DWDM-Based Frequency-Interleaved Optical Distributing System

Namita and Geetanjali Pandove

Abstract: From the facts it is becoming increasingly evident that dense wavelength-division multiplexing (DWDM) will soon become the core technology for the next-generation internet as it is offering multi gigabit rates per wavelength [1]. In this paper we have tried to implement radio over fiber technology i.e. we have implemented DWDM-based frequency-interleaved optical distributing system merging electrical and optical transmission media.

Keywords: **Fiber Bragg grating (FBG), frequency interleaving, optical access network, radio-over-fiber (RoF), wavelength-division multiplexing (WDM).**

I. INTRODUCTION

Radio-over-fiber (ROF) is the most promising technology for the future broadband networks because of its various advantages such as flexibility, huge bandwidth, high reliability, and transparency [2] [3]. Now days for the wired access applications the DWDM-PON (dense wavelength division multiplexing passive optical network) is attracting the service providers and the users because there will be need of various kinds of services [4]. So merging ROF and WDM-PON technologies will provide great convenience and flexibility for the users [5]. In this paper, a DWDM (dense wavelength division multiplexing) based optical distributing system merging electrical and optical transmission is experimentally demonstrated. This paper is organized as follows:

Section II shows the experimental setup.

Section III shows the output or results of this circuit.

Section IV concludes the whole work.

II. EXPERIMENTAL SETUP

Figure 1 shows the communication system i.e. Two tunable wavelength (TW) lasers are used for the two access points AP1 and AP2 respectively. The bias point of the MZM is adjusted to make the optical carrier and the two sidebands have the same level which is shown in results. After that process of amplification is done by an erbium-doped fiber amplifier (EDFA) and then the optical carrier and the two sidebands are split into two branches with the help of a fiber Bragg grating (FBG), where the optical carrier is reflected into one branch for carrying baseband signals and the two sidebands go through the FBG into the other for carrying 62.5-GHz signals. Either of the two branches is modulated by 1.25-Gb/s pseudorandom bit sequences (PRBS) electrical signal in an MZM, respectively, and then recombined to be transmitted to AP1. Similarly at the same time, the signals for AP2 are generated by TWL2. Here we have used the power splitters so that simultaneously the signal should be passed to AP1 as well as to AP2 to check and compare the output at various points.

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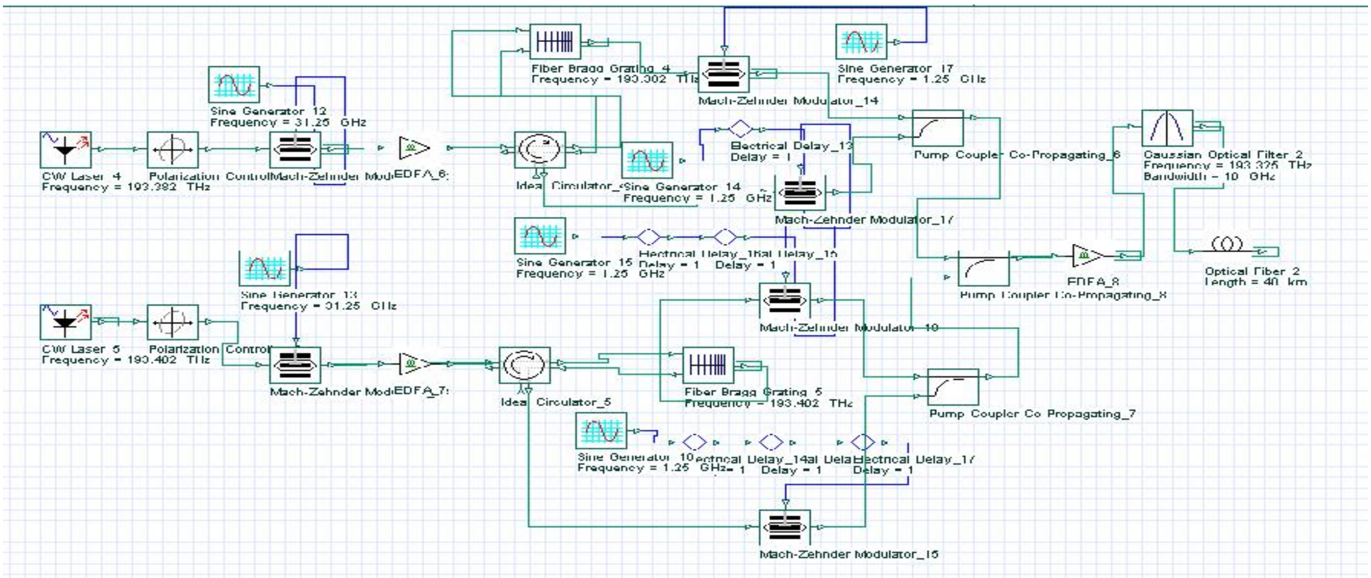


Fig1: Communication System (generation of the signals)

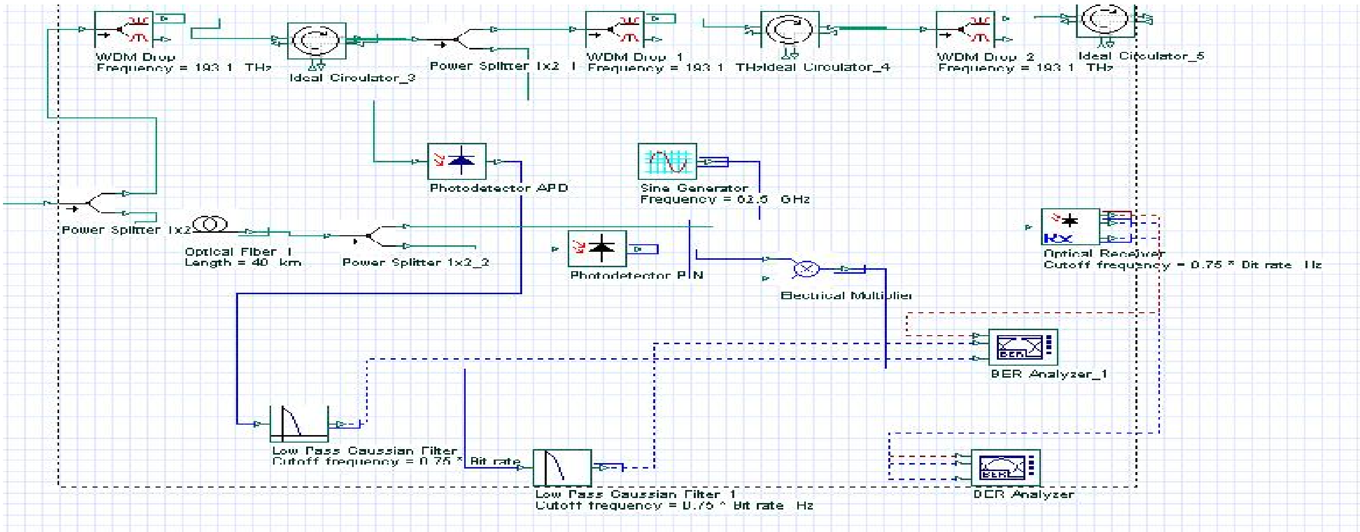


Fig 2: Transmission of Signal via Optical and Electrical path to AP1 and AP2 respectively

After the SMF transmission of 40-km, the interleaved optical signals will enter the AP1 [6].then by using power splitter we have provide signal to the drop demultiplexer. The first optical demultiplexer is used for dropping off the optical sidebands. The frequency interval between the two reflection peaks is set at 62.5-GHz, so the two sidebands carrying the signals for AP1 will be dropped off while the other frequency components go through the demux and the eye diagrams of both the optical and the electrical signals is shown in next section.

I. RESULTS

As we can see from Figure 3 which shows the power meter output and the optical spectrum analyzer output that the two generated sidebands are identical.

Fig 3(a). Power meter observations

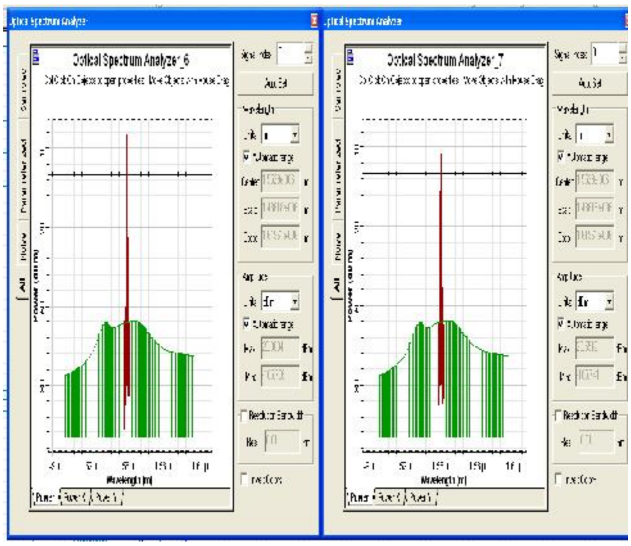
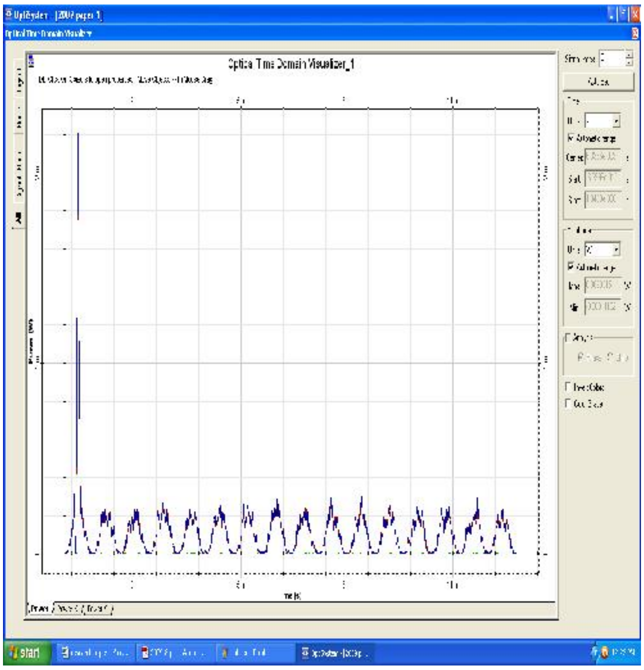


Fig 3(b): The Two Sidebands Generated are Identical (power and spectrum is shown)

Figure 4 shows the signal which will be passing through the 40 km SMF (single mode fiber) and it can be seen that only a small power penalty of about 0.5 dB is observed after the 40-km SMF transmission which show that fiber dispersion tolerance of the system is good and when this signal is given to the power splitter and the same signal is delivered to drop demultiplexer and the second optical fiber. Then mixing of the signals coming from photodiode and local carrier generated using sine wave generator is given to low pass filter and then to the BER analyzer and the other signal coming from other end of power splitter will be given to optical receiver and then to check the eye diagram, the optical receiver output is given to second BER Analyser.



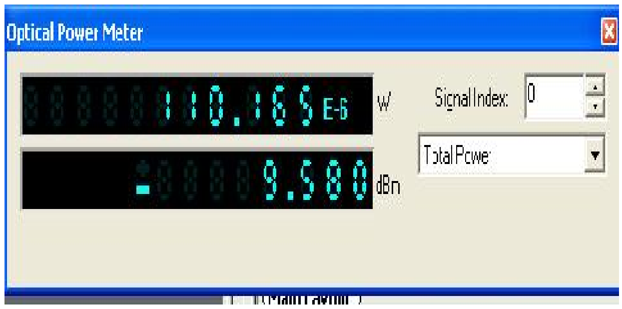
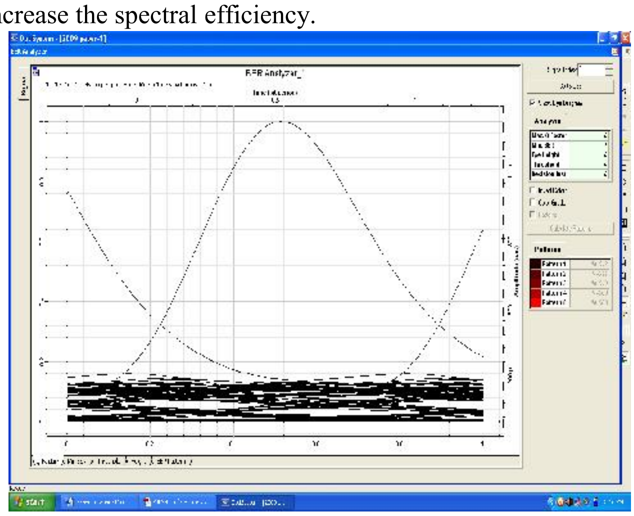


Fig 4: The Time Domain Visualizer Output Wave at the SMF Transmission and the Power recorded.

Figure 5 shows the output of BER Analysers showing Eye diagrams of Electrical and optical paths respectively. We can see that both outputs are acceptable and combination of optical and electrical technology is highly beneficial. We can also use the radio –over-fiber technology here by transmitting the signal by wireless channel and it is also emerging technology and also has lots of application. From the Eye diagrams it is clear that the merging of optical and electrical transmission technology is very beneficial and it has various advantages because the figure is very clear without much effect of crosstalk, interference and other kind of noise and distortion. Hence this technology is surely having the capability of being the next generation communication network.

II. Conclusion

A DWDM-based optical distributing system using the concept of frequency-interleaving and merging the wired and fibre techniques of transmitting the signals is experimentally demonstrated. It can be seen that two channels of baseband signals for electric path and two channels of 62.5-GHz signals via optical path sharing one single 100-GHz DWDM grid are distributed to the two APs through a 40-km SMF link to increase the spectral efficiency.



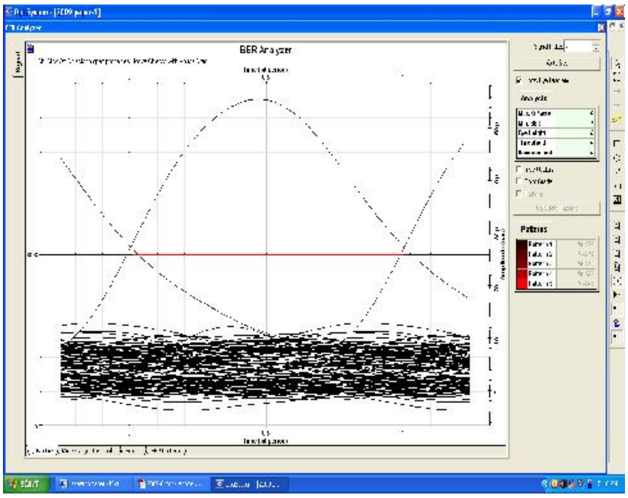


Fig 5: eye diagrams of electrical and optical path output respectively.

Only a small power penalty of about 0.5-dB at BER of 10^{-9} is observed after the 40-km SMF transmission, showings good fiber dispersion tolerance of the system. Here also we can merge wireless and wired applications i.e. instead of using optical fiber distribution at the AP. It will also be showing attractive results.

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