Simulative Investigation of Performance of Direct Intensity Modulation and External Modulation in Optical Network

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Abstract:- *In this report, analysis of three optical data channels dense wavelength division multiplexing optical network by direct intensity modulation and external modulation has been stimulated using OPTSIM.By comparing the results of external intensity modulation and direct modulation with respect to Q value ,BER , it can be seen that the performance of external modulations better than direct modulation.*

Key words:
ROF, External Intensity Modulation, Direct Modulation.

I. INTRODUCTION

Radio over Fiber (RoF) is an optical fiber link to distribute modulated RF signals from a central location to remote antenna units (RAUs). The RoF systems are developed to replace a central antenna with a low power distributed antennas system (DAS) [2]. RoF systems are usually composed of many base stations (BSs), which are connected to a single central station **F**OR many applications, it is quite advantageous to transmit several analog or digital subcarrier-multiplexed (SCM) RF channels over a fiber link or network. These applications include cable TV, wireless network interfaces, microwave photonic systems, and control information for optical packet switching .There are several optical techniques for generating and transporting microwave signals over fibre.. These include optical heterodyne [3] and self-heterodyne techniques [4], and using pulsed lasers [5],[6]. However, the simplest technique for the optical generation and distribution of the RF signal modulated with data is an intensity modulation scheme via direct or external modulation of a laser in which the RF signals are either externally or directly modulated onto the optical carrier. These optically modulated RF signals, then, are transported over an analog pho-tonic link. In this paper we simulate the optical modulation by direct intensity and external intensity. The simplest method for optically distributing RF signals is simply to directly modulate the intensity of the light source with the RF signal itself and then to use direct detection at the photo detector to recover the RF signal. This method falls under the IM-DD, as well as the RFoF categories.

II. SIMULATION SETUP AND DESCRIPTION

A DWDM Optical Communication System for three channels by direct detection method as well as external intensity modulation has been set up using OPTSIM. The simulation setup is shown in the Fig.1 and Fig 2. For transmitting the optical data channels, continuous wave semiconductor laser is used.. In a direct detection method A 10Gb/s NRZ signal is modulated by optoelectronic modulator whereas Mach Zendor modulator is used in external intensity..In a external intensity method, the output of electro absorption modulator is again modulated by Mach Zendor modulator.

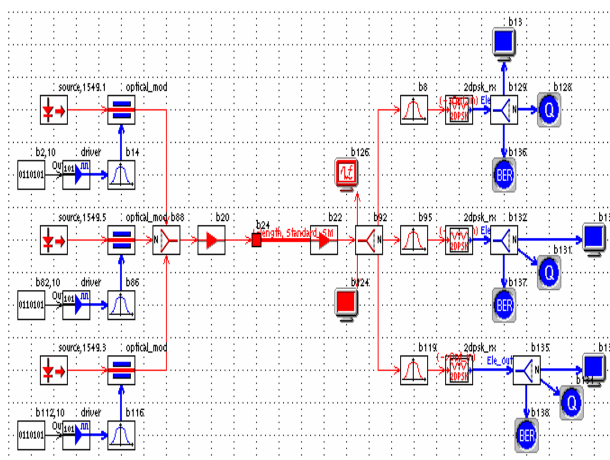


Figure 1

The dispersion has been fixed at 16ps/nm/km .The Output of the modulators are fed to the optical combiner (Multiplexer) and then amplified by the Inline Optical Amplifier with a fixed gain of 15dB followed by the booster with a fixed gain of 11dB. The centre frequency of

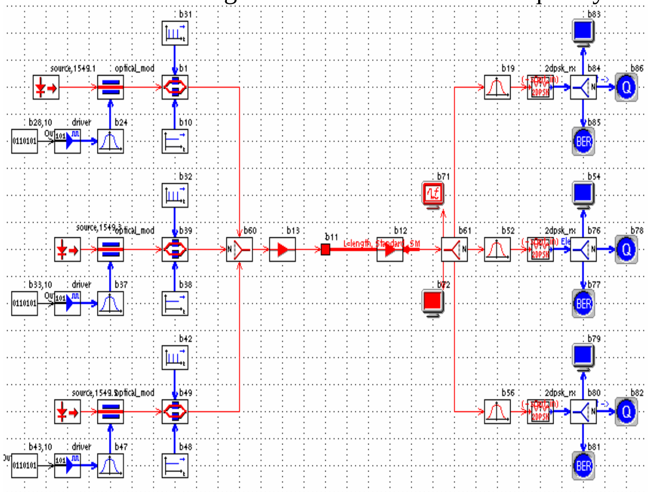
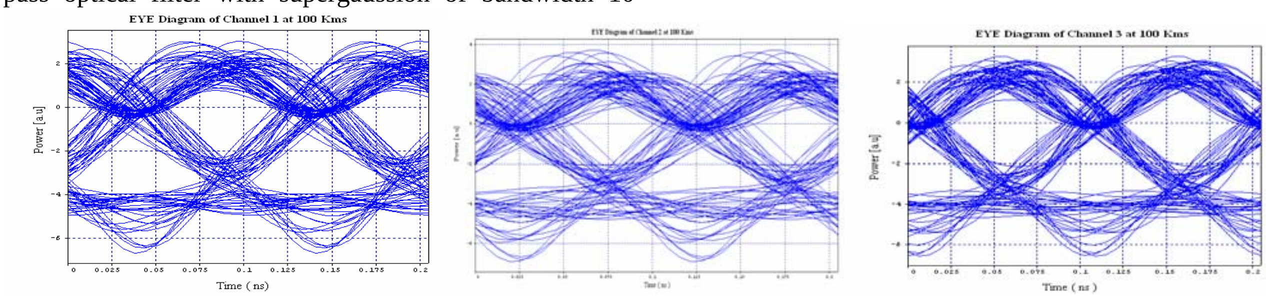


Figure 2

first LASER is taken as 1549.1 nm with the channel spacing of 0.3 nm. At the receiver a raised cosine band pass optical filter with supergaussion of bandwidth 10 GHz is used. The DPSK Receiver with bit rate of 10 GB/s has been considered. The Q meter at the receiving end estimates the average eye opening.

III. RESULTS AND DISCUSSION

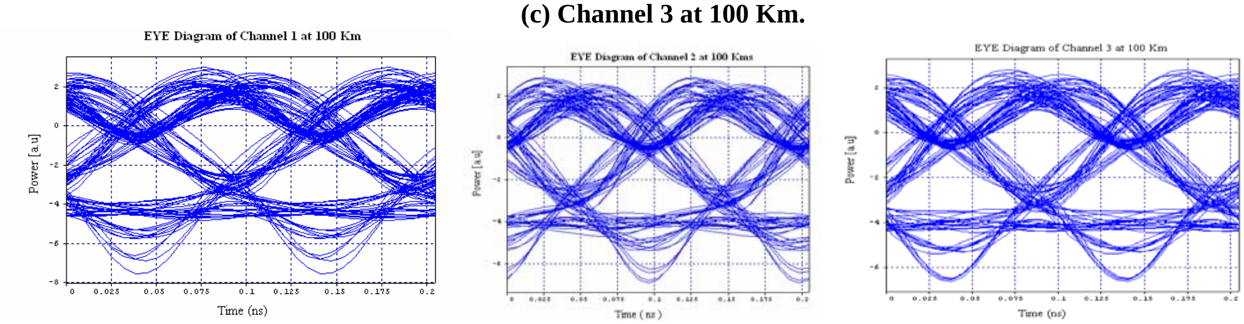
The performance of external intensity modulation and direct modulation has have investigated in terms of Bit error rate, Q value and eye diagrams. The Fig 3 and Fig 4 shows the eye diagrams of optical communication system by using direct modulation and external intensity modulation respectively. The Fig 5 and Fig 6 shows the Q estimation chart of the system with respect to length by using direct modulation and external intensity modulation respectively. The Fig 7 and Fig 8 shows the BER chart with respect to length by using direct modulation and external intensity modulation respectively. The Table 1 and Table 2 shows the



(a) **(b)** **(c)**

Figure.3

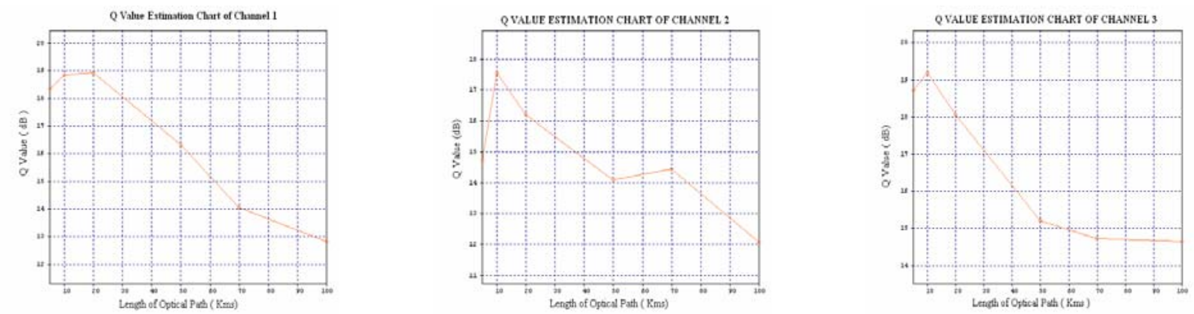
Output eye diagram of the system (Direct Modulation) with (a) Channel 1 at 100 km (b) Channel 2 at 100 km (c) Channel 3 at 100 Km.



(a) **(b)** **(c)**

Figure.4

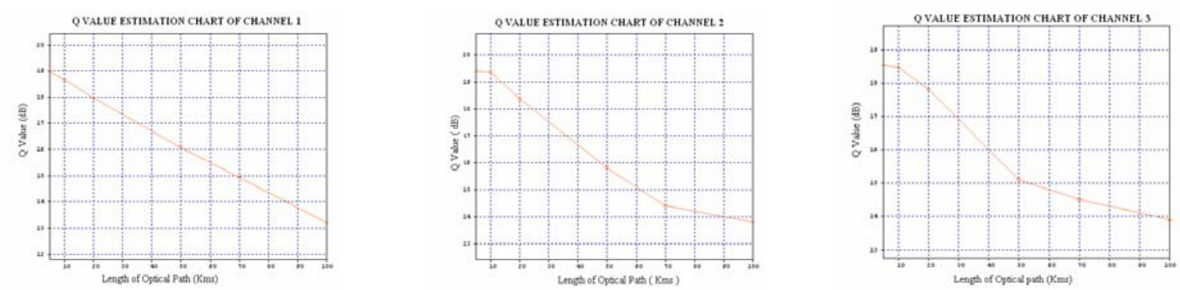
Output eye diagram of the system (Indirect Modulation) with (a) Channel 1 at 100 km (b) Channel 2 at 100 km (c) Channel 3 at 100 Km



(a) **(b)** **(c)**

Figure.5

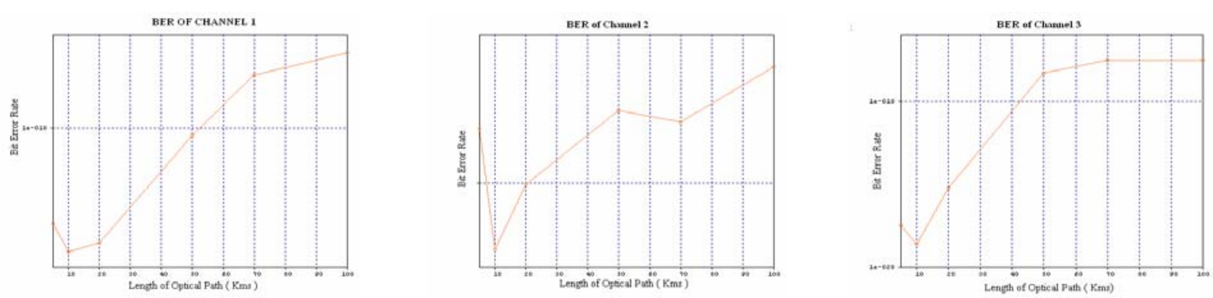
Q value estimation chart (Direct modulation) with (a) Channel 1 (b) Channel 2 (c) Channel 3



(a) **(b)** **(c)**

Figure.6

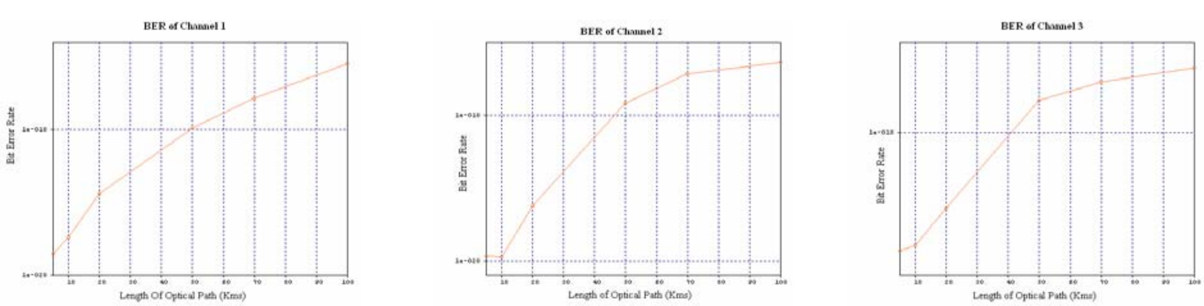
Q value estimation chart (External Intensity Modulation) with (a) Channel 1 (b) Channel 2 (c) Channel 3



(a) **(b)** **(c)**

Figure.7

BER chart (Direct Modulation) with (a) Channel 1 (b) Channel 2 (c) Channel 3



(a) **(b)** **(c)**

Figure.8

BER chart (External Intensity Modulation) with (a) Channel 1 (b) Channel 2 (c) Channel 3

Table 1 (Direct Modulation)

Length Of Fiber(Kms)	Channel 1		Channel 2		Channel 3	
	Q Value(dB)	BER	Q Value (dB)	BER	Q Value(dB)	BER
5	18.317	8.88426e-017	14.748	3.84638e-008	18.725	3.69754e-018
20	18.960	2.22889e-018	16.320	3.50931e-011	18.025	8.12571e-016
70	14.066	2.77291e-007	14.589	4.36442e-008	14.743	3.17657e-008
100	12.822	7.87398e-006	12.056	3.29044e-005	14.744	2.46947e-008

Table 2 (External Intensity Modulation)

Length Of Fiber (Kms)	Channel 1		Channel 2		Channel 3	
	Q Value(dB)	BER	Q Value (dB)	BER	Q Value(dB)	BER
5	18.986	2.75376e-019	19.387	2.27169e-020	18.570	1.76614e-017
20	17.974	4.56573e-015	18.372	6.86578e-017	17.797	9.05374e-015
70	14.955	1.53830e-008	14.491	5.82104e-008	14.497	7.07423e-008
100	13.227	3.63928e-006	13.762	5.45154e-007	13.906	4.21176e-007

the Q values, BER values at different length by using direct modulation and external intensity modulation respectively. Comparing the characteristics of the system by using direct modulation and external intensity modulation it can be seen that external intensity modulation have better Q value and BER.

IV. CONCLUSION

In this report we have analyzed the performance of optical system by using direct modulation and external intensity modulation. With the aid of OPTSIM we employed the optical system by using direct modulation as well as external intensity modulation. Better performance was shown when external intensity modulation technique is used. The BER and eye diagram technique have been evolved as a good means for evaluating the system performance in the present work.

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