Coarse Wavelength Division Multiplexing Technology – A Review

Anamika Basnotra

Abstract*— In Wavelength Division Multiplexing, multiple wavelengths are transmitted over the same fiber. Each set of data is carried over the different wavelength ; increasing the capacity of the fiber.

Coarse WDM and Dense WDM are more versatile forms of WDM and improving this versatility in a cost-effective manner is an area of concern.

This review paper describes Coarse WDM system which improves the capacity of the WDM system in a very cost-effective manner plus incredible services are provided by it.

***Index Terms*-. Coarse WDM, Dense WDM, Wavelength Division Multiplexing.**

I. INTRODUCTION

Wavelength Division Multiplexing is a multiplexing technique used specifically in optical communication, which transfers multiple signals by using different wavelengths over the single fiber. Basic WDM system can be upgraded to carry multiple channels simultaneously. Coarse WDM and Dense WDM are the two types of WDM systems.

The difference between the two lies in cost, distance they can support, manufacturing complexity, number of wavelengths supported etc. Both of them are well suited for their own markets.

II. OPTICAL NETWORKS

Optical networks are high capacity networks that use light as an electromagnetic carrier wave modulated to transmit information and provide routing, grooming, and restoration at the wavelength level as well as wavelength-based services[1]. The first generation networks used copper-based or microwave technologies. The second generation used these copper links or microwave links along with optical fiber . The backbone of optical fibers i.e, WDM is used in third generation.

WDM Technology

Manuscript received May, 2015.

***Anamika Basnotra**, Computer Science and Engineering, Indo Global College of Engineering, ., (abasnotra786@gmail.com). Chandigarh, India, 9878871620*

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

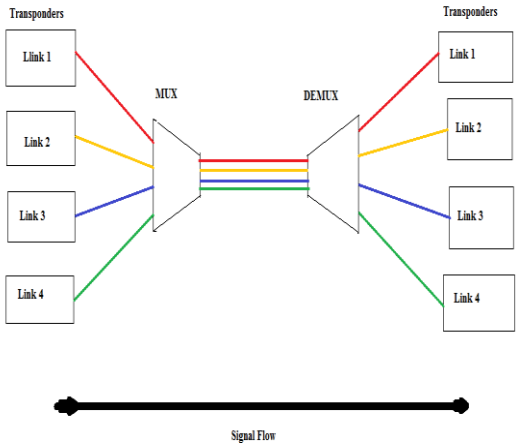


Fig. 1 A WDM System

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.

Table I. Difference between CWDM and DWDM

	CWDM	DWDM
Customer	Smaller compared to CWDM	Large number
Transmission Distance	less	More
Cost	Deployment cost is 20-25% less than DWDM.	Here the cost is more.
Wavelength grid	Smaller wavelength grid.	Large wavelength grid.
No. of channels delivered	17-18 atmost	Hundreds

ISSN: 2278 – 1323

III. COARSE WDM

.

Coarse WDM is an alternative to Dense WDM. It is used in metro and regional networks.

Main advantages of Coarse WDM are:

A. It is a cost-effective solution to areas where data traffic is lower as compared to DWDM networks.
B. It is very much simple.
C. Ease of implementation.
D. CWDM has smaller size of components. The transmitters of CWDM use approximately 12.5% area of DWDM.
E. The components used in CWDM have lower power consumption and therefore they provide longer battery backups.
F. The transmission cost of CWDM is about 20-25% of the cost of DWDM and is about 50% of the cost of DWDM filters.
G. Because of the lower power dissipation, the components require less air conditioning.
H. CWDM can not only use the legacy fiber laid before but also provide multi-service interface, it can realize IP/Ethernet over SDH, ATM over SDH, and it can provide router and ATM switch with fiber interface.[4]

IV. CWDM STANDARDS

According to the recommendations provided by ITU-T (International Telecommunication Union); CWDM technology can be used with 20 nm spacing with 18 wavelengths ranging from 1270 nm to 1610 nm.

This range of wavelengths is shown in following table:

Table II. CWDM Wavelength Grid

1271	1451
1291	1471
1311	1491
1331	1511
1351	1531
1371	1551
1391	1571
1411	1591
1431	1611

CWDM System Components

A. Optical fiber

The optical fiber used for CWDM technology is specially designed one for working in lower wavelength range as well. They substantially eliminate water peaks and thus we can work in O and E band as well.

The G.652.C fiber is one of this kind.

B. CWDM Lasers

In CWDM, specially designed low cost lasers can be used. They are different from typical lasers in the way that they have low cost, consume less power and have small size. [2]

They have small size because they need not to be incorporated with bulky heat sinks, control circuits and thermo-electric coolers (TECs)

C. Multiplexers and Demultiplexers

Multiplexes and demultiplexers based on film-filter is the most mature component used in CWDM technology.

D. Filters

CWDM filters are inherently less expensive to make than DWDM filters due to the fewer number of layers in the filter designs [5] CWDM filters are inherently less expensive to make than DWDM filters due to the fewer number of layers in the filter designs.

E. Photodetectors for CWDM

The receiver used in CWDM often require longer bandwidth, since they have to work with longer bandwidth range.

The PIN and Avalanche photo-detectors are well suited for this work. These have low cost, and have simpler receiver design; well suited for this technology.

F. Regenerators

The regenerators used here can be 2R or 3R.

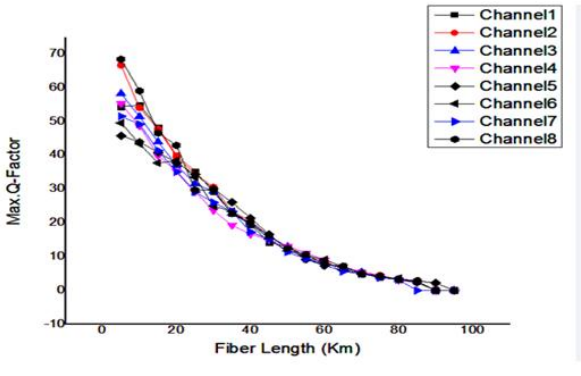
2R regenerator is used for reshaping the signal and 3R regenerator is for retiming.

V. PERFORMANCE EVALUATION OF WDM SYSTEM

While working on a WDM system without the use of specially designed components for CWDM, the results obtained are as follows:

A. WDM System without the use of EDFA

Maximum fiber length which a system can support is 90 km without EDFA. [6] The maximum Q-Factor is found out to be around 31.9354.



Q Factor v/s Fiber Length without EDFA

Fig. 3 Effect of fiber length on Q-Factor (without EDFA)

VI. WDM SYSTEM WITH EDFA

Maximum fiber length which a system can support is 110 km with EDFA.[6]

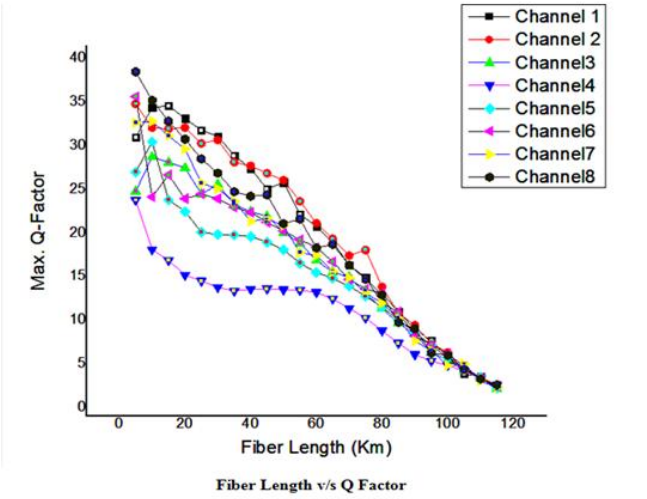


Fig. 2 Effect of fiber length on Q-Factor (with EDFA)

VII. CONCLUSION

Coarse wavelength division multiplexing is a much suitable technique for short-haul data transmission systems. The paper gives an overview of CWDM and how and how much it is helpful for low traffic communication systems.

REFERENCES

[1] Siddharth Bhatt, Shilen Jhaveri." A Review of Dense Wavelength Division Multiplexing and Next Generation Optical Internet" International Journal of Engineering Science and Innovative Technology (IJESIT) Volume 2, Issue 2, March 2013.

[2] NEC Cooperation of America (2007)."CWDM Technology, Applications and Operations". Available online at- https://www.necam.com/Docs/?id=99eeec0f-12a9-4e5d-b142-439a17691067

[3] B.C Colling s, et al., "A 1021-channel WDM systems", *IEEE photonics technology letters*, Vol.12, pp.906-908, 2001

[4] Chunlai Yi, "The techniques of the dense WDM",http://www3.chinatelecom.com.cn/20011127/ 00000309/html

[5] Huandong Zhao, Hao Chi, Qingji Zeng, Shilin Xiao, Min Jiang, "Techniques and applications of the coarse wavelength division multiplexing", Metro and Access Networks II, Wanyi Gu, Cedric F. Lam, Yuan-Hao Lin, Editors, Proceedings of SPIE Vol. 4908 (2002)

[6] Arashid Ahmad Bhat, Anamika Basnotra, Nisha Sharma, "Design and Performance Optimization of 8-Channel WDM System", 'International Journal of Advanced Research in Computer Science and Software Engineering', Vol 3, Issue 4.

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 2 papers in International Journals.
Her interest areas are Optical Fiber Communications and Digital Image Processing.

ISSN: 2278 – 1323