IMPLEMENTATION OF METRO CORE NETWORK BASED ON CWDM TECHNOLOGY AND ITS NETWORK PERFORMANCE ANALYSIS

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Abstract

Coarse wavelength division multiplexing (CWDM) is a method of combining multiple signals on laser beams at various wavelength for transmission along fiber optic cables, such that the number of channels is fewer than in dense wavelength division multiplexing (DWDM) but more than in standard wavelength division multiplexing (WDM). CWDM systems have channels at wavelengths of 1210-1670nm with spacing of 20 nanometers (nm) . CWDM systems can make high optical fiber transmission capacity; can improve the utilization of the resources of optical fiber. The performance of improved detected signals has been evaluated by the analysis of Quality factor,Eye pattern , bit error rate (BER),spectrum analyzed and WDM analyzed output . The simulation studies are carried out using optisystem software.

***Index Terms*— Bit Error Rate Parameter, Dense Wavelength Division Multiplexing Network, Erbium Doped Fiber Amplifier, Single Mode Fiber, Quality Factor.**

1. INTRODUCTION

Coarse Wavelength Division Multiplexing (CWDM) system in these networks to lower the cost dramatically at sufficient bandwidth capacity. In addition, to the stability required for DWDM sources passive modules such as mux/demux and add/drop modules used in DWDM systems also need to have very narrow filtering or wavelength separating characteristics that stay stable over a considerable temperature range. These filters are required to have very stringent tolerance and are difficult to fabricate, thus making these components inherently expensive. For a CWDM system, on the other hand the spacing between channel wavelengths is large so that the requirements and tolerances for components and modules are more relaxed. Less-stringent tolerances result directly in substantial cost reduction of a CWDM system as compared that of with a DWDM system. This price differential makes it very attractive for CWDM systems to be used in the Metro Area Network (MAN) applications where the cost is most sensitive to subscribers.CWDM systems have channels at wavelengths spaced 20 nanometers (nm) apart, compared with 0.4 nm spacing for DWDM. This allows the use of low-cost, uncooled lasers for CWDM. In a typical CWDM system, laser emissions occur on eight channels at eight defined wavelengths: 1610 nm, 1590 nm, 1570 nm, 1550 nm, 1530 nm, 1510 nm, 1490 nm, and 1470 nm. But up to 18 different channels are allowed, with wavelengths ranging down to 1270 nm. The energy from the lasers in a CWDM system is spread out over a larger range of wavelengths than is the energy from the lasers in a DWDM system. The tolerance (extent of wavelength imprecision or variability) in a CWDM laser is up to ± 3 nm, whereas in a DWDM laser the tolerance is much tighter. Because of the use of lasers with lower precision, a CWDM system is less expensive and consumes less power than a DWDM system. However, the maximum realizable distance between nodes is smaller with CWDM.

2. BASIC FUNCTION OF CWDM NETWORK

To avoid loss, the system uses huge bandwidth in fiber. By using the wavelength division multiplexer the signal light source can be send to the single mode fiber with different wavelength for transmission. Each light signal carrier signal. An optical communication system consists of transponder, communication channel and receiver. The function of transponder is to convert a wide pulse optical signal into narrow wavelength of the order of 1.6 nm, then the signals will be send to will be spitted depends on communication channel. The receiver receives the colored output from the demux and converted into the wide pulse optical signal. The output power level is +1 to -3dBm.

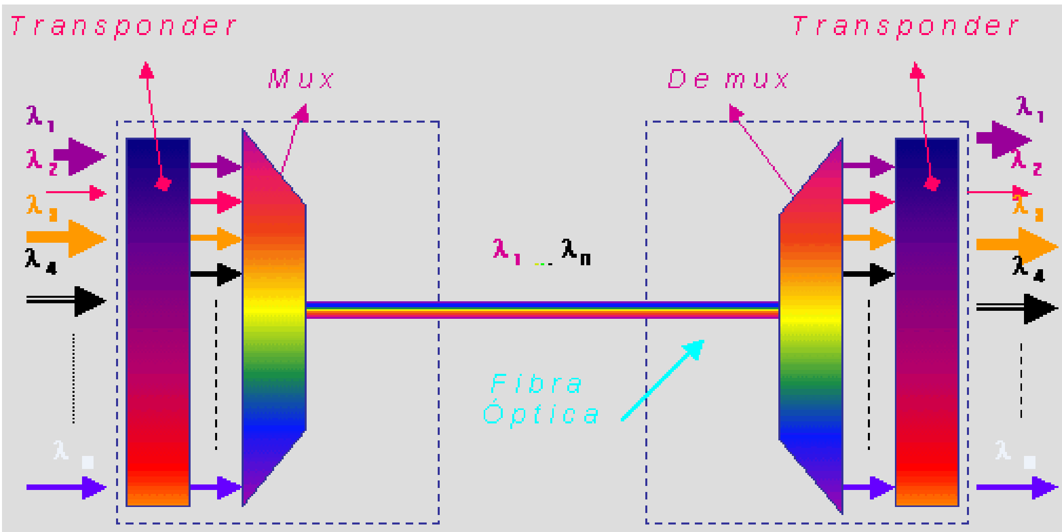

Fig 1:BLOCK DIAGRAM OF CWDM TECHNOLOGY

2.1.FIBER

For metro fiber network upgrades and Greenfield applications, the opportunity now exists to install the latest ITU-T G.652.C fiber technology, which substantially eliminates the water peak at 1383 nm and thus releases the E-Band for further capacity expansion. OFS championed the development of low loss fiber, which overcame the water peak problem, and now both OFS and Corning supply fiber that conforms to the G.652.C standard. .Legacy Dispersion Shifted Fiber (DSF or DS fiber) which cannot be used with DWDM in the C-Band due to 4-wave mixing problems can now be reused with the new Metro CWDM technologies. This may prevent the unnecessary tearing-up of an entire section of DS fiber cable that was once installed to support future 40.Gbit/s TDM systems

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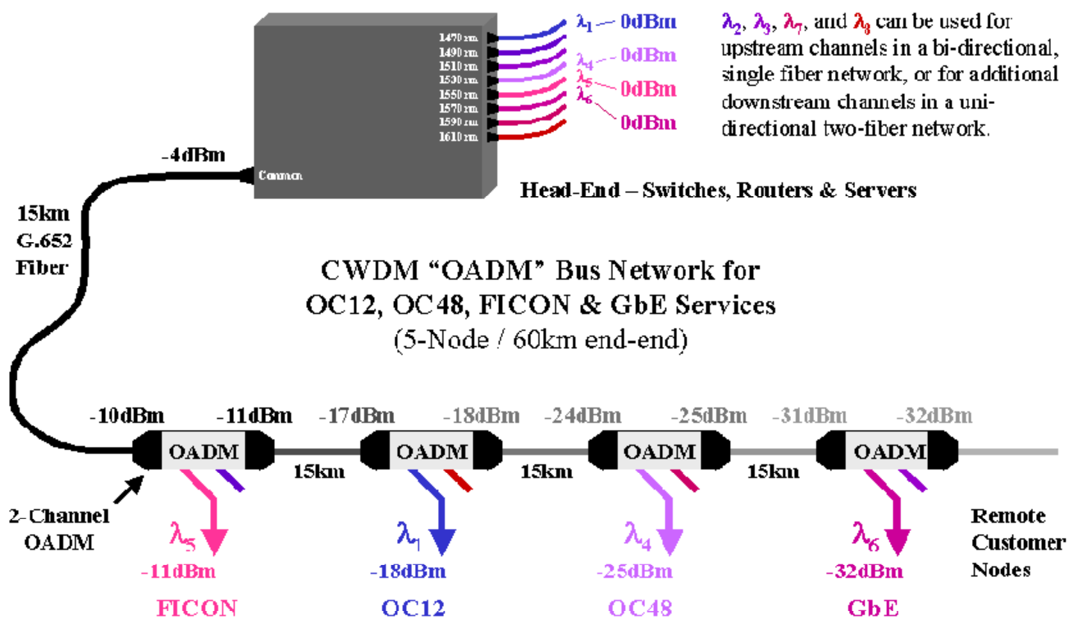
2.2 Direct Modulated CWDM Lasers

Direct Modulated CWDM Lasers with bit rates up to 2.5 Gbit/s are optimized for low cost. Their design is based on tried and proven DFB technology. The DFB technology has the benefits of a narrow line-width with highly suppressed side-modes, thus providing similar lowdispersion performance to direct modulated DWDM lasers.As a result, CWDM lasers are capable of transmitting 2.5 Gbit/s over distances of 80 km on ITU G.652 fiber. The low cost, small power and reduced space benefits of CWDM laser transmitters result from their uncooled design. This means that they do not have bulky heat sinks, control circuits and Thermo-Electric Coolers (TECs) coupled close to the laser chip, which saves electrical power and space. A typical optical output of 1 mW (0dBm) is achieved with low cost CWDM lasers.

2.3 OPTICAL ADD DROP MULTIPLEXERS, REPEATERS AND AMPLIFIERS

A linear (bus) network comprising an 8-wavelength CWDM mux/demux filter at the head-end or central office and four OADM filters distributed among remote customer nodes spaced 15 km apart. The total network size is 60 km, which in this example is loss limited - assuming an APD, 1 dB OADM insertion loss (express & add/drop), 4 db mux/demux insertion loss, and 0.4 dB/km fiber + splice loss at the 1470 nm and/or 1610 nm wavelengths.

Fig 2.2 Network of 2-Channel OADMs and an 8-Channel Mux/Demux



2.4 RECEIVER:

The receivers used in multi-channel CWDM systems are essentially the same as those used in DWDM systems. In contrast to standard single protocol receivers, they often require larger bandwidths that can capture all the specified bit-rates and protocols.. The front ends of these receivers use wavelength agnostic PIN or Avalanche Photodiode detectors (APDs) that cover the entire ITU CWDM band. It is the CWDM filters that provide the wavelength selectivity. The benefit of the PIN detectors is a lower cost, simpler receiving design. The benefit of the APD detectors is a 9-10 dB improvement in receiver sensitivity.

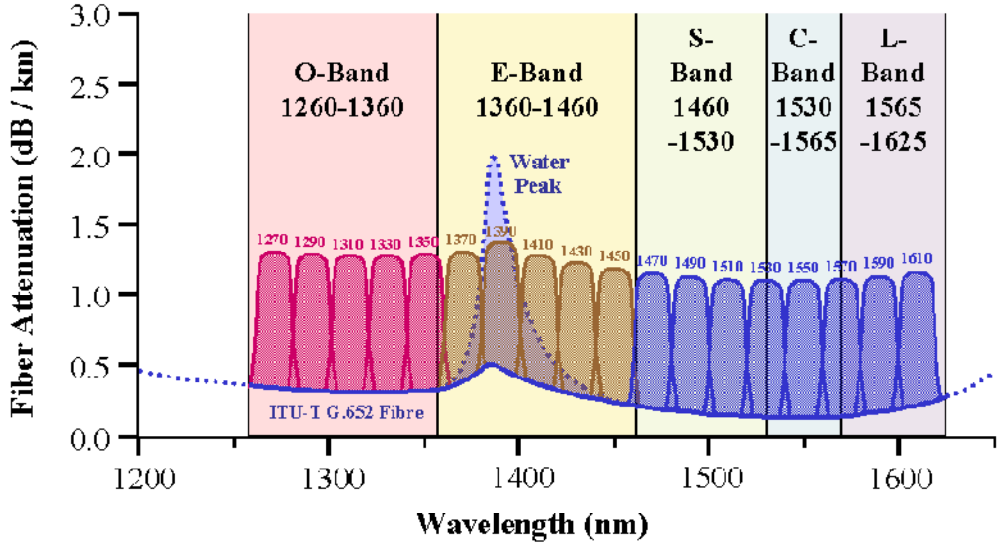


fig 2.4 Metro CWDM Wavelength Grid as specified by ITU-T G.694.2

3. SIMULATION OF CWDM BASED NETWORK

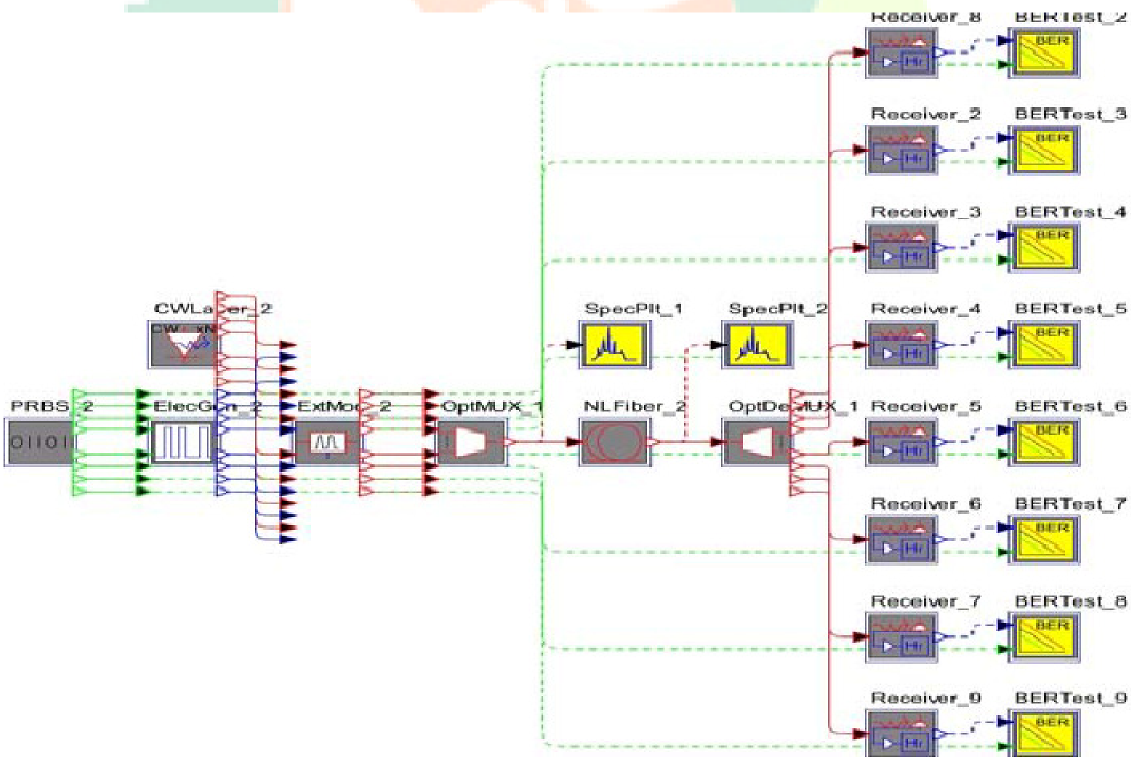


Fig 3.1 simulation design of cwdm network

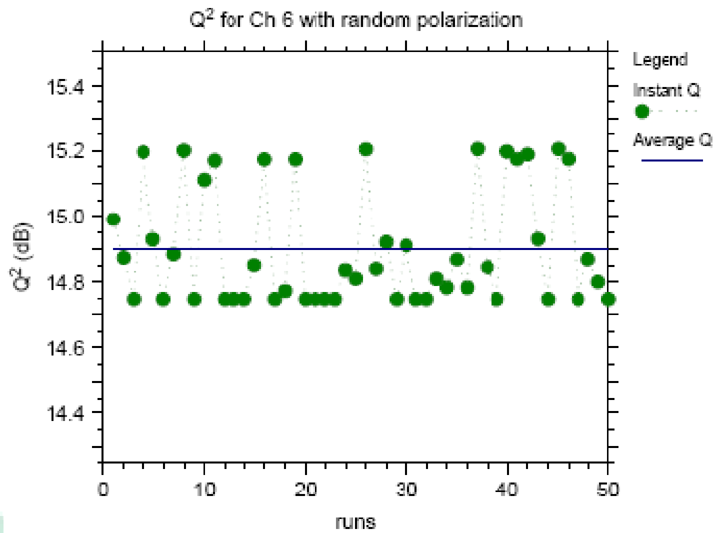


Fig 3.2 Polarization with adjacent channel

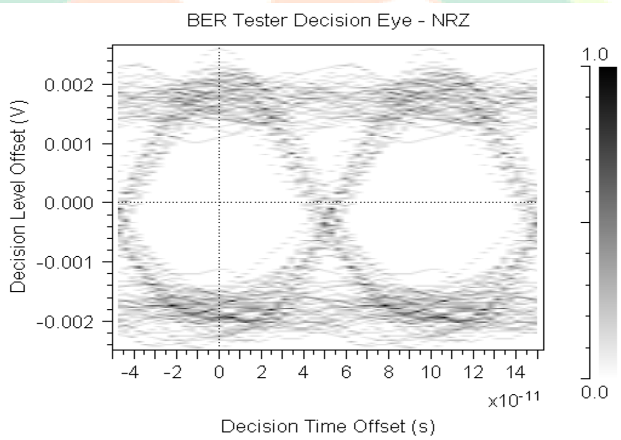


Fig 3.3 NRZ Operatiom in CWDM

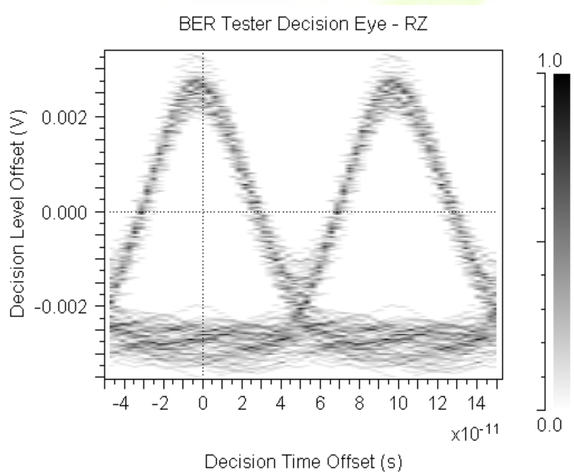


FIG 3.4 RZ OPERATION IN CWDM

4.. Estimation of λ for CWDM network

In the CWDM network estimation of λ is very important. In this scenario, estimation of λ is taken for various cities like A, B and C. the estimation of λ is taken in period of 5 years. For land line users, mobile users, data services, video services λ is estimated. The example scenario of the estimation of λ for DWDM network.

TABLE IV ESTIMATION OF LAMBDA

Estimation of λ for city A	2009-2014	2015-2019
Land line User	17261	22065
Mobile User	23015	29420
Land line Data Services	5753	7355
Mobile Data Services	11507	14710
Video Services	3452	4413

5. RESULTS AND DISCUSSION

In order to control inter symbol crosstalk, 100GHz channel spacing is selected in design .

A. Spectrum analysis

Optical spectrum analyzer is used to split signals in constituent wave length. The signal is graphically displayed, with power on horizontal axis and wavelength on vertical axis. Spectrum analyzer in the transmitter side and receiver side indicates the spectrum signal of each signal. Each channel the spectrum will be same but it will vary in amplitude due to long transmission.

B. WDM Analyzer

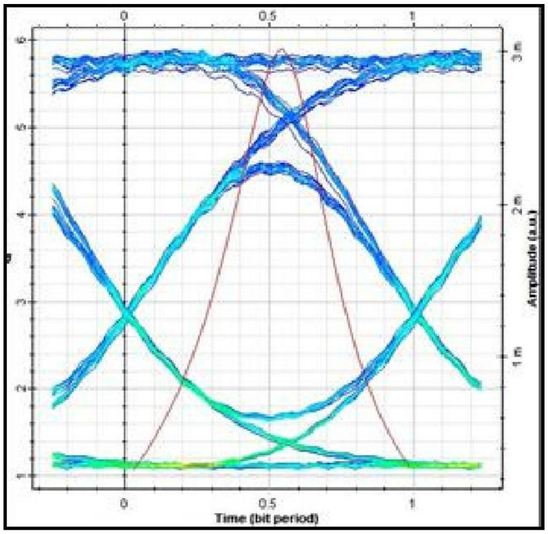
To verify the system setting here we use WDM analyzer, it will monitor the signal power, noise power, and signal to noise ratio of each channel.

T ABLE V TRANSMITTER SIDE SPECTRUM ANALYZER VALUES

Wavelength	Amplitude
Center: 1.5412798485m	Max: -11.48788567dBm
Start: 1.51897086m	Min: -104.2148625dBm
Stop: 1.563588836m	

C. Eye diagram analysis

The eye diagram is used to view the performance in digital transmission. The eye diagram provides the instantaneous view by repetitively to achieve good view of its behavior



Max. Q Factor	15.7692
Min. BER	3.68362e-009
Eye Height	0.0143276
Threshold	0.0153354
Decision Inst.	0.53125

6. CONCLUSION:

This paper presents the performance evaluation of Dense Wavelength Division Multiplexing (DWDM) using NRZ modulation schemes. The transmitter section consists of 40 channels, with 5dBm input power and here we use single mode fiber length of 100Km with channel spacing of 100GHz. The Bit Error rate we achieved is 10-9 for all channels. CWDM Network of optical fiber communication is designed through optisystem. From the above; WDM transmitter should be used in design of long distance transmission with EDFA and SMF to ensure the communication quality. In future the work will be extended to 80 channel CWDM system and the performance will be evaluated

. TABLE VII SPECIFICATION OF SMF

Parameters	Proposed Model
No of Channel	40
Q-factor	Channel 1=15.7692 Channel 4=15.8128 Channel 8=15.7202 Channel 12=15.7100 Channel 16=15.9162 Channel 20=16.0651 Channel 24=15.6028 Channel 28=15.1590 Channel 32=14.8301 Channel 36=14.8560 Channel 40=14.7460
Min. BER	Channel 1=3.68362e-009 Channel 4=4.02815e-009 Channel 8=2.89754e-009 Channel 12=3.5489e-009 Channel 16=5.2694e-009 Channel 20=6.0853e-010 Channel 24=3.5618e-009 Channel 28=1.5894e-009 Channel 32=2.5128e-009 Channel 36=4.0238e-009 Channel 40=4.2925e-009
Power (dBm)	5
Distance (Km)	100
Dispersion	Negligible

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