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Investigation the Effect of Channel Spacing for Long Distance Communication

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***Abstract:* — In this paper, the impact of different channel spacing on proposed system setup is investigated for long distance communication. This wavelength division multiplexing (WDM), dense wavelength division multiplexing (DWDM) and ultra-dense wavelength division multiplexing (UDWDM) is evaluated by considering the signal quality factor, bit error rate, optical gain, and received power for different signal input power and for distance. It is observed that at -5 dBm of signal input power the system covers 130 km with acceptable BER (10^{-8}) and Q-factor (14dB).**

Keywords: Long distance, Optical Gain, Output power, Channel spacing

I. Introduction

Optical amplifiers are intensively used in communication system. The erbium doped fiber amplifier (EDFA) in which erbium, ions are doped in the optical fiber which act as gain medium to amplify an optical signal. EDFAs are having of less noise figure and have a high gain bandwidth.

In WDM systems by multiplexing, a stream of wavelength channels can amplify to a desired power level where the amplification of any particular channel is dependent on the signal wavelength, the number of signals present in the system, the input signal powers and its absorption and emission cross-sections [1-3].

Desurvire et al. [4] demonstrates the potential of erbium-doped fiber amplifiers for application in wavelength-division multiplexed communication systems. It has low insertion loss, low crosstalk, high gain, polarization insensitive and low noise figure. An EDFA has a comparatively wide wavelength range of amplification making it useful as transmission amplifier in wavelength division multiplexing systems. Theoretically EDFA is capable of amplifying all the wavelengths ranging from 1500 to 1600 nm. However practically there are two windows of wavelength. These are C and L band. The C band ranges from 1530 nm to 1560 nm and L band from 1560 nm to 1610 nm. The semiconductor laser pumping source at 980 nm wavelength has proved to be the best in terms of efficiency (more than 10 dB gain per mW pump power) and better noise performance [5-10]. Jain et al. [11] analyzed the performance of WDM system using several external modulation schemes and optical filter under the FWM effects. Sharma et al. [12] stated the improved analysis for cross-phase modulation and self-phase modulation induced crosstalk by changing the walk off parameters (input optical power, transmission distance and modulation frequency) with the aim to attain the minimum value of total induced crosstalk.

II. System Setup

The simulation setup consists of 47 DWDM channels at different channel spacing using continuous wave lasers as shown in Fig. 1. To investigate the performance, we have used Opti system 7 simulation software. In this system optical transmitter which consider optical source, optical modulator and optical electric signal modules are used. Optical multiplexer is used to combined multiple input signal to one input single then it sends to dispersion compensating fiber through single mode fiber. When the light passed through the fiber then the light gets dispersed due to nonlinearities effect. To overcome these nonlinearities DCF is used and then transmit to demultiplexer where the single input can convert to multiple inputs. To compensate the positive dispersion the inline dispersion compensating fiber has been used with -96 ps/nm/km. EDFA is used at fixed output power 25 dB of gain is used to post compensate the power.

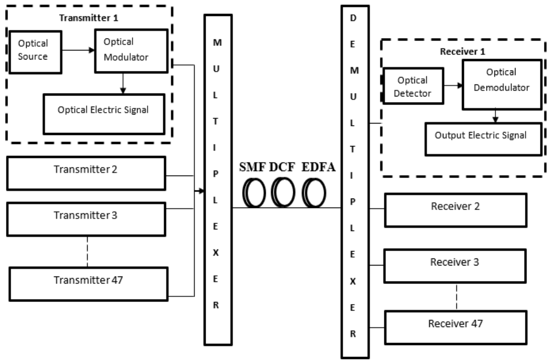
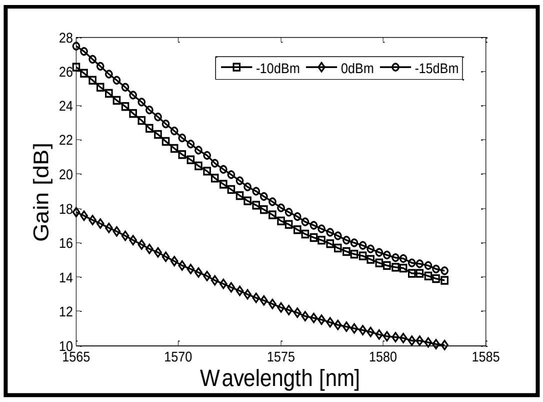


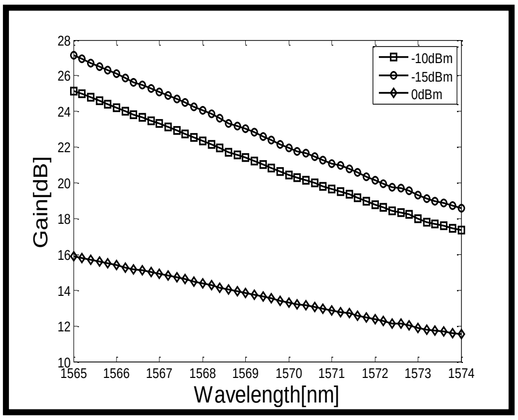
Fig. 1. System setup for 47 DWDM channels at different channel spacing

III. Result and Discussion

The system performance is observed in terms of gain, output power, bit error rate and quality factor as shown in fig. 2-5.



(a)



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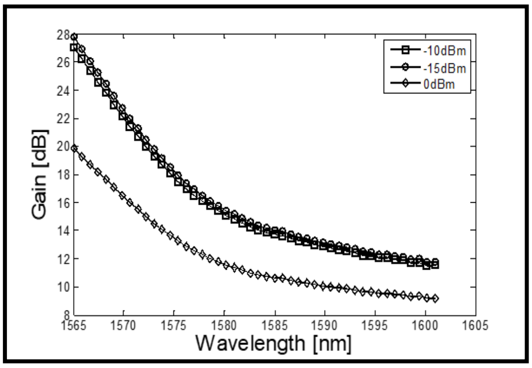
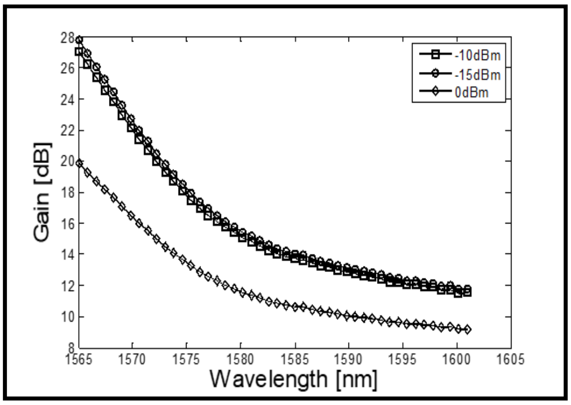


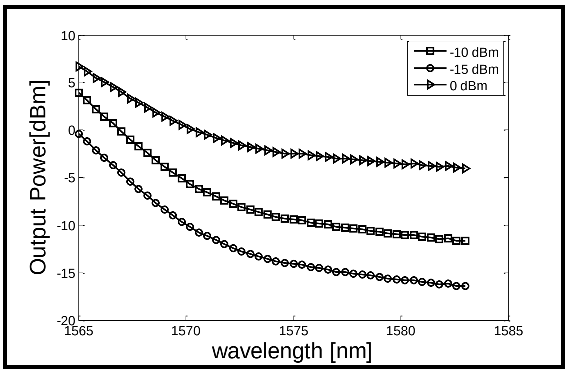
(c)

Fig. 2: Optical Gain as a function of wavelength at different optical power using (a) 0.2nm (b) 0.8nm (c) 0.4nm, channel spacing

From the graphs it is observed that the proposed setup gives the acceptable results for all channel spacing. We also analyze the performance for different transmission distance from 10 to 130 Km as shown in fig. 4-5. From the figure it is observed that as the Q-factor decreases on the other hand the BER increases due to nonlinearities in fiber.



(a)



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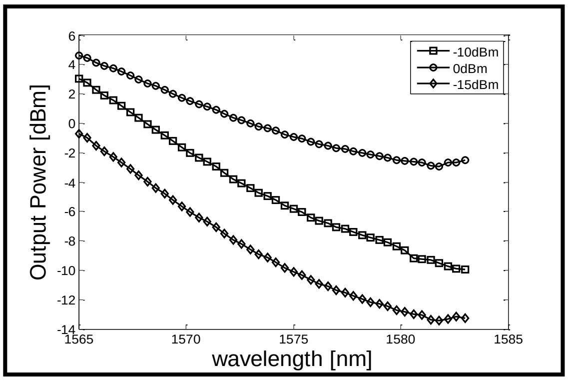

(c)

Fig. 3: Optical gain as function of wavelength at different optical power using (a) 0.8 (b) 0.4nm (c) 0.2 nm channel spacing.

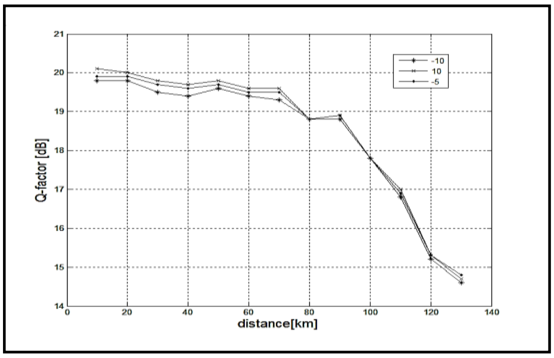

Fig 4: Transmission distance versus Q-factor for proposed system.

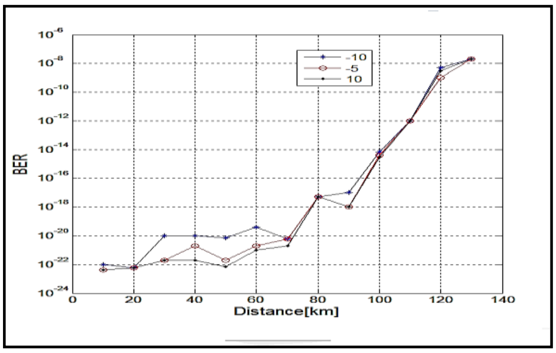

Fig. 5: Transmission distance versus BER for proposed system.

From Fig. 5 it is observed that at -5 dBm of signal input power the system covers 130 km with acceptable BER (10^{-8}) and Q-factor (14dB). From the results it is observed that the system can be used for long distance communication.

IV. CONCLUSION

In this study, the impact of proposed system been examined for 0.8 nm, 0.4 nm and 0.2 nm channel spacing and cover 130Km distance. Using the proposed system, we have achieved maximum 7dB, 27 dB, 28dB gain and minimum 11dB, 13.3 dB, 10dB for 0.2 nm, 0.8nm and 0.4 nm channel spacing, respectively. The output power is also observed using proposed system and achieved maximum 10dBm, 5dBm and 3.5 dBm and minimum -15dBm, -13dBm, -9dBm for 0.8nm, 0.4nm, 0.2 nm channel spacing, respectively. The proposed system is also investigated long distance communication in term of BER and Q-factor. And it gives the acceptable performance with values of BER (10^{-23} to 10^{-8} and Q-factor (20.3dB to 14dB).

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