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Video Signal Transmission through DWDM Network

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Abstract:
In this paper we proposed a procedure ,which determines where the interruption of the quality of transmission starts. Based on the algorithm, simulations of transmission for specific values are executed. The analysis of the results showed how the BER and Q-factor change depending on the length of the fiber, ie. on the number of amplifiers, how the number of multiplexed channels and the flow rate per channel affects on a transmited signals. Analysis of DWDM systems is designed for systems with flow rates of 2.75 Gb/s and 12 Gb/s per channel in the software package OptiSystem 7.0.

***Keywords** : DWDM network; amplifying section*

INTRODUCTION

Dense Wavelength Division Multiplexing is defined as a technology that multiplexes multiple optical carrier signals on a single optical fiber by using different wavelengths for transmission of various information. Smallest attenuation in optical fiber is achieved by applying the wavelength of 1550 nm or by using the "third optical window" [1-4].

DWDM systems allow expansion of existing capacity without laying additional fiber optic cables. Capacity of the existing system is expanded using multiplexers and de multiplexers at the ends of the system [5-6].

For successful transmission of optical signals over long distances a doped fiber amplifiers with erbium (EDFA - Erbium Doped Fiber Amplifier) are used. Erbium is a rare element that, when excited, emits light at a wavelength of 1.54 µm because this is the wavelength at which the attenuation is minimal. Weak signal enters the erbium doped fiber and than into the fiber the light is inserted using lasers pumps. This light excites erbium atoms to release accumulated energy as a additional light with wavelength around 1550 nm. As this process continues through the fiber, the signal increases. EDFA can amplify optical signals as much as they can be multiplexed in a given range until we are receiving a strong enough signal. When you reduce the level of the signal at the input, all multiplexed signals can not be steped up. EDFA is available in the C and L windows but with quite narrow range (1530-1560 nm) [7-8].

SYSTEM MODEL AND ALGORITHM

Analysis of DWDM transmission system was performed in the software package OptiSystem 7.0 . Figure 1 shows the layout of the proposed algorithm under which the assessment of whether the signal transmission through the DWDM network quality or not is made

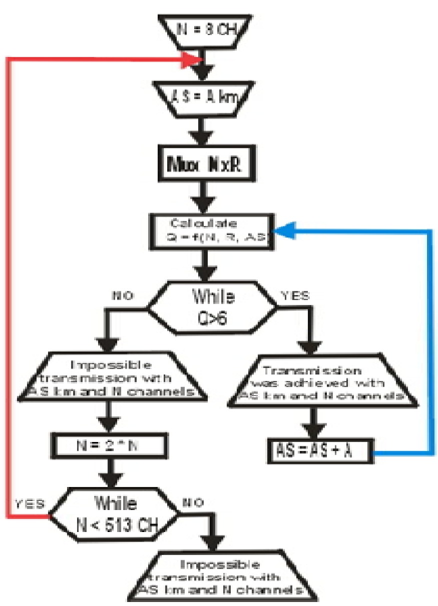

Fig. 1. Algorithm for the evaluation of quality of DWDM transmission network during the design stage.

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The proposed algorithm applies to a fixed flow rate R. The parameters that change are the number of DWDM channels (8 to 512) and the length of the amplifying section AS (km), at whose ends EDFA amplifiers are placed. Parameter of evaluation, whether the transmission quality is good, is Q factor, and transmission is good if the boundary is Q=6.

The algorithm consists of a sub-cycle and a main cycle, for which the number of execution varies. Sub-cycle (blue line in Figure 1) is the number of shares and the number of its executions depends on the Q values for a variable number of shares and constant number of DWDM channels. The main cycle (red line in Figure 2) is the number of DWDM channels and contains a sub-cycle for sections and it will be done seven times, for three values of N (N = 8, 16, 32, 64, 128, 256, 512). The algorithm is applied to specific values of the optical fiber system defined by the ITU G.652 standard [7]. Two systems are observed, the first being at a flow rate of 2.5 Gb/s, and the second with a flow rate of 10 Gb/s. The system is analyzed for 16, 32 and 64 DWDM channels, while the length of the amplifying section ranges from 40 to 80 km. Power emitted by each source is 5 dBm. After receiving the digital signal multiplexing is performed on these signals in DWDM multiplexers. The frequency of each channel is separated by 1 GHz. Then it sends a multiplexed signal through an optical fiber where on every A km a EDFA amplifier is set, whit parameters: Gain = 20 dB, Power = 15 dBm. Since the system works in the third optical window, the attenuation along the length of fiber is 0.2 dB/km. On the receiving side demultiplexing of the signals is done using DWDM demultiplexer running at the same frequency as the DWDM multiplexer.

At the receiver BER analyzer is set to determine which is the BER and Q-factor, on which one can determine the performance of the transmission system. Results showed that the BER and Q-factor change depending on the length of the fiber, ie. on the number of the amplifying shares, and what kind of an effect the number of multiplexed channels and the flow rate per channel have to transmission of the signals.

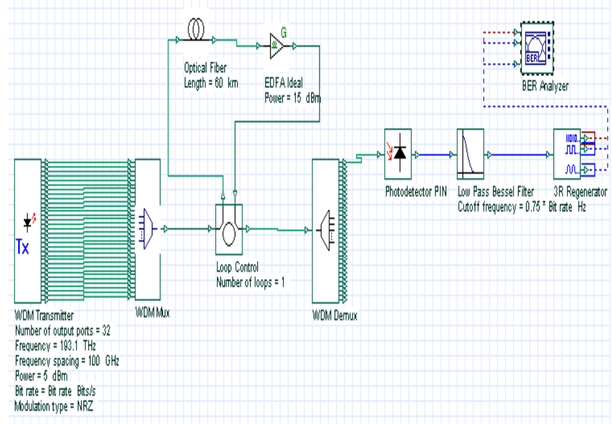

Fig 2: 16-channels DWDM network

Result Analysis

The following tables provide the BER parameter for flow per channel at 2.75 Gb/s and 12 Gb/s respectively

Table1: for 12 Gb/s

No DWDM Channels	Length of amp section	Number 1	Of Amp 2	Sections 3
16	40 km	2.80243E-183	6.34578E-069	3.76964E-040
32	50 km	8.3337E-090	3.97518E-048	8.41847E-025
64	60 km	2.40272E-044	1.75404E-033	8.84035E-19

Table2:for2.75Gb/s

No DWDM Channels	Length of Amp Sec	Number 1	Of Amp 2	Sections 3
16	40 km	2.80243E-183	2.84414E-087	1.73256E-063
32	50 km	5.85969E-160	2.27623E-065	8.52164E-047
64	60 km	7.22561E-065	8.84035E-051	1.05339E-043

Corresponding graphs of the above sample results are shown below and for the violation of boundaries of transfer, we take the value of the BER of 10^{-9} and Q=6, it can be seen that with the increase in the number of DWDM channels the

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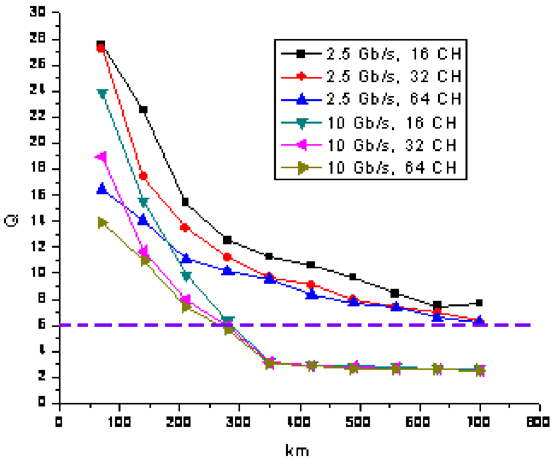
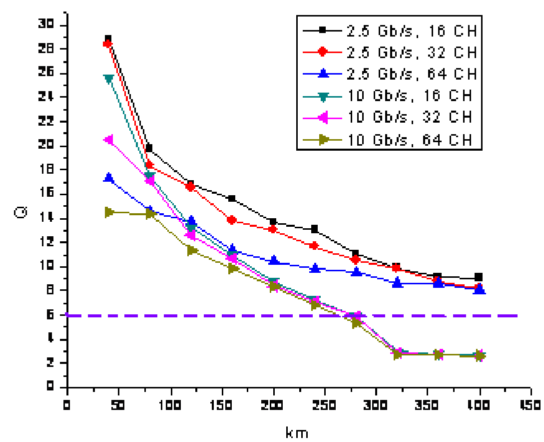
length at which it can achieve a quality transmission reduces. Decrease of Q factor is much more pronounced in the first amplifying sections, while with the greater number of them, Q factor becomes approximatelyconstant.



Graph 1 Q factor for 40 km



Graph2:QFactorfor60Km

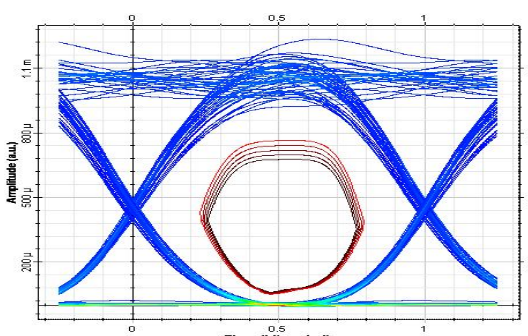


Fig 3

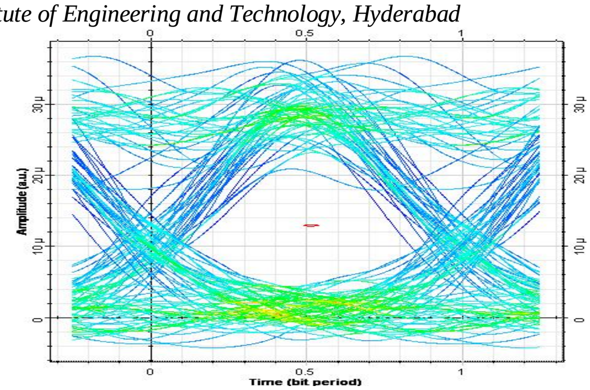


Fig 4

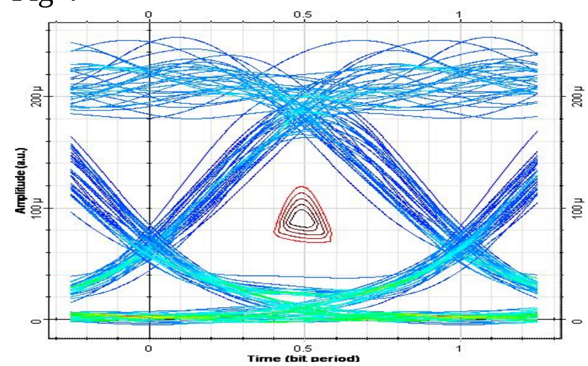


Fig 5

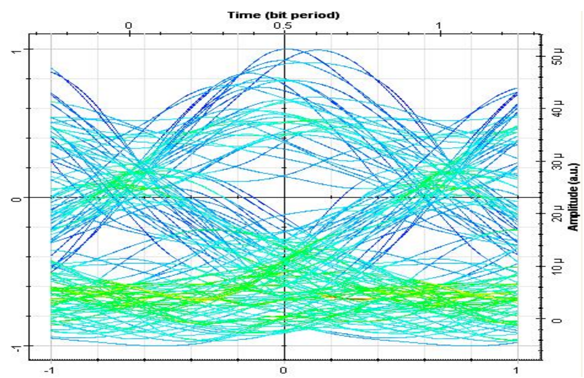


Fig6

Fig3 to fig 6 shows different eye diagrams of 12 Gb/s with 60 km and 400 km.

Conclusion:

In this paper an analysis of the BER parameter and Q factor determinated that the length of amplifying section, the flow rate per channel and the number of DWDM channels affect the transmission quality.It is identified that how BER and Q factor are changing with the change in length of an amplifying section. Decrease of Q factor is much more pronounced in the first amplifying sections,

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while with the greater number of them it becomes approximately constant. A conclusion was made: with increasing length of the amplifying section for the system of 10 Gb/s there is no major change in quality with the larger length of signal transmission. In the case of the system of 2.5 Gb/s, increasing the length of amplifying sections means that there will be degradation of transmission quality.

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