Design and Optimisation of WDM 32, 64 & 128 Channels Using Constant Channel Spacing and Fibre Length

Sandeep K. Arya [#1], Bhawna Patlani [*2]

[#] *Electronics and Communication Department, Guru Jambheshwar University of Science & Technology, Hisar, Haryana, India*

arya1sandeep@gmail.com

bhawnapatlani@yahoo.co.in

***Abstract*— In this paper, to increase transmission capacity of optical communication system by increasing number of WDM channels using constant channel spacing and fibre length has been designed and optimised. We have observed the effect of increasing number of channels on Bit Error Rate (BER) by keeping constant parameters.**

***Keywords*— optical fibre, fibre non linearity, BER.**

I. INTRODUCTION

To increase transmission capacity of fibre optic system, Wavelength Division Multiplexing (WDM) is best method. WDM offers a great number of advantages; mainly data can be transmitted at higher rate. Transmission capacity can also be increased by either using higher bit rates, increasing number of WDM channels or closer channel spacing. In this paper, Bit Error Rate (BER) of WDM 32, 64, 128 channel systems are compared. Channel spacing, fibre length & bit rate for all system are considered same. On this basis, BER is compared. If channel spacing decreases, number of channel increases, thus increasing the transmission capacity of the system [1-2]. Fibre length is also a great factor on which non linear effects depend. Basically non linearity refers to the dependence of the system on power of optical beam launched into fibre cable. The longer the optical fibre, the more the light interacts with fibre material and the greater the non linear effects. If the power decreases while the light travels along the optical fibre, the effects of non linearity diminish. One another way to avoid or reduce the presence of non linear effects is to increase the effective area of fibre [3]. Non linear effects into consideration are stimulated scattering, self phase modulation, cross phase modulation & four wave mixing. Interference will reduce if unequal channel spacing is considered because every FWM component will have different frequency from any other channel [4].

II. SIMULATION SETUP

A simulation setup of WDM 32, 64, 128 channel systems are shown in fig. a, b, c respectively. All the system operates at the bit rate of 10 Gb/s, channel spacing is taken as 0.2 nm and fibre length as 400 km.

A .Transmitter Section

At the transmitter section, WDM 16-channel/8-channel NRZ transmitter is used, based on CW lasers and Mach-Zhender Modulators. A Continuous Wave (CW) laser source of 1 mW power has been used by considering the laser phase noise, line width of 10 FWHM (MHz). The laser phase has been considered as random and laser noise bandwidth is taken as ideal. A Mach-Zhender (MZ) modulator based on electron optical effect in device has been used with maximum transmittivity offset voltage of 5 volts and ideal extinction ratio is considered with zero chirp factors, further the average power reduction due to modulation is 3 dB. The optical amplifier with maximum small signal gain of 35 dB is used.

B. Optical Link

In the optical link, all the WDM system uses four spans of dispersion shifted fibre. Fibre length is taken as 100 km, hence total fibre length is 400 km. For all system, reference wavelength for nonlinearity is 1550 nm, fibre average beat length is 5 nm, birefringence correlation length is 0.2 km, beat length standard deviation is 0.5 m, & dispersion correlation length is 20 km. Fibre non linear effects are taken into consideration.

C. Receiver Section

At the receiver section, channels are detected. A receiver consists of an optical Raised Cosine Shape filter with roll-off 0.2 and -3dB two sided bandwidth is 40 GHz. It also consists of an ideal photodiode with responsivity 1 A/W at reference frequency of 193 THz and quantum efficiency is 0.7 with -3dB bandwidth of 20 GHz is used. A 5^{th} order low pass Bessel filter with -3dB bandwidth of 8 GHz is also used.

The system performance analysis is based on measurement of BER of received signal, by considering same parameters for all system. Table 1shows frequency range used for channels.

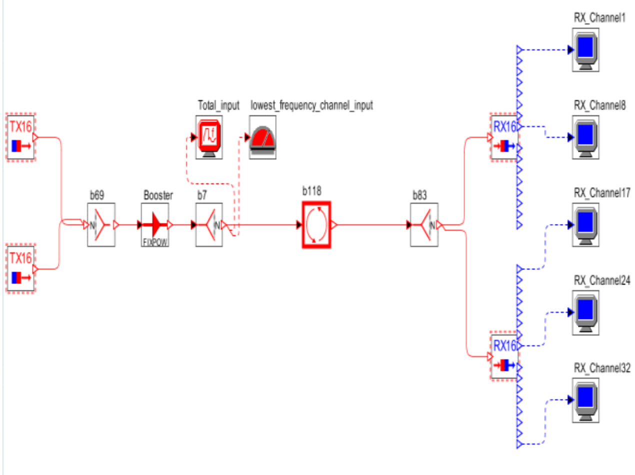

Fig. 1 WDM 32_channel system

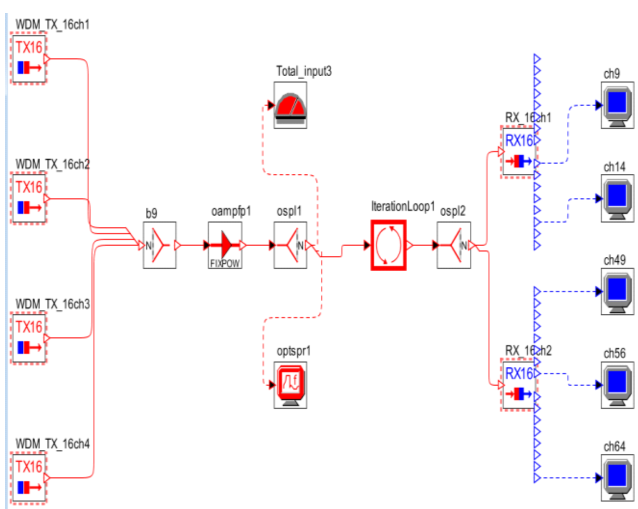

Fig. 2 WDM 64_channel system

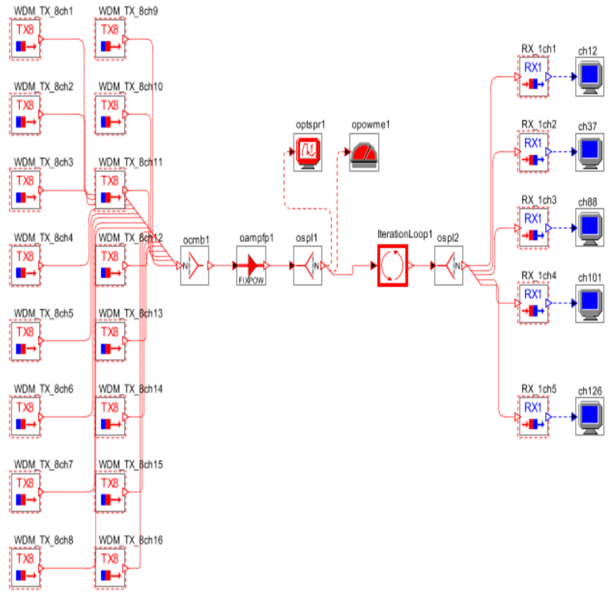

Fig. 3 WDM 128_channel system

TABLE 1
FREQURNCY RANGE USED FOR SYSTEM

Transmitter Channel	Frequency Range (THz)	Centre Frequency (THz)
1-16	189.1-192.1	190.6
17-32	192.3-195.3	193.8
33-48	195.5-198.5	197.0
49-64	198.7-201.7	200.2
65-80	201.9-204.9	203.4
81-96	205.1-208.1	206.6
97-112	208.3-211.3	209.8
113-128	211.5-214.5	213.0

•

III. RESULTS & DISCUSSION

Results have been obtained by comparative study of BER for WDM system by considering fibre length 400 km and channel spacing 0.2 nm. Eye diagrams are plotted for obtaining BER between sampling time (ns) and decision threshold (a.u.). After the comparative study of eye diagrams, it is concluded that BER varies from to . Figure (d) shows the eye diagram for WDM 32_channel system where BER is obtained as. As we go on further channels, BER gets improved as . Figure (e) shows eye diagram for WDM 64_channel system where BER is obtained as . Figure (f) shows eye diagram for WDM 128_channel system where BER is obtained as . As channel spacing is considered very less, but the number of channels gets increased, BER is improved as we have seen, so it is concluded that transmission capacity of system is increased.

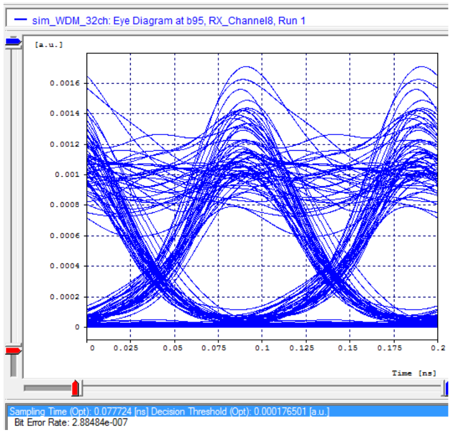

Fig. 4 BER of WDM 32_channel system

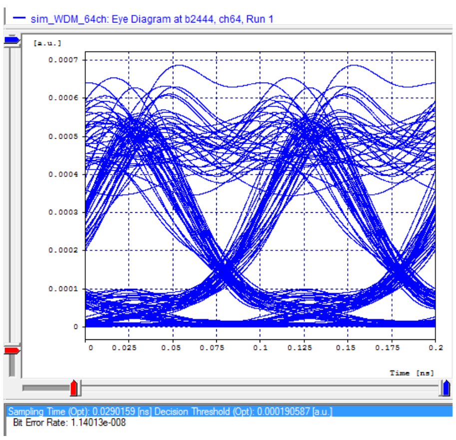

Fig. 5 BER of WDM 64_channel system

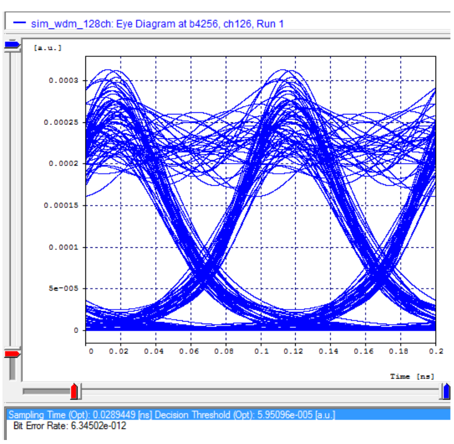

Fig. 6 BER of WDM 128_channel system

improved and transmission capacity of system is increased. As the fibre length is taken as longer, so the non linear effects are also more which can be either by reducing power or by increasing the effective area of fibre.

•

REFERENCES

- Laxman Tawade, Shantanu Jagdale, Premanand Kadbe, Shankar Deosarkar,'' Investigation of FWM effect on BER in WDM optical communication system with binary and duobinary modulation format'', IJDPS Vol.1, No.2, Nov.2010.
- A. R. Borsali, H. A. Badaoui, M. Aichi and W. Aichi,'' Effect of channel wavelength spacing for WDM system on the quality of transmission'', IJCSI Vol.9, Issue 3, No.2, May 2012.
- Sergio Tsuda and Valeria L. Dasilva,'' Transmission of 80 x 10 Gbps WDM channels with 50 GHz spacing over 500 km of LEAF fibre'', Lorning Inc-PRTC, 2200 Cottontail Lane, Somerset, NJ 08873.
- Nahyan AI Mahmud, Bobby Barua,'' Effects of four wave mixing on an optical WDM system by using Dispersion shifted fibre'', IJET Vol.2 No.7, July 2012.
- Optsim user manual.

•

IV. CONCLUSION

We have designed & optimized the performance of three WDM systems. We have studied the comparison of BER for 32, 64, 128 channel system. With the increasing number of channels & by reducing the channel spacing, BER gets

•

