PERFORMANCE EVALUATION OF HIGH DATA RATE DWDM SYSTEM WITH TW-SOA

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ABSTRACT

WDM technology act as important role in fiber optic communication. Dense wavelength division multiplexing (DWDM) is the major technology that can transmit multiple information streams simultaneously over the single fiber with reduced channel spacing. The optical fiber has established great application in long distance communications. In this paper, a 80 channel DWDM system is modeled with 0.1 nm channel spacing in the presence of travelling wave semi-conductor optical amplifier (TW-SOA). The performance of Bessel WDM mux/demux filter for various order of low pass Bessel filter has simulated and analyzed for 200 km distances at 160Gbps bitrate to improve the quality factor of this system model. The performance of the simulation system has been investigated in terms of quality (Q) factor and bit error rate (BER) by using Optisystem simulator 7.

Keyword:- *DWDM, OLT, ONU, CO , TW-SOA,*

1. INTRODUCTION

In fiber optic communication, sending the data from one place to another by transporting pulses of light through the optical fiber medium. Even though optical transmission have increased in speed and capacity, Wavelength division multiplexing (WDM) transmission technology for transmitting a wide range or large number of optical signals With different Wavelengths. In this WDM transmission technology, there are two kind of effects occur in fiber optical channel such that linear and non-linear effects. Linear effect depends on linear characteristic include attenuation, dispersion. Optical intensity increases, phase delay in the fiber gets larger. Non-linear interaction depends on transmission length and effective core area of fiber. Non-linear effects are Four Wave Mixing (FWM), Self-phase modulation (SPM) and cross phase modulation (XPM) in multichannel wavelength division multiplexing system. Those effects are leads to degrade the system performance [1].

2. RELATED WORKS

In the previous paper [2], authors have modeled the Dense wavelength division multiplexing (DWDM) with Dispersion compensation fiber at 25Gbps over the 120km. The effect of third order dispersion and non-linearity effects are taken for testing the strength of highest Q-factor. Better services are provided only to sixteen subscribers in this system model. In ref [3], authors have spread out the DWDM communication system to provide the services to 64 users at transmission bit rate 10Gbps with the length of 140km and power of 10dBm in the presence optical amplifiers with different pumping values for each amplifiers. Even though this model have maintained the 64 users, there is necessary to expand the transmission bitrate. In the reference [4], authors have investigate and compensate the positive dispersion accumulated over the fiber length at 20 Gbps by using dispersion compensating fibers (DCF).

3. SIMULATION SETUP

In optical fiber communication systems, Simulation setup for the 80-DWDM channels are shown in fig.5. Our proposed system consists of optical WDM transmitter, WDM multiplexer, Optical fiber, TW-SOA, WDM Demultiplexer and optical receiver such as ONU. A WDM transmitter with 160 Gb/s bit rate, 0.1nm frequency spacing, 10dBm power is transmitting 80 channels with the frequency starting from 193.1 THz having frequency spacing of 0.1nm through a WDM mux to the Optical Fiber. WDM mux is used to multiplex different optical carrier signals on to a single optical fiber cable by using different wavelengths or colors of laser light. Optical fiber communication channel consist of optical fiber with 50km distance, TW-SOA, loop control that is used to extend the fiber length up to 200 km.

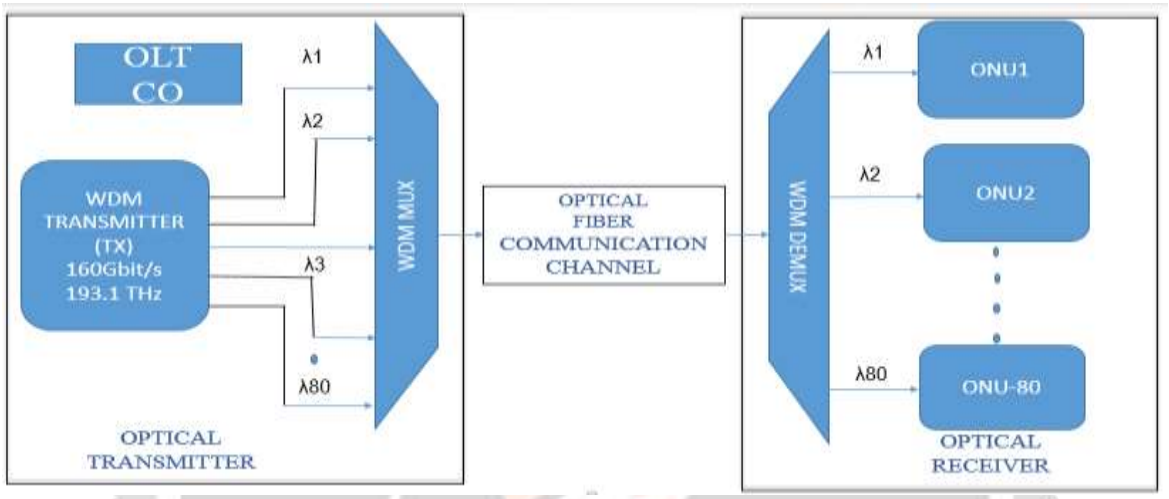

Fig-1:- Block diagram of 80 channel DWDM transmission system

The multiplexed signal is split to different signal wavelengths, which are equal to 80 Channels by using the WDM Demultiplexer. The output signal from the Demux is directed to APD photodetector to convert the light signal to signal,

Table-1:- Simulation parameter of this system model

SIMULATION PARAMETER	VALUE
Power, dBm	10
Bit rate,Gbps	160
Channel Spacing, (Δλ)	0.1 nm (12.45 GHz)
Fiber length, L (km)	200
Injection current of TW-SOA, I (A)	0.5
Number of Loop Control	4
Dispersion,D (ps/nm/km)	-20
Effective Area, A_{eff} (μm²)	24
Non linear refractive index,n_2 (m²/W)	2.99×10^{-20}

fork 1 x 8 is used to distribute the electrical signal to different electrical low pass Bessel filters 3R repeater is employed for retiming, reshaping, regeneration of the electrical signal.

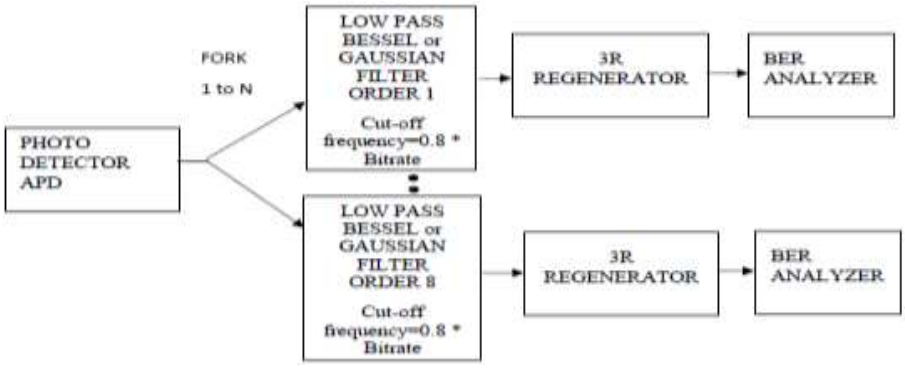

Fig-2:- Internal structure of ONU

In BER analyzer measures the maximum Q-factor and minimum bit error rate to analyses the system performance. The FWM efficiency can be estimated by the equation (1)

$$\text{FWM efficiency},\eta = \left[\frac{n2}{AeffD(\Delta\lambda)^2}\right]^2 \quad (1)$$

4. SIMULATION RESULTS

The simulation is carried out to evaluate the performance of different order of bessel WDM mux/demux filter on 80-channel DWDM system by using TW-SOA. The performance is investigated at 160 Gbps bitrates in terms of Q-factor (db) and bit error rate (BER) using NRZ modulation format. Simulation Parameters are shown in table 1.

Table-2: Performance parameters for Non-linearity signal processing with first order WDM Mux/Demux filter in the presence of TW-SOA

Order of the Low Pass Bessel Filter with 0.8*bitrate cut-off frequency	Performance Parameters	
	Q-Factor	BER
1	12.2089	1.28*10^-34
2	11.61	1.75*10^-31
3	12.80	7.89*10^-38
4	12.51	1.1*10^-36
5	12.46	5.8*10^-36
6	12.43	8.39*10^-36
7	12.048	9.62*10^-34
8	12.49	4.22*10^-36

Table-3: Performance parameters for Non-linearity signal processing with second order WDM Mux/Demux filter in the presence of TW-SOA

Order of the Low Pass Bessel Filter with 0.8*bitrate cut-off frequency	Performance Parameters	
	Q-Factor	BER
1	4.028	2.81*10^-5
2	3.853	5.50*10^-5
3	3.75	8.07*10^-5
4	3.69	9.9*10^-5
5	3.69	9.95*10^-5
6	3.7	9.5*10^&-5
7	3.72	8.98*10^-5
8	3.74	8.533*10^-5

Performance parameters of this system model with first, second and third order WDM Mux/Demux Bessel filter in the presence of TW-SOA are shown in table 2,3 and 4.

Table-4: Performance parameters for Non-linearity signal processing with third order Bessel WDM Mux/Demux filter in the presence of TW-SOA

Order of the Low Pass Bessel Filter with 0.8*bitrate cut-off frequency	Performance Parameters	
	Q-Factor	BER
1	3.47	2.1*10^-4
2	3.153	5.4*10^-4
3	3.01	7.9*10^-4
4	2.95	9.2*10^-4
5	2.933	9.7*10^-4
6	2.933	9.7*10^-4
7	2.93	9.57*10^-4
8	2.945	9*10^-4

Figure 3 Maximum quality factor Vs different order of the Low Pass Bessel Filter up to 1 to 8 at ONU for optical fiber length of 200km with TW-SOA based on various order of Bessel filter WDM Mux./Demux. Figure 4 Variation of maximum peak power versus operating frequency after 200km fiber length /TW-SOA with 0.1nm channel spacing based on first order Bessel filter WDM Mux./Demux. with highest Q-factor of 12.80.

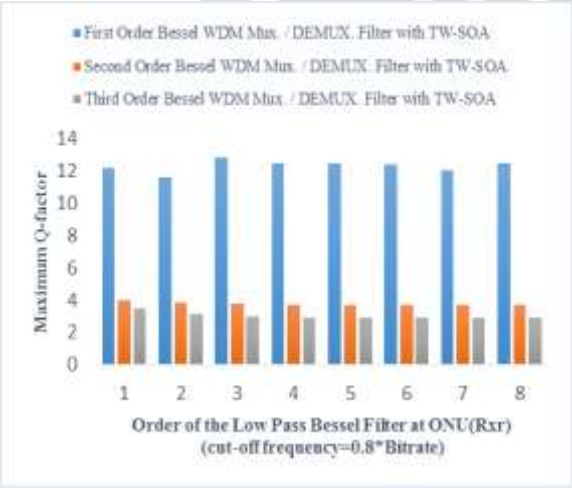

Fig-3:- Comparative analysis for various order of Bessel filter

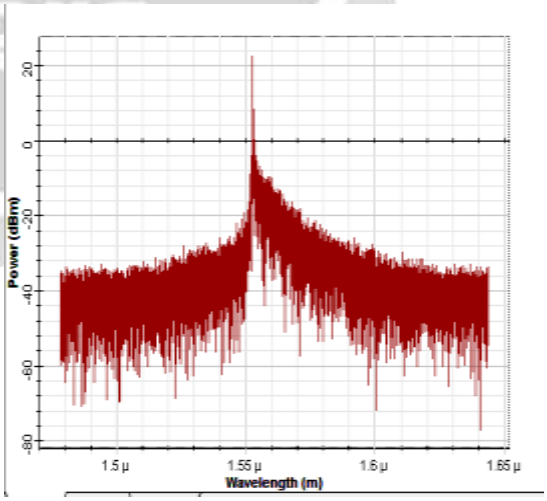

Fig-4:- Output of spectrum analyzer after 200 km distance

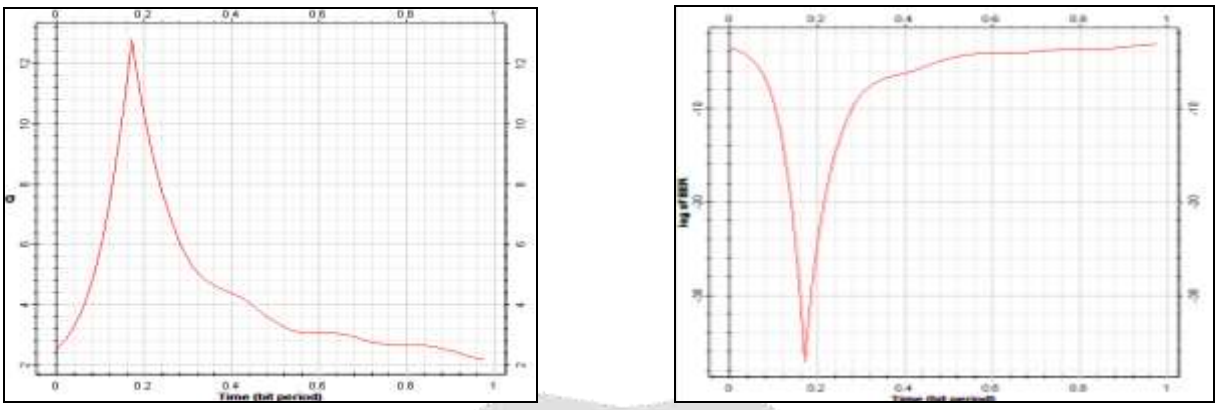

Fig-5:- Performance of quality factor and BER at 160 Gbps bitrate

4. CONCLUSIONS

In this investigation, the performance of different order of bessel WDM mux/demux filter on 80-channel DWDM system at 160 Giga bit rates is evaluated in the presence of TW-SOA. The channel spacing of 12.45 GHz is used in this system with the 10 dBm power. The performance of simulated system has been investigated in terms of Q-factor and bit error rate as shown in above graphs. From the simulation results, it has been observed that the First order Bessel WDM mux/demux filter has the highest quality factor of 12.80 for long-distance and high-bit-rate DWDM transmission system.

5. REFERENCES

[1]. Govind P. Agrawal.(2003), 'Fiber-Optic Communications Systems', John Wiley &sons, Inc. Publication.

[2]. Rupinderjit Singh, Ashok K Goel, Surinder Singh.(2016), 'Analysis of Third Order Dispersion and Four Wave Mixing in 16 × 25 Gbps DWDM Optical System with Variable Channel Spacing', IJEDR, Vol.4, No.1 , ISSN: 2321-9939

[3]. Aziz, H. M., & Ebad Zahir.(2015),' Investigating a simulated model of 2.5 GHz 64 channel 140 km DWDM system using EDFA and Raman amplifier considering self-phase modulation',IOSR Journal of Electronics and Communication Engineering (IOSR-JECE), Vol.10, No.1, Ver. III, 91–pp.95. e-ISSN: 2278-2834,p- ISSN: 2278-8735.

[4]. Manpreet Kaur, Himali Sarangal. (2015),' Analysis on Dispersion Compensation with Dispersion Compensation Fiber (DCF)', SSRG International Journal of Electronics and Communication Engineering (SSRG-IJECE) , Vol.02, No.2 .

[5]. Simarpreet Kaur Gill, Gurinder Kaur. (2016),' Performance Evaluation of 32 Channel DWDM System Using Dispersion Compensation Unit at Different Bit Rates' International Research Journal of Engineering and Technology (IRJET),Vol.03, No.6.

[6]. Mehtab Singh, Vishal Sharma. (2015),' Investigation of Four Wave Mixing Effect at Different Transmission Power Levels and Channel Spacing', International Journal of Computer Applications (0975 – 8887) Vol. 128, No.1.