QAM Transmission over RoF Using Fabry Perot Laser Diode and Continuous Wave Laser Diode

Kuruvilla John, Merin Philip, Abhijith S., Jincy Francis

Abstract: ***This paper introduces the Quadrature Amplitude Modulation (QAM) Radio over Fiber (RoF) framework dependent on Optical Frequency Comb (OFC) generation utilizing Fabry-Perot Laser Diode (FPLD) and Continuous Wave Laser Diode (CWLD). In this, optical Millimeter-Wave (MMW) can be created ether utilizing ease FPLD with an outside optical infusion or a continuous wave laser diode. At the base, optical MMW can be recognized by utilizing photodetector in the two transmissions. The experimental results are explained by using the constellation and eye diagram.***

Index Terms: Continuous Wave Laser Diode, Fabry-perot laser diode, Optical MMW generation, Radio over Fibre (RoF).

I. INTRODUCTION

The cutting edge wireless communication needs to meet the fundamental prerequisites, for example, high data transfer capacity, high speed, high capacity and so on for long-distance communication. The Radio over Fiber (RoF) framework is a substitute answer for setting up rapid and high speed with minimum loss. For commercial wireless communication, data transfer capacity of 7 GHz (57-64 GHz) is distributed by the Federal Communication Commission (FCC). The primary use of MMW framework incorporates radar, rocket, and military. A 25-Gb/s Orthogonal Frequency Division Multiplexing (OFDM) at 60-GHz Radio over Fiber (RoF) transmission framework utilizing Distributed Feed Back (DFB) laser diode is shown in paper [1]. More than 50 km of fiber transmission underneath 7 rate Forward Error Correction (FEC) limit is accomplished. The DFB was remotely infused to get a low linewidth coherent comb source to overcome phase noise because of optical decorrelation [1]. The portrayed framework is amazingly steady to changes in fiber length.

Remote sign transmission at 35 Gb/s is tentatively shown utilizing a Radio-over-Fiber framework with single-transporter Quadrature Amplitude Modulation (QAM) in [2]. A choice input equalizer (DFE) is utilized to moderate the impedance and blurring impacts. The power penalty under 1 dB is accomplished after 25 km single-mode fiber transmission [2]. Power penalty of Double Side Band Suppressed Carrier (DSBSC) is bigger than that of Single Side Band Suppressed Carrier (SSB-SC) [2]. In paper [3] a 60-GHz Direct Modulation-Direct Detection OFDM-RoF dependent on Gain-Switched Laser is portrayed. Theoretically and experimentally analyzed the power fading due to multipath transmission incited by fiber chromatic scattering [3].

The performance analysis of the wireless transmission of OFDM over optical fiber connection is depicted in [4]. The transmission of OFDM over RoF connection can be utilized for short separation and long-run transmission with high information rate. The proposed framework can be helpful for Wireless LANs, Fiber-To-Home (FTH), WiMax, Digital Video Broadcasting (DVB) [4] and other low control advanced frameworks [5-10]. A Multi-Band Orthogonal Frequency Division Multiplexing (MBOFDM) transmission of utilizing Quadrature Phase Shift Keying (QPSK) adjustment for Ultra Wide Band (UWB) applications at 60-GHz RoF system is depicted in paper [11]. The transmission execution is assessed utilizing Error vector size (EVM) estimations. 60 GHz OFDM RoF framework dependent on optical recurrence duplication is exhibited in paper [12]. OFDM with staggered tweak configuration, for example, 16 QAM is depicted. More than 25 km fiber length immaterial power punishment is watched and framework can give more service range to broadened application. The simple transmission execution of single-mode Fabry-Perot Laser Diode (FPLD) is clarified in paper [13]. The proposed model depends on time area recreation of rate condition [13].In paper [14] a 60 GHz RoF Wavelength Division Multiplexing Passive Optical Networks (WDMPON) utilizing Parallel Phase Modulation with a Single MachZehnder Modulator (MZM) is displayed. The paper is additionally depicted distinction between Radio Frequency (RF) and base band adjustment in hypothetically just as tentatively. The optical millimeter age without bearer concealment for long separation fiber application is clarified in paper [15]. The decrease strategies for Inter-subcarrier Interference and Frequency-Selective Fading in OFDM RoF framework is exhibited in paper [15]. Turbo codes and bit interleaver innovations are proposed to dodge mistakes in OFDM RoF framework. In this paper, we proposed the performance of Quadrature Amplitude Modulation (QAM) Radio over Fiber (RoF) framework dependent on Optical Frequency Comb (OFC) utilizing Fabry-Perot

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Laser Diode (FPLD) and Continuous Wave Laser Diode (CWLD). The Performance is analyzed at utilizing a constellation diagram and eye diagram.

II. SIMULATION SETUP

A. Simulation Setup using FPLD

The simulation set up for QAM RoF transmission framework with FPLD based OFC age as appeared in Fig.1. For this situation, optical MMW generation should be possible by utilizing an infusion securing FPLD. For this master laser diode is Distributed Feedback (DFB) laser diode, which is designed with a bias current 27 mA and Bragg wavelength 1545 nm. Optical circulator is utilized to move the yield of DFB laser to FPLD and the Optical Frequency Comb (OFC) is created at the yield of FPLD. The optical Wavelength Division Multiplexing (WDM) interleaver is utilized to choose the frequency at 193.896 THz and 193.968 THz for downlink transmission. Focal frequency of 193.896 THz and frequency separating of 70 GHz are the structure parameters for WDM interleaver. Optical Band Pass Filter (OBPF)is used to filter through undesirable frequency components. The LiNbO3 (Lithium Niobate) Mach-Zehnder Modulator (MZM) is intended to balance optical frequency utilizing 4-QAM groups. So as to suppress the optical transporter and to transmit two optical sidebands, a LiNbO3 MZM is utilized. Here, the QAM is structured with 15 GHz modulator frequency and 20 Gb/s bit rate. The frequency at 193.968 THz is unmodulated and transmitted over defer lines for enhancing the time delay. Polarization Controllers (PC) are utilized to control the polarization in two channels. Both the channel yields are joined utilizing power combiner and Erbium-Doped Fiber Amplifier (EDFA) is utilized to enhance the optical signal. After transmission more than 25 Km Single-Mode Fiber (SMF), the optical signal is received by base station. The received optical signal separated utilizing Optical Band Pass Filter (OBPF) and intensified by Erbium-Doped Fiber Amplifier (EDFA). A Variable Optical Attenuator (VOA) is utilized to control the received optical power before applying to the photodetector. At the base station, a photodetector is utilized to identify the signal and changed over to an electrical arrangement. The Electrical Amplifier (EA) is utilized to enhance the yield of the photodetector. Radio Frequency (RF) signal is then transmitted to the receiver unit. At the recipient unit, the signal is down-converted and analyzed. From the received demodulated signal, constellation diagram and eye diagrams are plotted.

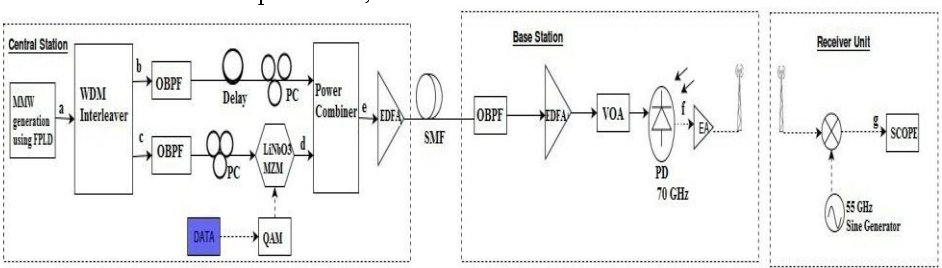
B. Simulation Setup using CWLD

The simulation set up for QAM RoF transmission framework utilizing CWLD for MMW age as appeared in Fig.2. For this situation optical frequency at 193.89 THz is received legitimately from CWLD and OBPF is utilized to filter through undesirable sideband frequencies. The Mach-Zehnder modulator (MZM) is intended to modulate optical recurrence 193.889 THz utilizing 4-QAM designs. Interleaver is utilized to choose single side band from the yield of MZM. Single Mode Fiber (SMF) of length 25 Km is utilized to transmit signal from focal station to base station. At the base station signal is filtered utilizing OBPF and optically intensified utilizing EDFA. The remaining activity of base station and recipient units are comparative as the above case. From the demodulated signal constellation and eye diagrams are plotted.

III. SIMULATION RESULTS

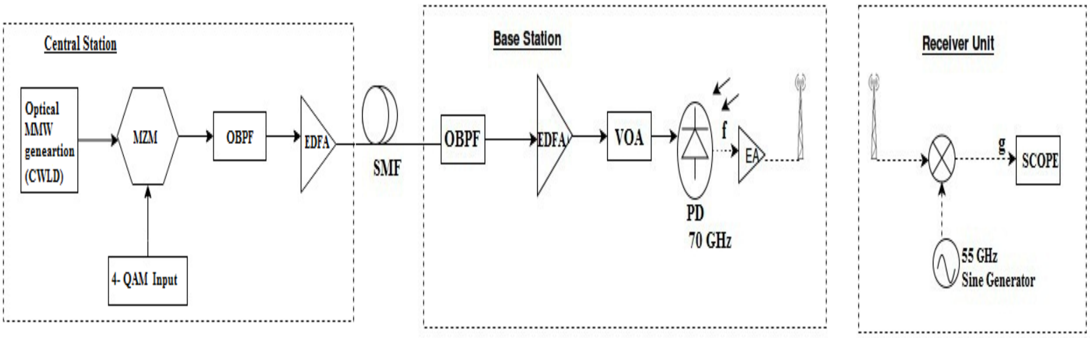
The performance is assessed after transmitting more than 25 km fiber. It is conceivable to control the noise impacts of the fiber by controlling dispatch capacity to the fiber [1]. The Optical frequency produced utilizing continuous-wave laser diode as appeared in Fig. 3, and generated OFC using FPLD is shown in Fig.4.

The optical Single-Mode Fiber (SMF) of length 25 Km is utilized to transmit the optical signal created at the central station towards the base station. The OBPF is utilized to filter undesirable signal obstruction at the base station. The received optical signal is intensified utilizing EDFA and applied to VOA. The capacity of the photodetector is to distinguish the intensified optical signal at the base station and changed over to an electrical configuration. The downlink signal is then transmitted to the client unit and down-converted over to low frequency. From demodulated signal, constellation and eye diagrams for CWLD and FPLD are plotted. Fig.5 and Fig. 6 shows Constellation outline for 4-QAM CWLD and FPLD transmission separately. Fig.7 and Fig. 8 shows the Eye diagram analysis for 4-QAM CWLD and FPLD transmission separately by utilizing FPLD. Satisfactory framework execution is obtained for both downlink transmission utilizing FPLD and CWLD and it is additionally conceivable to actualize frequency increase.



FPLD: Fabry-Perot Laser Diode, WDM: Wavelength Division Multiplexing, OBPF: Optical Band Pass Filter, PC: Polarization Controller, LiNbSO_{3}SMZM: Lithium Niobate Mach-Zehnder Modulator, QAM: Quadrature Amplitude Modulation, EDFA: Erbium Doped Fiber Amplifier, SMF: Single Mode Fiber, VOA: Variable Optical Attenuator, PD: Photo Detector, EA: Electrical Amplifier

Fig.1. Simulation Setup of QAM RoF Using FPLD



CWLD: Continuous Wave Laser Diode, OBPF: Optical Band Pass Filter, MZM: Mach-Zehnder Modulator, QAM: Quadrature Amplitude Modulation, EDFA: Erbium Doped Fiber Amplifier, SMF: Single Mode Fiber, VOA: Variable Optical Attenuator, PD: Photo Detector, EA: Electrical Amplifier

Fig.2. Simulation Setup of QAM RoF Using CWLD

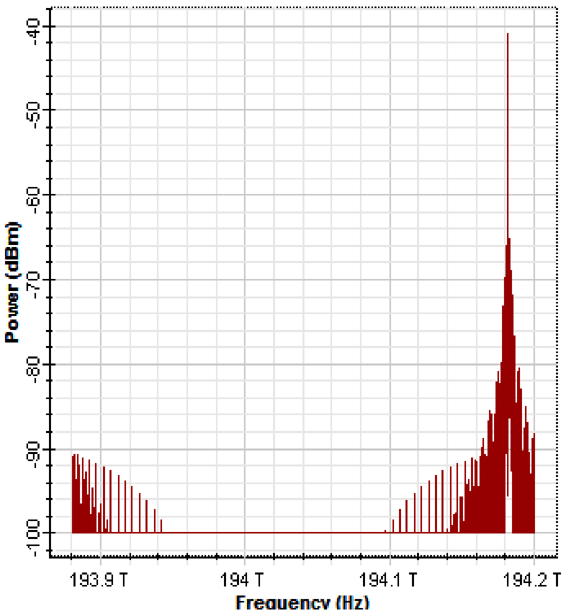


Fig. 3. Optical Frequency generated by continuous wave laser diode

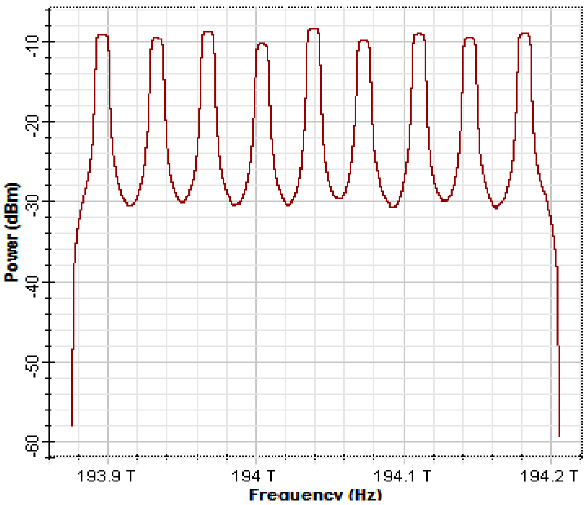


Fig. 4. Optical Frequency Comb generated by FPLD

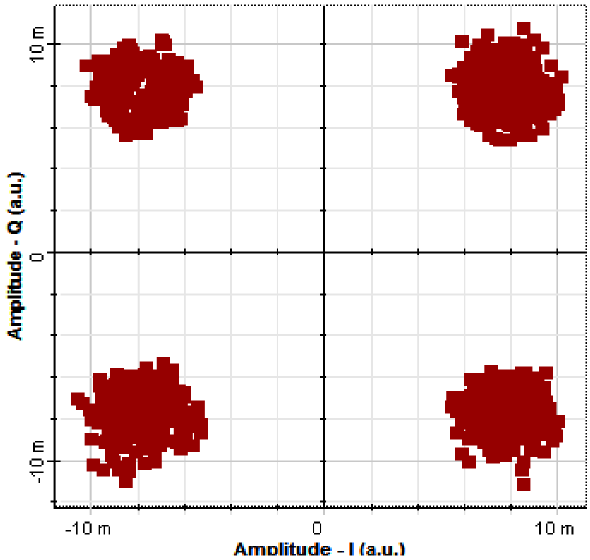


Fig. 5. Constellation diagram for 4-QAM CWLD transmission

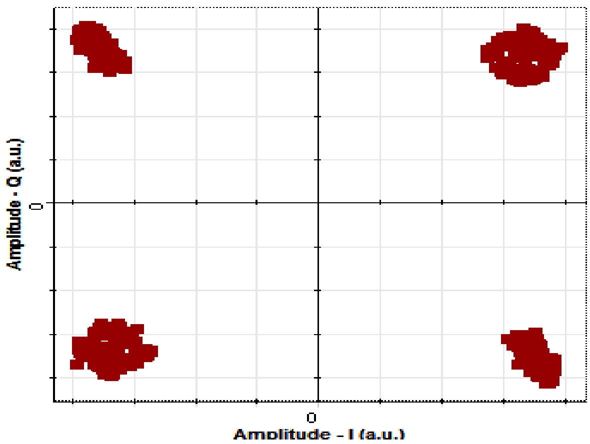


Fig. 6. Constellation diagram for 4-QAM FPLD transmission

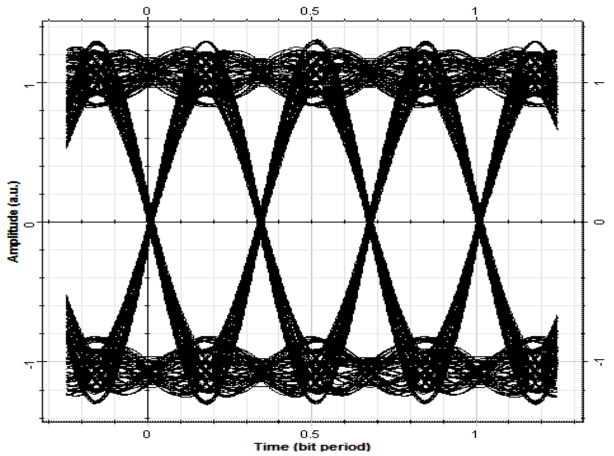


Fig. 7. Eye diagram for 4-QAM CWLD transmission

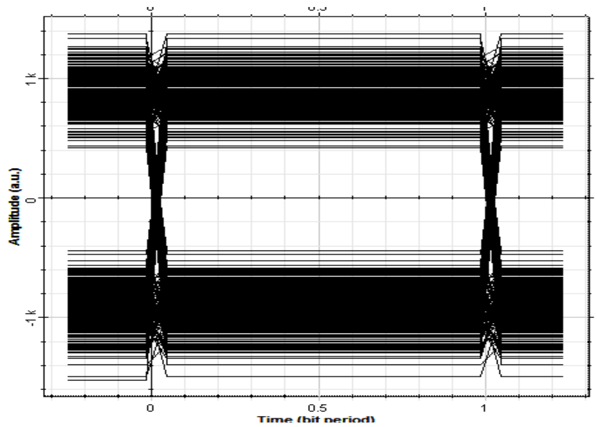


Fig. 8. Eye diagram for 4-QAM FPLD transmission

IV.CONCLUSION

In this paper, the performance of Fabry-Perot Laser Diode (FPLD) and Continuous Wave Laser Diode (CWLD) is analyzed by transmitting QAM through Radio over Fiber (RoF) framework. Similar constellation is acquired for CWLD and FPLD, however eye diagrams progressively open for CWLD transmission. The optical millimeter generation utilizing CWLD and FPLD is straightforward, yet low linewidth optical comb generation is obtained.

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