International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)
Volume 3, Issue 1, January 2014

Review on DWDM PON Access Network using Chromatic Dispersion Compensation

Rahul Sharma[1], Vijay Prakash Singh[2], Durgesh Pansari[3]
M. Tech Scholar, Electronics and communication Engineering, RKDF College of Engineering, Bhopal, India [1]
Associate Professor, Electronics and communication Engineering, RKDF College of Engineering, Bhopal, India[2]
Assistant Professor, Electronics and communication Engineering, RKDF College of Engineering, Bhopal, India [3]

Abstract: This paper presents a detailed review of the available techniques to investigate long-reach high speed 16-channel DWDM-PON system with efficient CD compensation methods. It is observed that chromatic dispersion compensation has a crucial role for guaranteed downstream optical link performance and maximum link length of high speed long-reach DWDM-PON system. FBG can be used for chromatic dispersion compensation to increase the maximum transmission distance of high speed DWDM-PON system.

Here, we discuss pre, post and mix compensation technique to reduce the BER.

Thus this paper aims to improve the channel performance and increase the length of optical fiber.

Keywords: Wavelength division multiplexing passive optical network (WDM-PON); chromatic dispersion (CD); fiber Bragg grating (FBG): Bit error rate (BER)

I. INTRODUCTION

A method of reducing BER and improve Q factor to increase the length of transmission medium. Opti System 7.0 is used to simulate the WDM-PON for dispersion compensation.

Here we are discussing about different method used for reducing bit error rate. There are number of techniques used to reduce bit error rate to improve the channel performance and to increase the channel length.

II DIFFERENT METHODS USED FOR REDUCING BIT ERROR RATE

Performance Characterization of PON Technologies

Alex Vukovic ; Michel Savoie ; Heng Hua ; Khaled Maamoun The simulation models for a typical PON layout are developed and three major PON technologies are considered. The models support the analysis of various important characteristic parameters, namely: 1) link budget for acceptable losses from splices, attenuation and splitters, 2) link performance characterization based on data (BER, SNR) or video signal quality, and 3) linear and nonlinear fiber effects such as dispersion, PMD, self- and cross modulation, FWM, etc. Analysis outcomes may be used to optimize the performance of the applied system design including fiber maximum length and type, the need to change some of the optical components (e.g. couplers, splitters, etc.) and digital links bit rate (e.g. 1.2 Gb/s or 2.4 Gb/s) according to the required BER. The simulation models developed enable us with these detailed analyses of PON technologies without the need to build prototypes. [1]

Schemes for Compensation of Chromatic Dispersion in Combined HDWDM Systems

In this Paper authors V. Bobrovs, A. Udalcovs S. Spolitis G. Ivanovo seek gives best ways to realize chromatic dispersion (CD) compensation schemes for differently modulated optical signals in high-speed mixed data rate HDWDM systems. The research is based on OptSim 5.1. Simulation software, which numerically solves nonlinear Schrödinger equation using the split-step Fourier method. It is shown that the CD compensation scheme is crucial for the performance evaluation in combined HDWM transmission channels. Therefore, a scheme of the type is proposed that is suited best for a very complicated combined fiber optical transmission system. It is also found that asymmetrical CD compensation schemes in pre- and post-compensation modules are the most efficient, allowing the best BER in a channel to be achieved.[2].

Realization of Combined Chromatic Dispersion Compensation Methods in High Speed WDM Optical Transmission Systems

S. Spolitis, G. Ivanovs Chromatic dispersion (CD) has a significant impact on a quality of transmitted optical signal in high-speed fiber optic communication systems with data rates up to 10 Gbit/s, and as a result CD limits the maximum length of transmission distance. In order to operate fiber optic communication system with a sufficiently low bit error ratio (BER) and minimize the performance degradation caused by pulse distortion and broadening, dispersion compensation is needed. In this work using OptSim simulation software we realize an experimental high-speed WDM fiber optic communication system model with a new combined dispersion compensation mechanism where a conventional dispersion-compensating fiber (DCF), fiber Bragg grating (FBG) or optical phase conjugator (OPC) are used together. The best results were obtained by using FBG-OPC dispersion compensation scheme which showed the lowest BER value. Basis of the results we recommend avoiding the use of DCF for CD compensation where it is possible and use FBG [3].

Optimization of DCF Length with Minimum BER using SMF

Deepinder Singh, Jagtar Singh Proposed that the analysis of optimum DCF Length for minimum bit error rate (BER) in SMF is done. With the aid of optsim simulation tool a DCF is

ISSN: 2278 – 909X

employed with the proper variation in length to overcome the non linearity to get the minimum BER. Better performance was shown when the combination of SMF Length 90Km and DCF Length 12Km was chosen. At this particular value the minimum BER was obtained and maximum Q value was seen and Eye opening also helps to evaluate the system performance. *[4]*.

Reach Improvement of Spectrum-Sliced Dense WDM-PON System

Riga, Latvia ; Bobrovs, V. ; Ivanovs, G. demonstrate that reach improvement of spectrum-sliced dense wavelength-division-multiplexed passive optical network (SS-DWDM PON) where amplified spontaneous emission (ASE) source is used as a seed light. Investigated optical system is built on the ITU-T DWDM frequency grid, defined in recommendation G.694.1 and therefore it is potentially much more compatible with other already existing WDM PON optical systems. In this way it is possible to replace the classic WDM PON system with our proposed extended-reach spectrum-sliced WDM PON system and reduce complexity of network architecture as well as cost per one user. The maximum reach of the spectrum-sliced dense wavelength-division-multiplexed passive optical network (SS-DWDM PON) system with data transmission speed 2.5 Gbit/s can be fairly limited by chromatic dispersion (CD) because of large optical bandwidth per channel compared to the bit rate. And therefore, dispersion degrades the performance of a SS-DWDM PON system more than it is observed in conventional laser-based system. This paper contains the investigation of high speed 8-channel spectrum-sliced DWDM PON system with efficient CD compensation methods like dispersion compensating fiber (DCF) and fiber Bragg grating (FBG). It is shown that CD compensation has an important role for guaranteed downstream optical link performance and maximum transmission line length of high speed SS-DWDM PON system. Results show that FBG used for CD compensation in high speed spectrum-sliced dense WDM PON systems provide better accumulated CD compensation and increase optical link length up to 150% while DCF fiber provides up to 130% reach improvement [5].

Performance optimization of high capacity long reach 32 channel FTTH downstream link employing triple play services

Jagjit Singh Malhotra Manoj Kumar Ajay K. Sharma In this paper performance of high capacity, long reach, 32 channel FTTH downstream link employing triple play services has been investigated on the performance metrics viz. eye-opening, BER and Q^2 dB. DWDM has been employed for bandwidth optimization. The triple-play service is realized as a combination of data, voice, and video signals. The Internet component is represented by a data link with a high-speed of 2.5 Gb/s downstream. The voice component is represented as VOIP and then combined with data component. The video component is represented as a RF video signal. The reach of the WDM-PON system can be severely limited by chromatic dispersion. Therefore, we have employed 80 km of non-linear fiber in combination with 20 km of reverse dispersion fiber to negate the accumulated chromatic dispersion which ensures long reach of the modeled FTTH system. Investigations reveal the effective bandwidth optimization using DWDM. High 'Q^2 dB' and low BER results confirm the feasibility of proposed high capacity, long reach FTTH link. [6].

An Improved Methodology for Dispersion Compensation and Synchronization in Optical Fiber Communication Networks

Ajeet Singh Verma, A. K. Jaiswal, Mukesh Kumar Proposed that Optical communication network offers very high potential bandwidth and flexibility In terms of high bit-rate transmission. However, their performance slows down due to some parameter like dispersion, attenuation, scattering and unsynchronized bit pattern. In long haul application, dispersion is the main parameter which needs to be compensated in order to provide high level of reliability of service (ROS). Fiber Braggs Grating (FBG) is one of the most widely used element to compensate it, however its performance slows down with the increase in distance. In this paper we proposed a method for dispersion compensation which offers much better performance than FBG compensation. This method offers almost negligible dispersion and very high value of synchronization by reducing jitter portion in the Eye diagram. This method also offers very high value of Q-factor, SNR and Reduced BER in long haul optical communication networks**.** [7].

Extending the Reach of DWDM-PON Access Network Using Chromatic Dispersion Compensation

Sandis Spolitis, Girts Ivanovs Proposed that Chromatic dispersion compensation is an important premise to achieve higher performance of long-reach DWDM-PON fiber optical system and increase the maximum transmission distance from OLT to ONT. In this work OptSim simulation software was used. They realized an experimental high- speed DWDM-PON system model where DCF fiber and FBG are used for accumulated CD compensation. They have investigated the maximum achievable reach improvement of DWDM-PON system using proposed CD compensation methods. The maximum reach of realized DWDM-PON system without CD compensation was 57 km.. Using DCF fiber the 16 channel DWDM-PON system maximum link length between OLT and ONT was improved by 19.3% or 11 km in length – from 57 km to 68 km. The best results were obtained by using FBG for CD compensation. DWDM-PON system simulation model with FBG was able to provide data transmission with BER<·10 -9 in length of 72 km. Using the FBG for CD compensation DWDM passive optical network reach can be improved by 26.3% or 15 km in length – from 57 km to 72 km. [8]

III ANALYSIS

All above articles Proposed that the method for reducing bit error rate and Improve Long Haul transmission for 16 Channel. The BER value recommended by ITU (International

ISSN: 2278 – 909X

Telecommunication Union) for fiber optical transmission systems with data rate 10 Gbit/s per channel is defined to be no more than 10^-9. In Previous Work the bit error rate of 3.62e-10 is obtain by using Pre Compensation Technique. Bit Error Rate can be improved by using Mix Compensation Technique by DCF.

IV CONCLUSION

We have observed the resistivity of the various techniques towards the different methods to reduce Bit Error rate. Now we aim at introducing a technique which offers a much better reduction in Bit Error rate. The work can be extended by using Dispersion Compensation Fiber.

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ISSN: 2278 – 909X