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# DESIGN OF CO-OFDM WDM-ROF NETWORK WITH DIFFERENT MODULATION TECHNIQUES AND DISPERSION COMPENSATION USING FBG AND DCF

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***Abstract*- The origination of innovative frameworks of optical amplification, modulation formats, or fiber configuration are essential for fiber limit of Tb/s postures new trials. In this paper, WDM-RoF in view of the CO-OFDM format and dispersion compensation employing FBG and DCF for various modulation techniques i.e. QAM and DPSK is to be suggested. The execution of the framework as far as BER, Q-factor and OSNR is evaluated and a system with a remarkable induction stuff is found. By contrasting consequences of QAM and DPSK, it is found that DPSK accomplishes 22.75% better regarding Q-factor than QAM when using FBG and DCF together and it performs 7.41% better than QAM in terms of Q-factor without using FBG and DCF.**

*Key Words*: **WDM-RoF, CO-OFDM, FBG, DCF, Dispersion Compensation, QAM, DPSK, OSNR, BER.**

## I. INTRODUCTION

Orthogonal Frequency Division Multiplexing (OFDM) is a technique for encoding digital information on different carrier frequencies. OFDM has formed into a prominent plan for wideband digital communication, utilized as a part of uses, for example, advanced TV and sound telecom, remote systems and 4G versatile interchanges. A large number of firmly separated orthogonal sub-carrier signs are utilized to convey information on a few parallel information streams or channels. Each sub-carrier is modulated with the conversion modulation scheme at a low symbol rate in the same wideband. The primary advantage of OFDM over single carrier scheme is its ability to cope with severe channel conditions without complex equalization filters.

Furthermore, the WDM is a multiplexing procedure for fiber optic framework to multiplex various optical carrier signals onto a solitary optical fiber by utilizing different wavelengths of laser light to convey various signals. By applying this method, it is conceivable to perform bidirectional communication above one strand of fiber optic and it permits multiplications in capacity. It is known that near the wavelength 1.55μm silica fiber has the minimum loss.

Coherent detection is used in this system as CO-OFDM (Coherent Detection OFDM) represents the appropriate capability in spectral efficiency, receiver sensitivity, and polarization or chromatic dispersion tolerance.

RoF is a key technology for future communications as it provides required bandwidth and accomplish various demands of end users. RoF implies that a fiber connection where the optical signal is balanced at radio frequencies (RF) and transmitted through the optical fiber to the less than desirable end. At the point when achieving the less than desirable end the RF signal is demodulated and transmitted to the relating wireless client.

The rest of the paper is organized as follows. Related work is explained in section II. Proposed system and its experimental setup is presented in section III. Experimental results and discussions are presented in section IV. Concluding remarks are given in section V.

## II. RELATED WORK

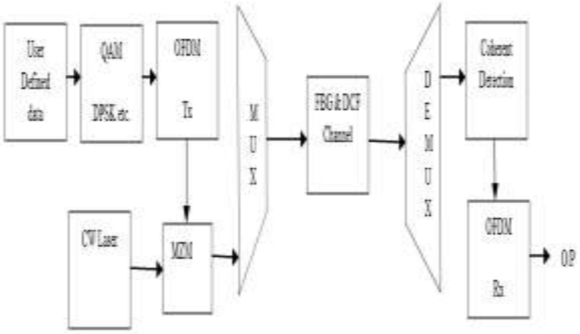
In [5] the author introduces WDM RoF which is one of enabling technologies for 3G and beyond. Simulation is done for 10km length of various fibers like standard single mode fiber, dispersion compensation fiber, teralight fiber etc. it is investigated that system provides optimum results at data rate of 9.5 Gbps. In [6] authors proposed that mix- compensation of dispersion compensation performs better and the corresponding BER performance is better. In [8] author showed a schematic for 10 Gb/s reasonable 512-subcarrier 16-QAM OFDM framework; however the information for the OFDM modulator can have diverse modulation formats, for example, BPSK, QPSK, QAM, and so forth. Fiber dispersion is completely compensated by the DCF in every traverse. In [9] the author have observed the 8 channel WDM framework at 15 Gbps for DCF and FBG. It is found that both of the compensators, DCF and additionally FBG functions admirably. In any case, the FBG compensator performs superior to anything DCF in fast 8 channel WDM organize.

## III. PROPOSED SYSTEM

OFDM is a multicarrier transmission procedure where an information stream is conveyed with many lower-rate subcarrier tones. The signal at all the four channels is transmitted utilizing single mode fiber in the wake of multiplexing to the CBS. At CBS every base signal is de-multiplexed utilizing WDM de-multiplexer then the individual base station identifies the signal utilizing RoF collector. The framework has been modulated and simulated for various powers, bit rates and fiber lengths. CO-OFDM consolidates the benefits of 'coherent detection' and 'OFDM modulation' and has many benefits that are basic for future rapid fiber transmission frameworks.

### A. Experimental setup for proposed network:

Fig. 3(a). Experimental setup of CO- OFDM in WDM–RoF network for different modulation techniques



As demonstrated in fig. 3(a) the data at desired rate is produced by using Pseudo-random generator. The wavelength to which the data is converted is generated by the CW laser. Above block diagram comprises of three parts i.e. the transmitter part, dispersion compensation and receiver part. The transmitter part consist of the user defined data i.e. pseudo random input, CW laser, OFDM transmitter and modulation techniques i.e. QAM and DPSK. The receiver part consist of coherent detection system network and OFDM receiver. The dispersion compensation block contains the optical filter which is utilized to filter out the required signal and the signal from CW laser and data from user are applied to optical amplifier. The output signal from optical amplifier is then applied to the semiconductor optical amplifier (SOA) after passing from SMF.

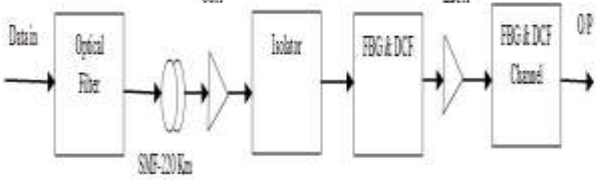


Fig. 3(b). Experimental setup for Dispersion Compensation using FBG and DCF

Inside the SOA production of non-linear effect FWM will take place and hence as a result of which the new signal is generated at a new frequency. FBG is used to remove the pump power after the conversion. DCF is used as a loop of fiber having negative dispersion equal to the dispersion of transmitting fiber. As a result of above setup the desired signal is filtered out using BPF optical filter.

**B. Simulation Parameters of the proposed system:**

Table 3(a). Simulation parameters used in proposed system:

| Sr. No. | Parameters | Value Type |
|---|---|---|
| **1** | **No. of channels** | **4** |
| **2** | **Laser frequency** | **193.1 to 193.4** |
| **3** | **Laser line bandwidth** | **10 MHz** |
| **4** | **Laser power** | **6dbm to 30 dbm** |
| **5** | **SMF length** | **0.03e+006 km** |
| **6** | **SMF attenuation** | **0.2 dB/km** |
| **7** | **SMF dispersion** | **16ps/nm/km** |
| **8** | **EDFA numerical aperture** | **0.24** |
| **9** | **EDFA length** | **10m** |
| **10** | **Injection current of SOA** | **0.15A** |
| **11** | **Optical filter bandwidth** | **10GHz** |
| **12** | **Detection technique** | **Coherent** |

## IV. RESULT AND DISCUSSION

The simulation work in this paper is carried out using opyisystem 14.0. Fig 4(a) shows the maximum Q-factor performance versus the input power for different modulation techniques i.e. QAM and DPSK with FBG and DCF together. Here, the input power varies from 6dbm to 30 dbm and the data rate is 1Tb/s. the maximum Q- factor value for DPSK is 52.8789 and for QAM it is 29.5491. In Fig. 4(b) the graph for maximum q factor versus power is shown for two modulation techniques without using both FBG and DCF. The maximum Q-Factor value for DPSK 14.4967 and for QAM 13.053 is observed.

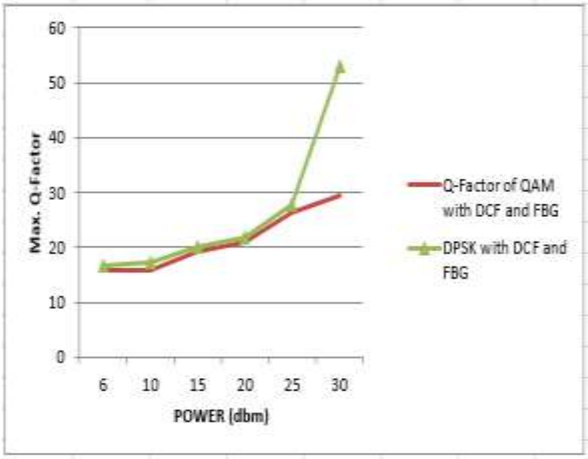


Fig. 4(a). Comparison of QAM and DPSK using FBG and DCF

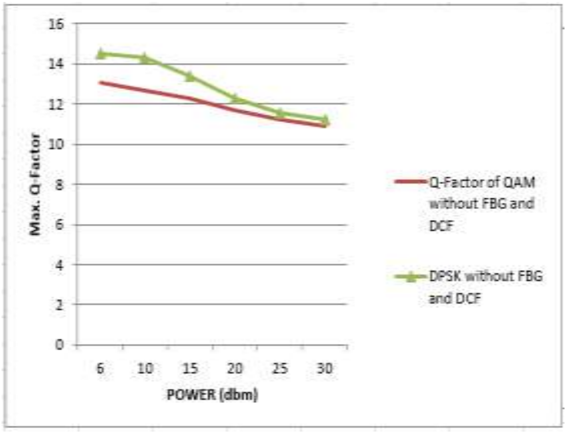


Fig. 4(b). Comparison of QAM and DPSK without using FBG and DCF

**The comparison of results for different modulation techniques:**

Table 4(a). maximum q-factor versus power by using FBG and DCF:

| Power (dbm) | Q Factor | |
|---|---|---|
| | **QAM with FBG and DCF** | **DPSK with FBG and DCF** |
| **6** | **15.7697** | **16.8131** |
| **10** | **15.8101** | **17.31** |
| **15** | **19.2886** | **20.1559** |
| **20** | **20.8751** | **21.7862** |
| **25** | **26.322** | **27.7137** |
| **30** | **29.5491** | **52.8789** |

Table 4(b). Maximum q-factor versus power without using FBG and DCF:

| **Power (dbm)** | **Q Factor** | |
|---|---|---|
| | **QAM without FBG and DCF** | **DPSK without FBG and DCF** |
| **6** | **13.053** | **14.4967** |
| **10** | **12.6989** | **14.2848** |
| **15** | **12.2598** | **13.3701** |
| **20** | **11.6743** | **12.2493** |
| **25** | **11.2387** | **11.5489** |
| **30** | **10.9128** | **11.2118** |

Fig. 4(c), 4(d), 4(e), 4(f) shows the eye diagrams for different modulation techniques i.e. QAM and DPSK with and without using FBG and DCF.

The maximum Q-factor is observed for DPSK by using DCF and FBG i.e. 52.8789.

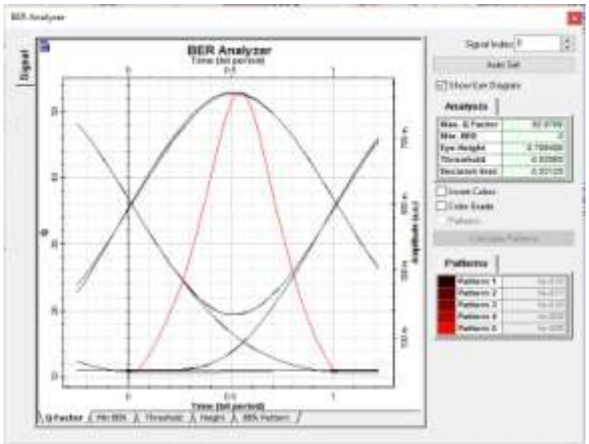


Fig: 4(c) eye diagram for DPSK using FBG and DCF

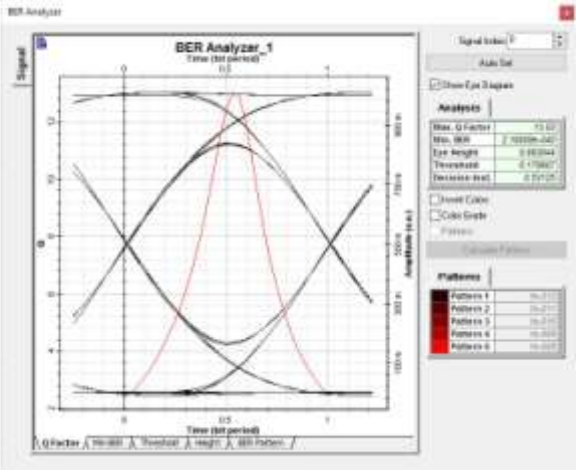


Fig: 4(d) eye diagram of DPSK without using FBG and DCF

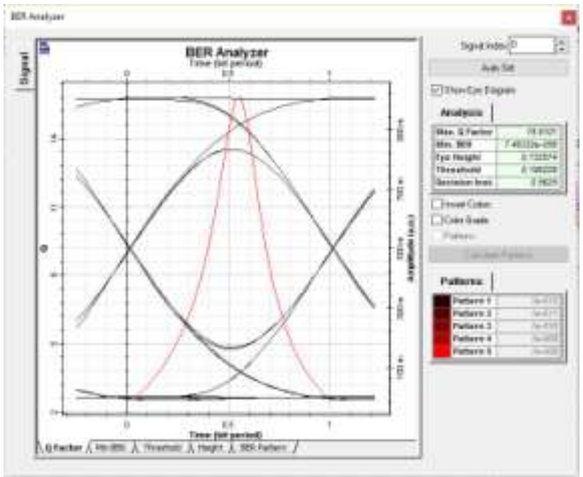


Fig: 4(e) eye diagram of QAM without using FBG and DCF

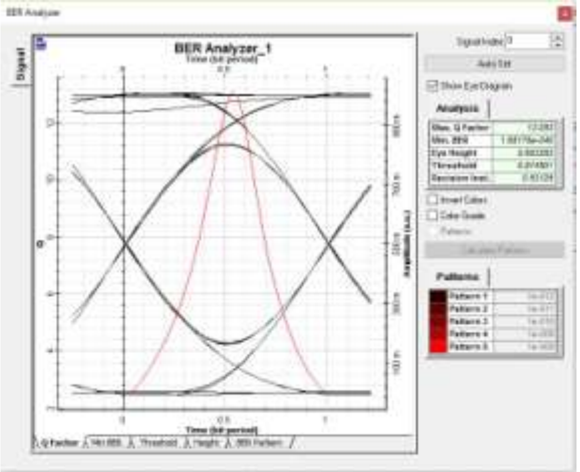


Fig: 4(f) eye diagram of QAM without using FBG and DCF

The eye diagrams for QAM and DPSK modulation techniques at different powers are shown above.

## V. CONCLUSION

The simulation gives the results that for high-speed circuit design of CO-OFDM, bandwidth condition is greatly reduced, which is extremely attractive where electrical signal bandwidth dictates the cost. The work introduced in this paper has demonstrated that DPSK performs superior to QAM in terms of Q-factor at different estimations of laser power. It is concluded that DPSK shows 22.75% better results than QAM when using FBG and DCF, and shows 7.41% better result than QAM when concluding without using DCF and FBG. Ideally, the advantages of the advanced modulation systems exhibited in this work will be suitable to overthrow the disadvantages of additional transmitter and receiver obscurity.

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