Network Enhancement by Using Dispersion Compensation Technique

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ABSTRACT- This paper is evaluates various dispersion compensation techniques results to improve the distance ability of network without effecting quality of the signal and cost. By using this technique augment the transmission distance from central office to users and transmission distance increase from 20 km to 50 km. It provides us network growth and better results of running system without affecting any cost. It makes us enable to send audio, video and information data over large distance network.

KEYWORDS- Dispersion compensation Fiber (DCF), Passive Optical Network (PON), Gigabit Ethernet Passive Optical Network (GEPON), Single Mode Fiber (SMF), Erbium Doped Fiber Amplifier (EDFA), Optical Line Terminal (OLT)

I. INTRODUCTION

From last few years the demand of bandwidth increases very sharply to access network because the area of our network increasing day by day. Residential subscribers demand first mile access solution that have high bandwidth and offer media rich services. Similarly, corporate users demand broadband infrastructure through which they can connect their local area network to backbone
[3]. It is estimated that there would be bandwidth demand of 1 Gbps or more in next 20 years [5]. So it is important to invent new network deployment strategy so that we can satisfy the future network demands. So this paper is based upon to enhance more area by using different dispersion compensation technique without effective Performance. Our purpose is introduced new generation PONs by using previous passive splitter infrastructure.

II. COMPENSATIONS TECHNIQUES

Dispersion basically pulse spreading during the travel of signal on the medium which limits the data carrying capacity of the fiber optics. So basically dispersion is reason behind the breakdown strength of signal. By using of different techniques of dispersion compensation we can sustain the quality of the signal over the long distance. Three basic compensation techniques used to magnify length of network.

- Post compensation technique: - In which DCF placed after SMF.
- Pre compensation technique: - In which DCF earlier to SMF.
- Fiber Bragg Grating: - In which inline filter used to certain wavelength and to compensate dispersion.

III. SIMULATION SET UP

Optimization of data transmission uses pre compensation technique in PON through the optical fiber cable where the range of voice data within 1480-1500 nm, and range of video data within 1550-1560 nm.

In the simulation set PON, OLT act as central office which is generate signal by using PSEB. Here laser is regulating by using chirped return to zero format. To improve the signal strength so that they can travel long distance EDFA is used. For the purpose of analyzing spectrum and power of the signal spectrum as well as spectrum analyzer is used. Single mode fiber is used to achieve higher transmission and less distortion. As well as dispersion compensation fiber is installed in the transmission channel to compensate dispersion.

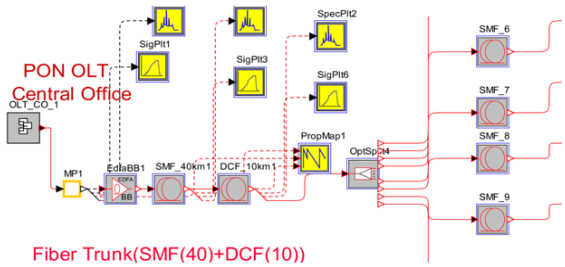

Fig. 1: Pre compensation technique set up

To provide equal signal power into customer nodes optical splitter is installed between senders to receiver. As fig 1 simulation set up shows that EDFA is used before optical splitter for purpose to amplify signal so that it become more powerful initially and cover more distance. Firstly single mode fiber is used up to 40 km then DCF is used to oppose the dispersion. Due to negative dispersion ranging from -70 to -90 nm/km DCF can compensate positive dispersion of fiber transmission which gives strength to signal to cover more distance.

IV. RESULTS AND DISCUSSION

By different experiment results of various compensation techniques we try to improve the transmission distance of the network. The main cause behind the degradation of signal is dispersion so if we can control dispersion our signal can be

cover more distance. So with help of these compensation techniques we can improve our GE-PON based FTTH network without effecting cost and performance. Firstly we observed the performance of network without using any compensation technique up to 50 km distance. Then we observed the results of using pre, post and fiber Bragg compensation techniques and we observed that it improve the network performance.

Table 1:-Observed Parameter results

Techniques	Q factor	BER
Without any tech.	8 dB	2.03e-04
Post compensation	14.4 dB	4.76e-018
Pre compensation	18.2 dB	6.83e-022
Fiber Bragg Grating	14.3 dB	2.43e-018

As in table 1 shows that the parameter results of various compensation techniques with help of these results we try to find out best technique to improve network performance. First of all we observed Q factor and BER parameter result without using any compensation technique that is 8 db as well as 2.03e-04 which is below standard. Then we observed results of post compensation technique which 14.4 dB and 4.76e-018 is little bit better but still not up to mark.

Then we take the experimental results of pre compensation technique that is 18.2dB and 6.83e-022 which is good to improve performance. Finally we also observed the results of Fiber Bragg Grating that is 14.3dB and 2.43e-018 which is also good but not good as compare to pre compensation technique. So with the help these experimental results we find that the pre compensation technique is best to control dispersion as well improve our network performance.At the same time we also observed the results of eye diagram so that we can ensure results of various compensation techniques. Here again first we take the results of eye diagram without using any technique as shown in fig. 2:

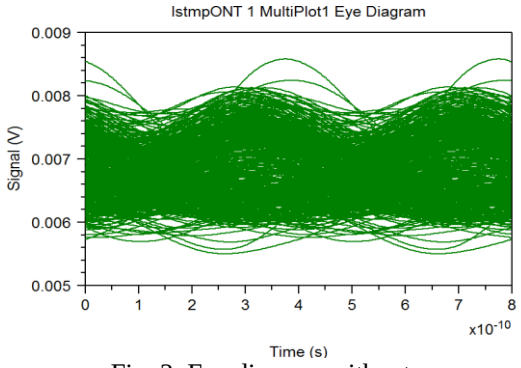

Fig. 2: Eye diagram without compensation

So as shown in eye diagram of without using any dispersion compensation that the quality of signal after 50 km very poor which is not acceptable. Then we find the results of eye diagram by using post compensation technique which clearly shown improvement in signal. In Fig 3 it shows that even after 50 km our signal not degraded which good for our network.

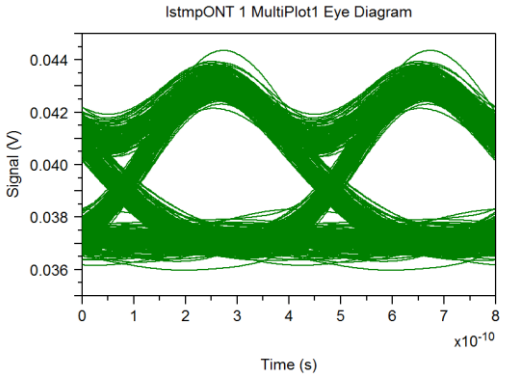

Fig.3: Diagram by using post compensation

Actually we placed DCF after single mode fiber as shown in simulation set up that help us to control dispersion. In our further research we are examine the results of eye diagram by using pre compensation technique so that we make our signal strength much better.

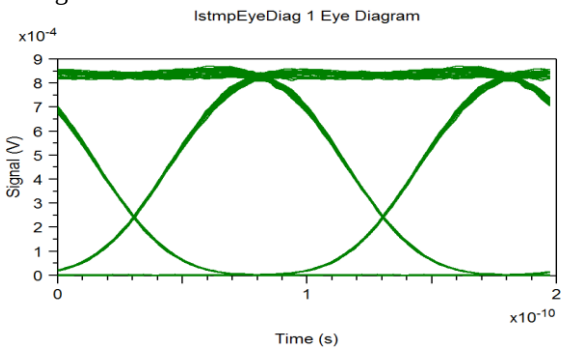

Fig.4: Diagram by using pre compensation

Here fig 4 shows the results eye diagram by using pre compensation technique that clearly shown the result is much better as compare of post compensation technique. The width of eye diagram is much broader as compare to post compensation eye diagram width which means its result is much better. Finally we examine the eye diagram results of Fiber Bragg Grating as shown in fig 4 that is observed good but not as much as of pre compensation technique.

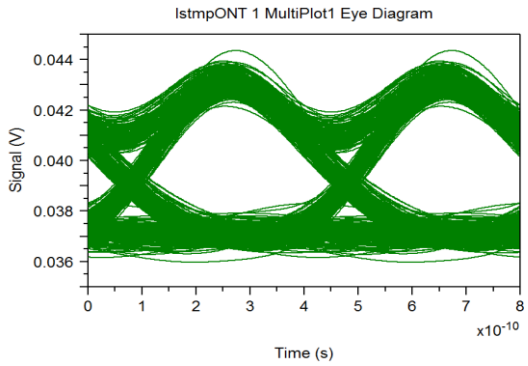

Fig.4: Diagram by Using FBG technique

So the width of eye diagram using FBG technique is also broad which mean it has also good results but not much better as compare to pre compensation technique results. As we see the results of various dispersion compensation techniques that is clearly shows that pre compensation technique best to improve our signal strength. We use Opt Sim simulator to evaluate these results so that we can find out better dispersion compensation technique to improve our network distance.

V. CONCLUSION

So according to the above mention results we find that the pre compensation technique is the best technique to control the dispersion during the data transmission. We observed the performance of the network with the help of three basic parameter that is Q factor, BER and eye diagram. As shown in above table in which parameter results of Q factor and BER without using any dispersion compensation technique is 8dB, 2.03e-04 respectively. Similarly post compensation results are 14.4 dB of Q factor and 4.76e-018 of BER, for the pre compensation is 18.2 dB and 6.83e-022 respectively. If we talk about Fiber Bragg Granting it is 14.3 dB and 2.43e-018 which is also good but as we mentioned before results of pre compensation is best to control the dispersion. So according to these parametric results it is proving that the pre compensation technique is best technique to improve the performance as well as distance of the network. By using pre compensation technique we can augment transmission distance without effecting cost and performance of our previous GE-PON based FTTH network. In our previous network our data signal maximum can travel up to 20 km but by using this compensation technique we can increase up to 50 km which very good for our perspective because if we see our previous system maximum distance travel by signal is 20 km if we try beyond 20 km the quality of the signal will sharply degraded but now we can travel it up to 50 km without compromising with quality.

VI. REFERENCES

[1]. McDonna, A.P.Mac Donald, "Optical component technologies for FTTH applications" Publication Year: 1995, Page(s): 1087 – 1091 IEEE Conference Publications.
[2]. JongKim "Communications Volume DOI:10.1109/ICICS.1997.652306 Publication Year: 1997, Page(s): 1800 - 1804 vol.3 Cited by: Patents (3)_ IEEE Conference Publications.
[3]. Frank Effenberger "Next generation PON: lessons learned from G-PON" 35th European Conference on Publication Year: 2009, Page(s): 1 – 3.
[4]. Ken-ichi Kitayama, "OCDMA over WDM PON—Solution Path to Gigabit-Symmetric Ftth" Journal of Light wave Technology, Vol. 24, No. 4, April 2006.
[5]. Jensen, M.Nielsen, R.H. ; Madsen, O.B. "Comparison of Cost for Different Coverage Scenarios between Copper and Fiber Access Network" Publication Year: 2006, Page(s): 2015 - 2018 IEEE Conference Publications.
[6]. Chang-Hee Lee, W.V.Byoung Yoon Kim "Fiber to the Home Using a PON Infrastructure "Publication Year: 2006, Page(s): 4568 – 4583 IEEE Publications.
[7]. Chia-Sheng Tsai "Bandwidth allocation schemes for FTTH networks" Publication Year: 2006, Page(s): 4 pp. – 4.
[8]. Mukai, H. ; Yokotani, T. ; Kida, T."Rapid Growth of FTTH by Use of PON in Japan"Publication Year: May 2007 IEEE Conference Publications.
[9]. P. Shu mate, "Fiber-to-the-Home: 1977–2007," IEEE/OSA J. Light wave Technology., vol. 26, no. 9, pp. 1093–1103, May 2008.
[10]. S. Appathurai, R. Davey, and D. Nesset "Next generation fiber-to-the-home solutions" in Proc. 5th International Conference on Broadband Communications, Networks and Systems, BROADNETS 2008, London, UK, Sep. 2008, pp. 232–235.