

PERFORMANCE ANALYSIS OF 8 CHANNEL WDM SYSTEM USING CWDM FIBER

Anamika Basnotra

Abstract— This paper focuses on performance evaluation of 8-channel WDM system using a special fiber which is CWDM fiber and then optimizing the performance parameters. This paper also gives the optimum values which the system of such a kind supports. It also gives a comparison of values based on the system with EDFA and without EDFA. the whole work has been carried out on OPTISYSTEM9 simulation tool.

Index Terms— WDM, CWDM, DWDM.

I. INTRODUCTION

Wavelength Division Multiplexing is a technique in which multiple wavelengths are transmitted over the single fiber. CWDM and DWDM are the two main types of WDM.

Choosing from CWDM and DWDM purely depends on the area of implementation. Both have their own spark in their respective fields. Optical Fiber Communication is a technology which not only works effectively in transport networks, but is also gaining much importance in metro-core and metro-access networks. The most important benefit of WDM is its ease in upgrading the capacity.

One of the forms of WDM is CWDM which delivers multiple wavelengths over an optical fiber at a fraction of cost of DWDM.

II. WDM

Wavelength division multiplexing is a multiplexing technique where a number of optical signals having different wavelengths are transmitted together. [1]

By combing multiple colors of light into a single fiber, the capacity of system could effectively multiply existing capacity by one or two orders of magnitude. And WDM is transparent to the protocol. By now, hundreds of wavelengths can be placed in one fiber. [3].

CWDM and DWDM are two perspectives of WDM technology. CWDM is used for short range metro or regional communication, and DWDM is used for long range.

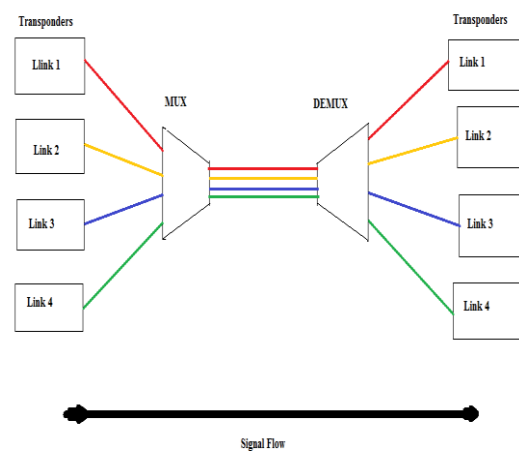


Fig. 1 A WDM System [1]

III. WHERE IS CWDM BENEFICIAL OVER DWDM

A. Transmission Distance

When the transmission distance is less, then it is beneficial to go for CWDM over DWDM.

B. Market to be addressed

The market in which we have moderate traffic growth projections; it is beneficial to switch over CWDM.

C. Cost

The market where cost is a concern. Since, the overall cost required for CWDM system is 1/3 of the cost of DWD system.

D. When we want simpler deployment

CWDM system has comparatively simpler deployment which is definitely a plus point.

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Anamika Basnotra, Computer Science and Engineering, Indo Global College of Engineering, Chandigarh, India, 7298104392

IV. BASIC SIMULATION SETUP

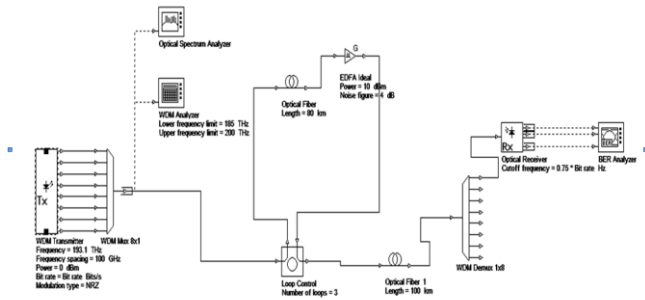


Fig. 3 Simulation Setup for an 8-Channel WDM System

Fig. 2 Basic Simulation Setup [2]

All the simulations have been performed using the OptiSystem 9 simulation tool.

The WDM transmitter is used to generate the input data streams. Once the data is generated, it is sequenced, modulated; its optical conversion is done. The job of MZ modulator is to do external modulation.

Since it is an 8 channel WDM system; eight data streams are generated and multiplexed using 8x1 multiplexer. The amplification is done using EDFA amplifier which is a looped one. The data is then transmitted to the receiver end through the optical fiber.

At the receiver end; a 1x8 demultiplexer is used to demultiplex the signals. BER, optical and electrical analyzers are used for checking the quality of the signals.

Table I. Q-Factor with respect to Fiber length

	Q-FACTOR
05	148.107
10	116.676
15	110.622
20	102.403
25	87.5684
30	74.1232
35	67.0143
40	61.7884
45	53.4676
50	47.3538
55	41.3433
60	30.575
65	25.6956
70	24.0912
75	20.5801
80	15.1821
85	11.9139
90	10.7165
95	8.56372
100	6.42734
105	5.13363

V. SIMULATION SETUP DEPLOYED WITH THE USE OF CWDM FIBER (WITHOUT EDFA)

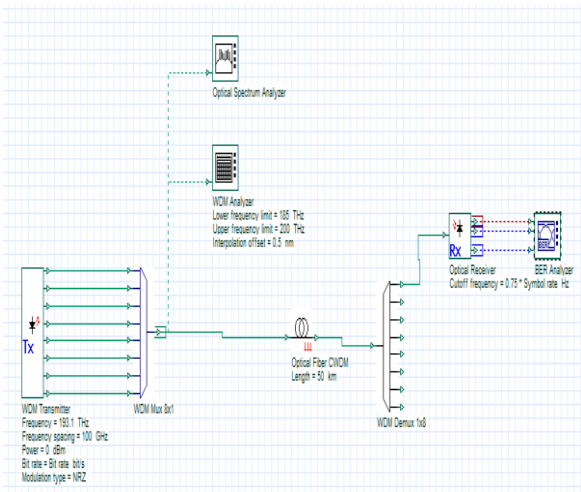


Fig. 3 Simulation setup deployed with EDFA (without EDFA)

The setup displayed above is without the use of EDFA. The biggest change made here is the deployment of CWDM fiber. The calculations performed are based on this setup. Following is the data retrieved.

Table 2. BER with respect to Fiber length

FIBER LENGTH	BER
05	0
10	0
15	0
20	0
25	0
30	0
35	0
40	0
45	0
50	0
55	0
60	1.27583×10^{-205}
65	6.45473×10^{-146}
70	1.52637×10^{-128}
75	2.06866×10^{-94}
80	2.31076×10^{-52}
85	5.00781×10^{-033}
90	4.2575×10^{-027}
95	5.43669×10^{-018}
100	6.47743×10^{-011}
105	1.41728×10^{-007}

Table 3. Eye Height with respect to Fiber length

FIBER LENGTH	EYE HEIGHT
05	0.00206943
10	0.00163443
15	0.0012976
20	0.00102678
25	0.000811164
30	0.000642309
35	0.000508934
40	0.000403161
45	0.000317889
50	0.000249818
55	0.000197146
60	0.000151799
65	0.000118188
70	9.34708×10^{-005}
75	7.24785×10^{-005}
80	5.35817×10^{-005}
85	3.98737×10^{-005}
90	3.07798×10^{-005}
95	2.21252×10^{-005}
100	1.44506×10^{-005}
105	9.17375×10^{-006}

VI. SIMULATION SETUP DEPLOYED WITH THE USE OF CWDM FIBER (WITH EDFA)

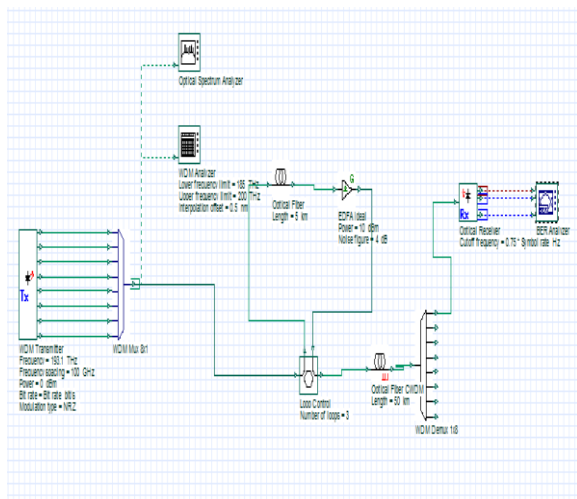


Fig. 4 Simulation setup deployed with EDFA (with EDFA)

An EDFA has been deployed in the basic setup along with the use of CWDM fiber and simulations have been performed which are as follows.

Table 4. Q-Factor with respect to Fiber length

FIBER LENGTH	Q-Factor
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05	127.829
10	100.22
15	89.9907
20	77.4641
25	72.314
30	53.5745
35	47.8252
40	37.268
45	30.007
50	23.902
55	18.1012
60	15.9114
65	12.588
70	9.71602
75	7.34655
80	6.32906
85	5.19797

Table 5. BER with respect to Fiber length

FIBER LENGTH	BER
05	0
10	0
15	0
20	0
25	0
30	0
35	0
40	2.67365×10^{-304}
45	3.97096×10^{-198}
50	1.44704×10^{-126}
55	1.55208×10^{-073}
60	2.63994×10^{-057}
65	1.22879×10^{-036}
70	1.28829×10^{-022}
75	1.01308×10^{-013}
80	1.15259×10^{-010}
85	1.00701×10^{-007}

Table 6. Eye Height with respect to Fiber length

FIBER LENGTH	Eye Height
05	0.00077459
10	0.000611794
15	0.000484044
20	0.000382574
25	0.000302967
30	0.000237175
35	0.000187234
40	0.000146273
45	0.000113223
50	8.78601×10^{-005}
55	6.59307×10^{-005}
60	5.10437×10^{-005}
65	3.84372×10^{-005}

70	2.75883×10^{-005}
75	1.86216×10^{-005}
80	1.31104×10^{-005}
85	8.51057×10^{-006}

VII. EYE DIAGRAMS

A. With EDFA

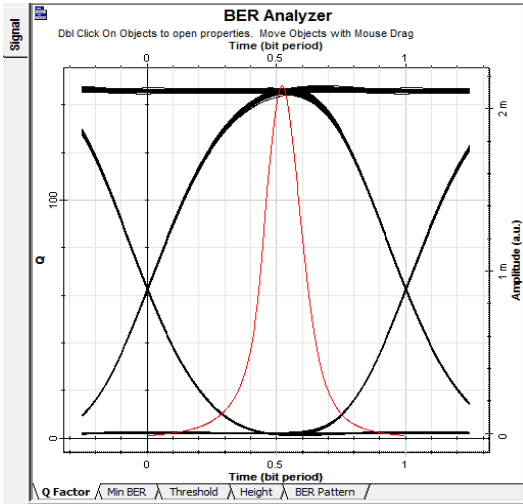


Fig.5 At 5 km

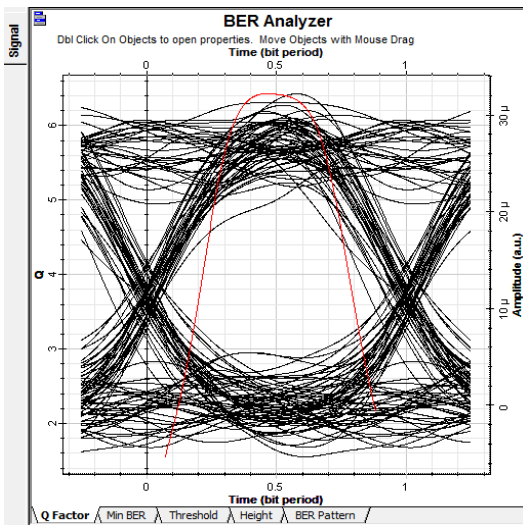


Fig.6 At 100 km

B. Without EDFA

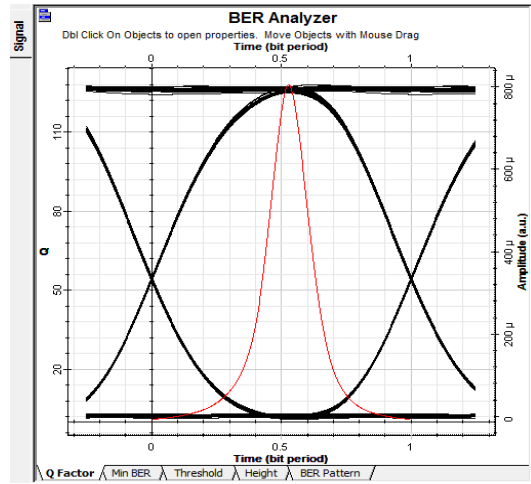


Fig.7 at 5 km

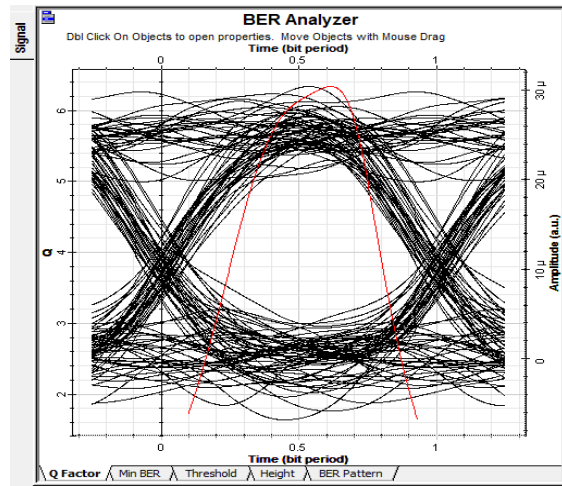


Fig. 8 At 80 km

VIII. SIMULATION GRAPHS

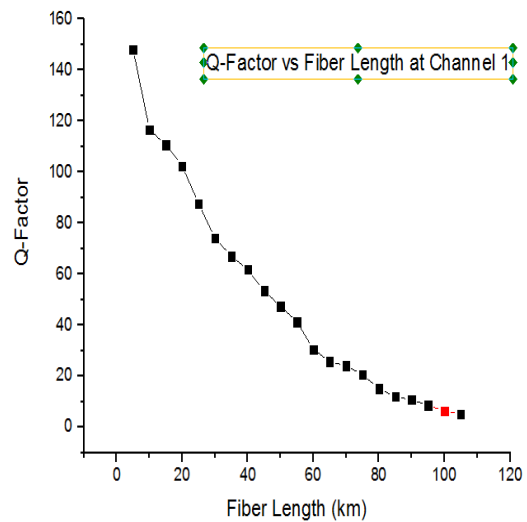


Fig. 9 simulation graph with the use of EDFA

Her interest areas are Optical Fiber Communications and Digital Image Processing.

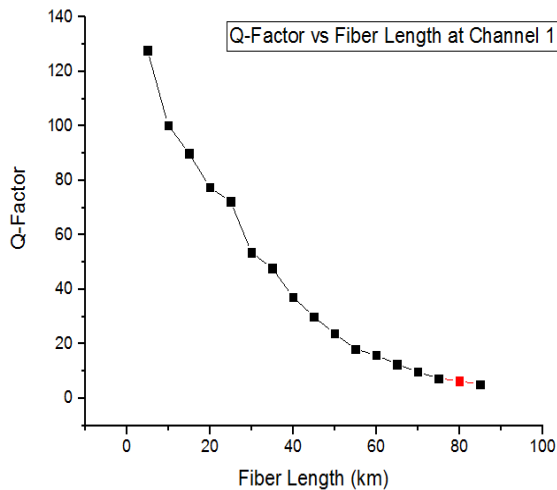


Fig. 10 simulation graph without the use of EDFA

IX. INFERENCES FROM GRAPHS

- A. Q-Factor values showed a gradual decrease with the increase in fiber length.
- B. Maximum value of Q-Factor was found out to be 150 with EDFA and 125 without EDFA.
- C. Maximum fiber length that the system supported was found out to be 100 km with EDFA and 80 km without EDFA.
- D. Maximum fiber length and minimum BER that the system could support is masked with red color.
- E. The Q-factor values showed an ideal linear fall with the increase in fiber length except at 5km; a deep steep was found there.

X. CONCLUSION

This paper gives the detailed view of how CWDM is beneficial for small distance data transfer. It also shows what change is made to the system with the use of EDFA.

REFERENCES

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Anamika Basnotra was born in India in December 1991. She has done B.Tech in ITE from Baba Ghulam Shah Badshah University, Rajouri, India and currently pursuing M.Tech in CSE, from Indo Global College of Engineering, Mohali, India. She has published 3 papers in International Journals.