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Comparison of Dispersion Pre and Post-Compensation Scheme using DCF at 10 Gbps

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Abstract— **Dispersion and attenuation are the limiting terms in optical fiber communication systems with long distance communication. Attenuation can be overcome by amplifiers but dispersion leads to inter symbol interference and errors in communications. The performance of negative dispersion fiber used as a dispersion compensating module is investigated with pre compensation and post compensation schemes with their comparison. The optimal operating condition of the DCM was obtained by considering dispersion management configurations i.e. post-compensation and post compensation. The DCF was tested on a single span, single channel system operating at a speed of 10 Gbit/s with the transmitting wavelength of 1550 nm, over 120 km of convention single mode fiber. Furthermore, the performance of the system at 240 km, 480km, 720km, 960km, 1200km were also used to examine the results for the over and under compensation links respectively. SMF transmission is used at high amplifier spacing from 90 km to 120 km with conventional NRZ-format. The Q-factor and BER was estimated for individual configurations and performance is compared.**

Key Words: Dispersion, Dispersion Compensating Management (DCM) , Dispersion Compensating Fiber (DCF), Non Return to Zero(NRZ).

I. INTRODUCTION

All the systems which are using Fiber Optic cables as medium operate in the second transmission window. The 1550 nm wavelength region has the lowest attenuation coefficient, thus expanding the repeater distance in the network. However, the influence of the large dispersion coefficient associated with the second transmission window limits the operating speed of the network to 2.5 Gbit/s or less. In order for the network to operate at higher bit-rate, a dispersion management scheme is needed. Dispersion compensation in Optical systems operating at 1550 nm can be achieved by employing dispersion mapping techniques. In this technique, fibers of opposing dispersion coefficient are made to alternate along the length of the optical link. In general NDFs have a large dispersion in comparison to standard SMFs, thus a relatively short NDF can compensate for dispersion accumulated over long links of SMFs . NDFs are easy to install and require little modification to an already existing system. The major disadvantage of NDF is that it exhibits a large attenuation in signal power, as a result more optical amplifiers are generally deployed in the system. This in turn enhances the other limitations in the system because the non-linear attributes of this fiber is considerably higher. Results have also been validated through numerical simulations with the optical system simulator *OptSim.*

II. DISPERSION MANAGEMENT SCHEMES

Dispersion management[1] can be achieved with various combinations of fiber layout. The widely implemented configurations are pre and post-compensation depicted as type 1 in the schematic below, and pre-compensation depicted as type 2. The accumulated dispersion and relative power for both pre- and post-configuration are depicted in figure

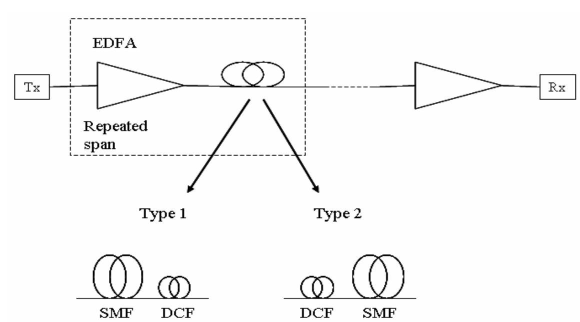


Fig:1. Dispersion Management Schemes

III. DISPERSION MANAGEMENT SYSTEM IN OPTSIM

The considered system configurations are depicted in Fig. 1 . In all schemes the transmission line consists of equal numbers of 120 kin SMF and 24 kin DCF sections. The fiber parameters for SMF and DCF are listed in Table 1 . We assumed a partial compensation of second-order dispersion by DCF units. We assumed zero path-average dispersion in all schemes. The amplifier gain, 26.4 dB after SMF section and 19.2 dB after DCF section, equalizes the loss. The amplifier noise figure is supposed to be 6dB. or NRZ-modulation format the transmitter emits chirp-free modulated pulses with a rise time of *25%* f the bit slot. At the receiver the signal was optically filtered, detected and then electrically filtered. As a measure of system performance Q factor and BER are evaluated that in standard fiber transmissions operating at 10Gb/s at high amplifier spacings of I20km the impact of fiber nonlinearity is diminished by symmetrical ordering of dispersion compensating fibers allowing 1200km

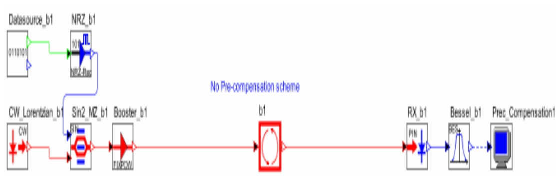


Fig:2. Dispersion Management Schemes implemented in OptSim-Pre-Compensation.

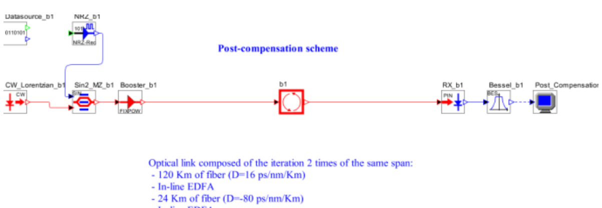
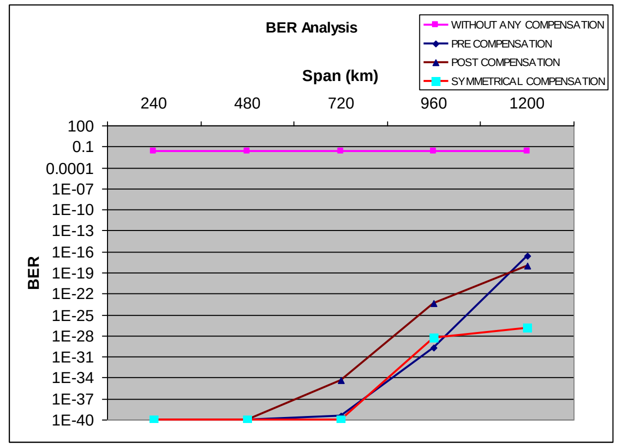


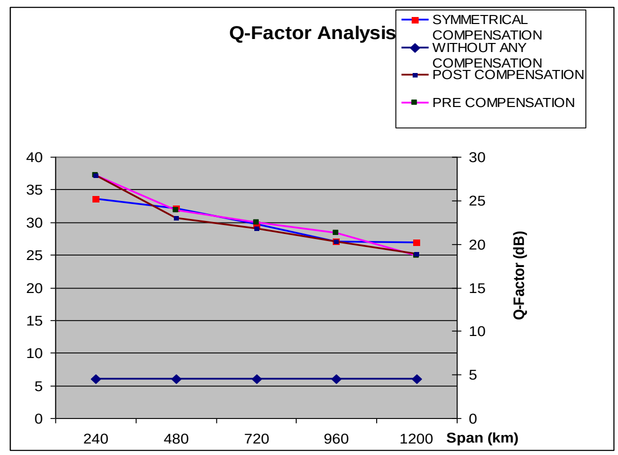
Fig:3. Dispersion Management Schemes implemented in OptSim- Post-Compensation.

IV. RESULTS AND DISCUSSIONS:

In the single channel optical system experiment, it was found that the system performance gradually improved as the total dispersion of the transmission fiber tended toward that of the DCF and in a similar fashion, the system performance decreased as the total dispersion of fiber exceeded that of the DCF. Results obtained with pre and post-compensation. Furthermore, analysis of the Q-factor also revealed that system performance had exceeded the minimum requirement of 6 by a large margin. The experiment showed that differences between BER for precompensation and for post compensation also for Q factor.



Graaph:1. BER Analysis



Graph:2. Q Factor Analysis

V. CONCLUSION

From the above summary, one may conclude that for a single channel, single span optical communication system, the dispersion distance limit increased by introducing dispersion management into the network.

By comparison it is found that post configuration have better BER than pre configuration but after 1200 km performance of pre is better than post. From 240 to 480 km BER performance is constant. From 480 km to 960km Q factor of precompensation is higher than post compensation. So Q factor is almost equal for both configurations. So upto 480 km any method is suitable but after 480 km post compensation gives better results.

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Configration	PreCompensation	PostCompensation

Span in Km.	Q factor	BER (bits/s)	Q factor	BERb(bits/s)
240	27.94	1 e-40	27.904850	1e-40
480	23.88	1e-40	22.938838	1 e-40
720	22.4668	3.27344e-40	21.812637	4.09423 e-35
960	21.277393	1.741e-30	20.306856	4.67606e-24
1200	18.68920	2.36803e-17	18.896957	9.45207 e-19

Table:1. Results at various spans

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