. The resulting signal is then fed to QAM decoder to convert it in digital signal [9]. BER analyzers are used to analyze the performance of the system.

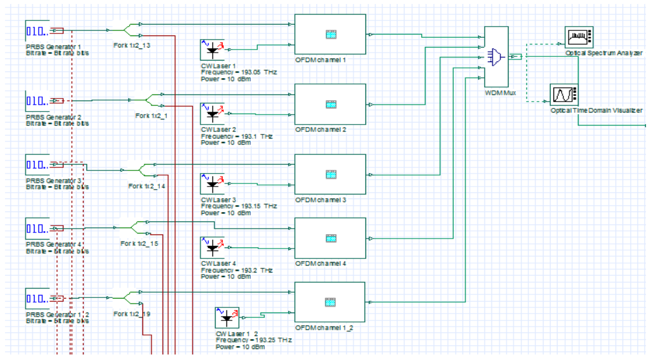

Fig. 2.1. Simulation schematic of CO-OFDM Transmitter

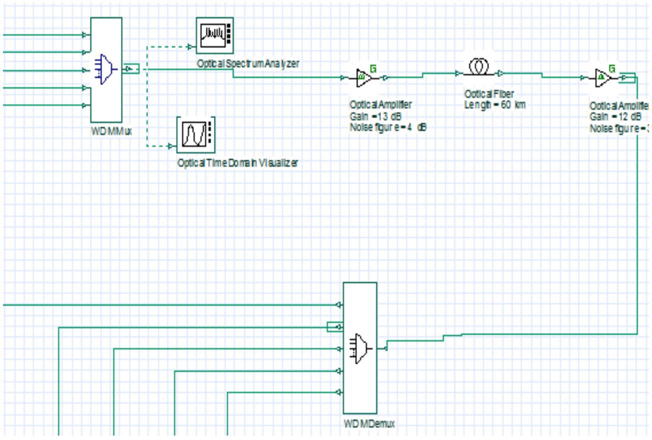

Fig. 2.2. WDM channel

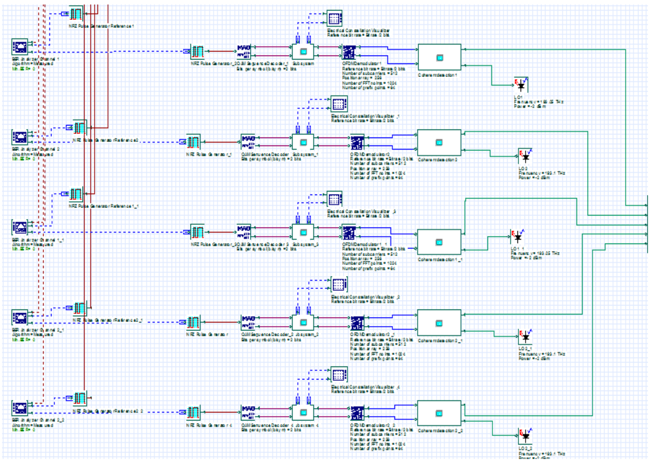

Fig. 2.3. Simulation schematic of CO-OFDM Receiver

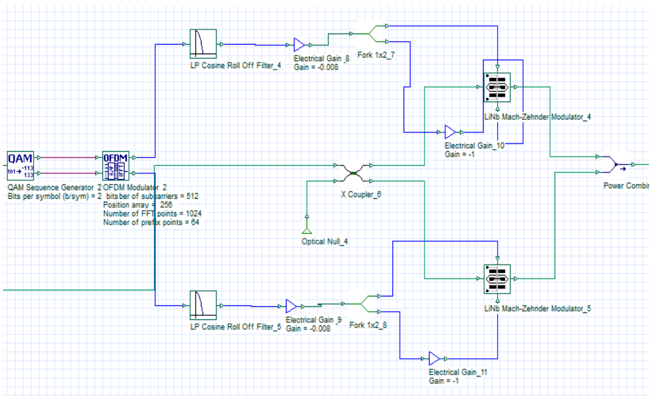

Fig. 2.4. OGDM Channel Subsystem

3. RESULT AND DISCUSSION

In this paper two types of analyzer and visualizer are uses like Optical spectrum analyzers and Bit error rate analyzer. Power spectrum analyzer at the Transmitter sides shows that there are five variable signals of frequencies 193.05, 193.1, 193.15, 193.20 & 193.25 THz having power gain of - 42 dBm. These frequencies are transmitted on the fiber link of 60km. At the receiver side, getting power gain of -16dBm .

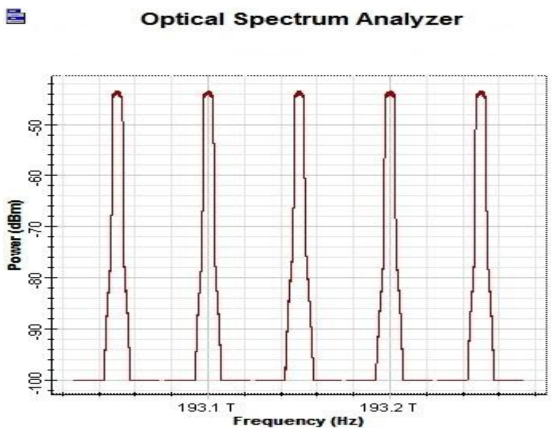

Fig. 3.1. Input optical spectrum of the five signal Frequencies

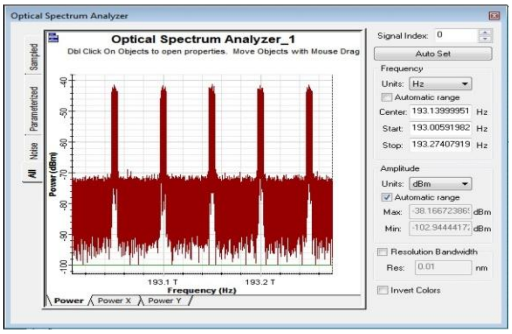

Fig. 3.2. Output optical spectrum of the five signal Frequencies

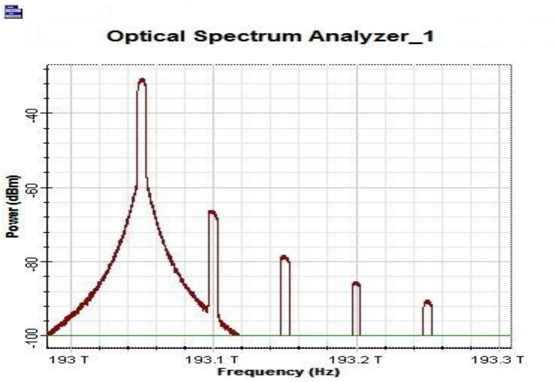

Fig. 3.3 Output of signal frequencies at 193.05 THz

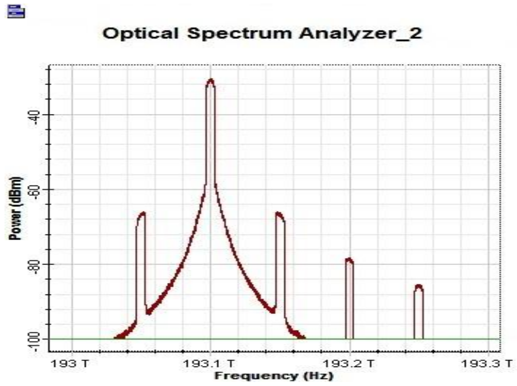

Fig. 3.4 Output of signal frequencies at 193.10 THz

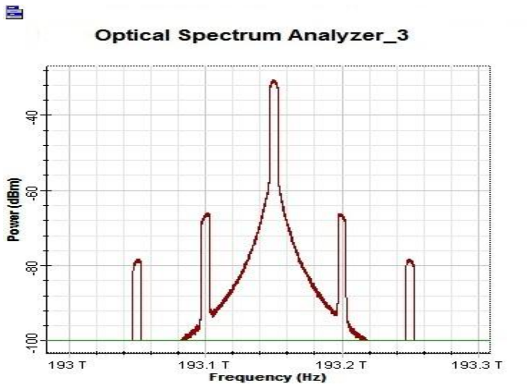

Fig. 3.5 Output of signal frequencies at 193.15 THz

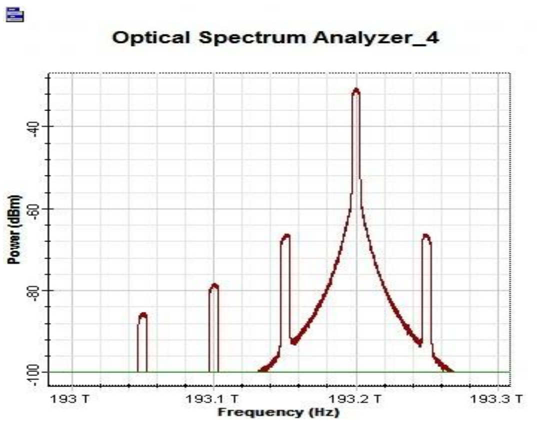

Fig. 3.6 Output of signal frequencies at 193.20THz

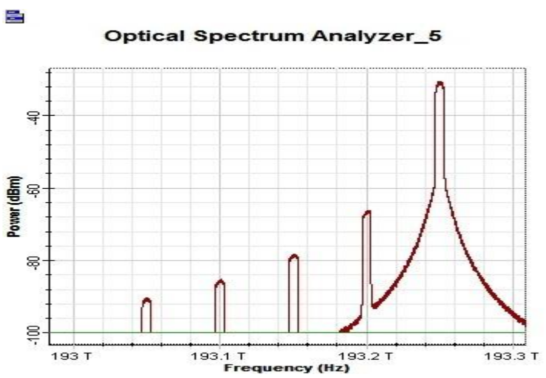

Fig. 3.7 Output of signal frequencies at 193.25 THz

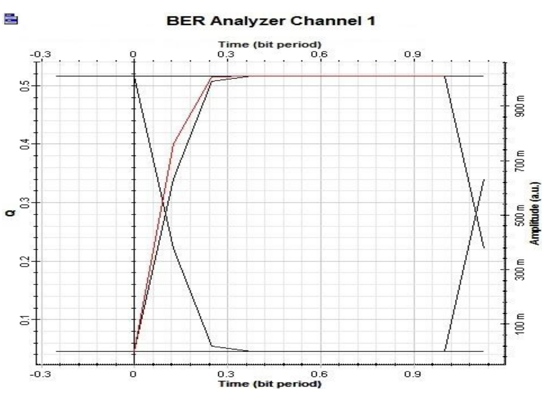

Fig 3.8 Eye diagram of signal Freq 193.05 THz

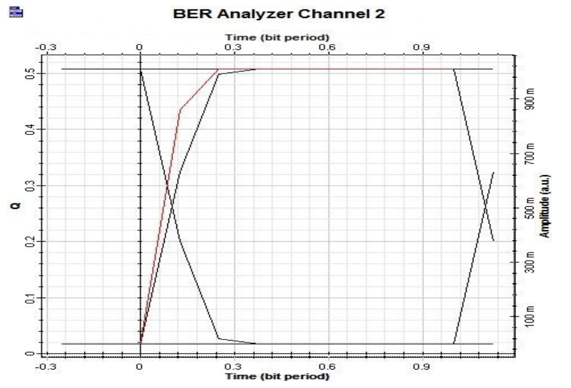

Fig 3.9 Eye diagram of signal Freq 193.10 THz

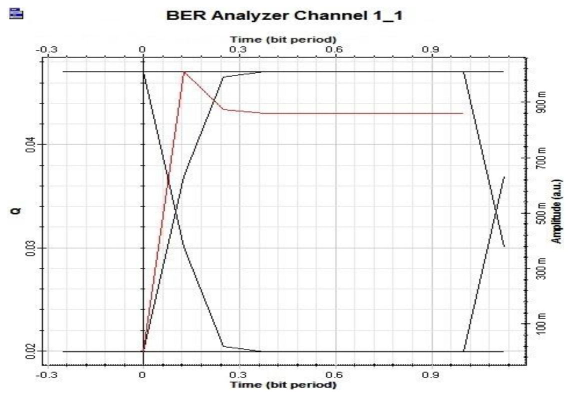

Fig 3.10 Eye diagram of signal Freq 193.15 THz

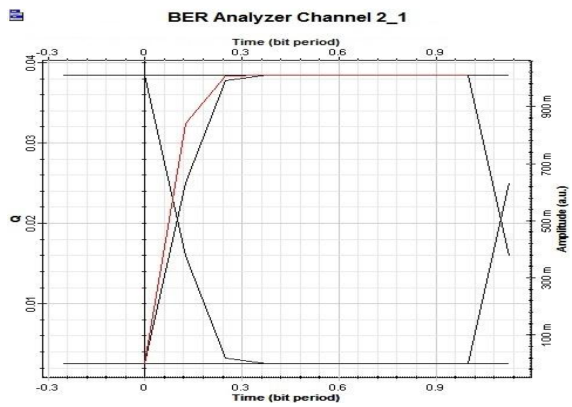

Fig 3.11 Eye diagram of signal Freq 193.05 THz

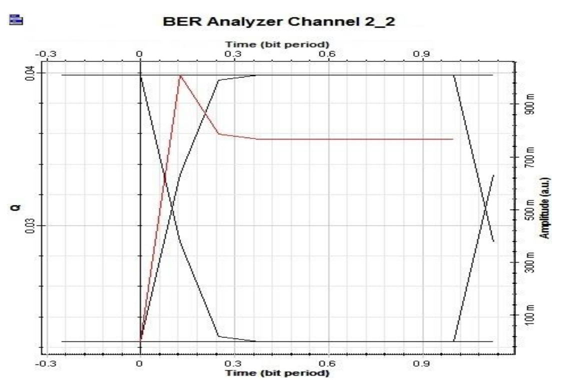

Fig 3.12 Eye diagram of signal Freq 193.25 THz

4. CONCLUSION

In this paper it has been presented that the OFDM-RoF system has achieved RF signal through the optical fiber using Optisystem simulation software. The approach of this work is to compensate higher order dispersion of Coherent detection WDM Optical OFDM system using Phase Modulator and compare the performance of optical spectrum with optical fiber. The result shows the output of RF signal is little degraded as compare to input value but the signal is considerable. From the result it has been observed that the orthogonality of OFDM signal can be easily maintained in 5QAM format at 12 Gbps data bit rate.

In future generation wireless and mobile communication system must be increase with high quality bandwidth service for inaccessible area while the recent network service providers facing the problem of insufficient bandwidth for transmission of voice, data and multimedia service for fixed and mobile users. This demand is to be satisfied for wireless system using Orthogonal Frequency Division Multiplexing (OFDM) with Radio over Fiber (RoF) technique.

5. ACKNOWLEDGEMENT

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