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Dispersion Post-Compensation Using DCF at 10 GBPS

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Abstract- In this paper, the performance of negative dispersion fiber used as a dispersion compensating module is investigated. The optimal operating condition of the DCM was obtained by considering dispersion management configurations i.e. 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 fibre. 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. So far, most investigations for SMF transmission at high amplifier spacings in the order of 90 km to 120 km focused on conventional NRZ-format. The Q-factor and BER was estimated. The results indicate performance for all the configurations.

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Dispersion Post-Compensation Using DCF at 10GBPS

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Abstract-In this paper, the performance of negative dispersion fiber used as a dispersion compensating module is investigated. The optimal operating condition of the DCM was obtained by considering dispersion management configurations i.e. 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 fibre. 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. So far, most investigations for SMF transmission at high amplifier spacings in the order of 90 km to 120 km focused on conventional NRZ-format. The Q-factor and BER was estimated. The results indicate performance for all the configurations.

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I. Introduction

Light wave systems used in the core transport network of telecommunication systems operate in the second transmission window. The 1550 nm wavelength region exhibits 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, fibres 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.

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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 fibre is considerably higher. Results have also been validated through numerical simulations with the optical system simulator OptSim.

II. DCF Information

In order to meet the growing demand of bandwidth for internet and other related communication applications, future long-haul systems are required to operate at bit-rate of 10 Gbit/s, 40 Gbit/s or even higher. In high capacity systems, dispersion compensation is critical. The transmission fibers in the existing network are the standard non-zero dispersion fibres (NZDF)5 with nominal value for dispersion equal to +17 ps / nm · km . Although these fibers were deployed several decades ago, they are still preferred by system designers today because the high dispersion of the fiber is used efficiently to impair the non-linear manifestation of fibre in systems. However, the accumulation of dispersion in these fibres limits the transmission distance to approximately 60 to 300 km for 10 Gbit/s systems and 4 to 18 km for 40 Gbit/s systems if dispersion compensation is not employed. Hence dispersion compensation is required to increase the transmission distance in systems operating at high bit -rates. Furthermore, the DC device is required to have a sufficiently large bandwidth in order to achieve simultaneous compensation across all the channels. This implies that the DC device must be capable of dispersion slope compensation. Several dispersion and dispersion slope compensating devices have been demonstrated, including single-mode and higher-order-mode dispersion compensating fibres, fibre Bragg grating devices, Although many of these devices have great potential, including tuneable dispersion, single mode dispersion compensating fibres (DCF) are still the only one that is widely deployed.

III. Dispersion Management

Dispersion management1 can be achieved with various combinations of fibre layout. The widely implemented configurations are 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.

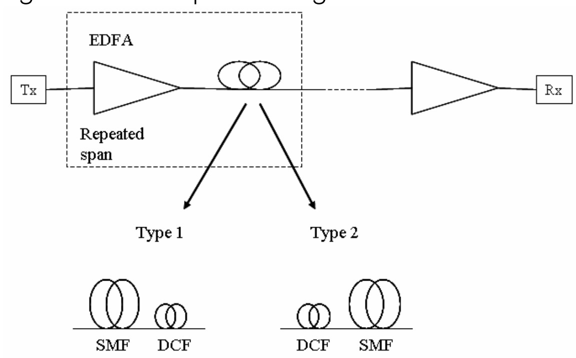

Fig1: Dispersion Management Schemes

IV. 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 fibre 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 risetime of 25% f the bitslot. 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 fibre transmissions operating at 10Gb/s at high amplifier spacings of I20km the impact of fibre nonlinearity is diminished by symmetrical ordering of dispersion compensating fibres allowing 1200km

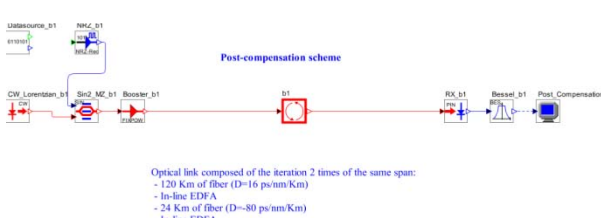

Fig 2: Dispersion Management Schemes implemented in OptSim

Fibre Parameters	SMF	DCF
Length(km)	120	24
Dispersion [ps/km/nm]	+16.2	-81
Dispersion slope [ps/km/nm^2]	+0.08	-0.15
Loss(dB/km)	0.22	0.8
Nonlinear Coefficient(Wkm)$^{-1}$	1.28	4.05
Transmitter / Receiver Param.	NRZ	
Bit rate [Gb/s]	10	
Pattern length	2^7	
Sampling points	2^{14}	

Table1: Parameters of Fibers used

Following schematics shows implementation of PRE Dispersion Compensation Post Dispersion Compensation and Symmetrical Dispersion Compensation.

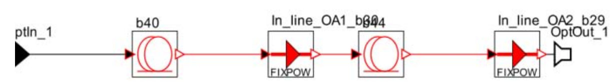

Fig3: Dispersion Management Schemes implemented in OptSim(Internal part)

V. Results and Discussions

Span (Km)	Q factor	BER(bits/s)
240	27.904850	1e-40
480	22.938838	1 e-40
720	21.812637	4.09423 e-35
960	20.306856	4.67606e-24
1200	18.896957	9.45207 e-19

Table2: Results at various spans

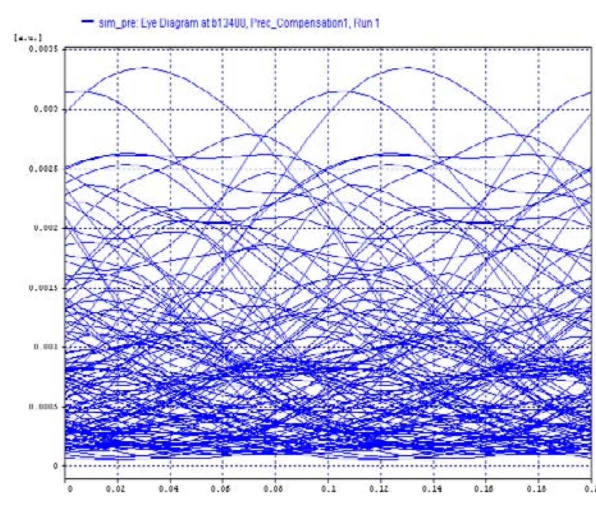

Figure4: Eye diagram at 240 km without compensation

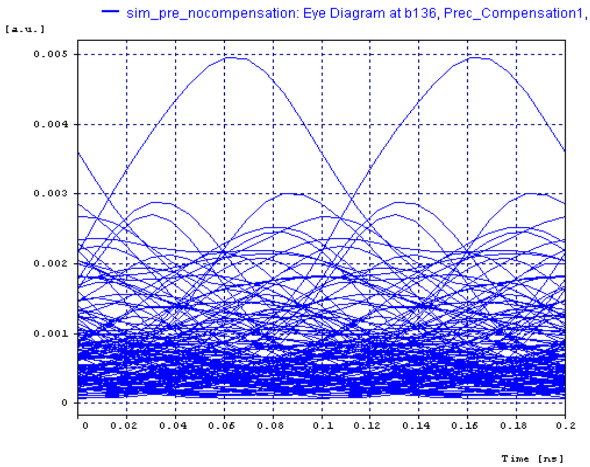

Figure5: Eye diagram at 1200 km without compensation

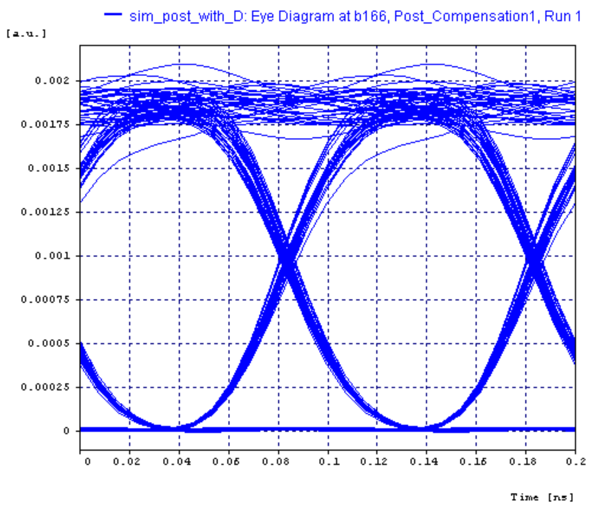

Figure6: Eye diagram at 240 km with Post compensation

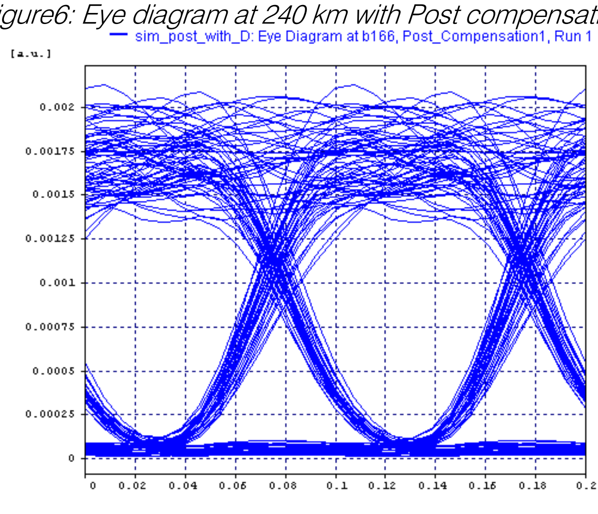

Figure7: Eye diagram at 1200 km with Post compensation

The experiment showed that the amount of negative dispersion introduced, with respect to the total accumulated dispersion of the transmission fibre, also impacted on the performance of the system.

In the single channel optical system experiment, it was found that the system performance gradually improved as the total dispersion of the transmission fibre tended toward that of the DCF and in a similar fashion, the system performance decreased as the total dispersion of fibre exceeded that of the DCF. Results obtained with no compensation, to for the post- compensation Furthermore, analysis of the Q-factor also revealed that system performance had exceeded the minimum requirement of 6 by a large margin.

VI. 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.

References Références Referencias

1. D.Breuer, K.Peterman, A. Mattheus, S.K.Turitsyn , "Combatting Fibre Nonlinearity In Symmetrical Compensation Schemes Using RZ Modulation FormatAt 120 km Amplifier Spacing Over Standard Fibre", IEE September , 1997.
2. M. I. Hayee and A. E. Willner, Senior Member, IEEE "Pre- and Post-Compensation of Dispersion and linearities in 10-Gb/s WDM", IEEE PHOTONICS TECHNOLOGY LETTERS, VOL. 9, NO. 9, SEPTEMBER 1997
3. C. Caspar, H.-M. Foisel, A. Gladisch, N. Hanik, F. K¨uppers, R. Ludwig A. Mattheus, W. Pieper, B. Strebel, and H. G. Weber "RZ Versus NRZ Modulation Format for Dispersion Compensated SMF-Based 10-Gb/s Transmission with More Than 100-km Amplifier Spacing" IEEE PHOTONICS TECHNOLOGY LETTERS, VOL. 11, NO. 4, APRIL 1999
4. John Senior "Optical Fibre Communications"
5. Gerd Keiser "Optical Fibre Communications"
6. Harry J. R. Dutton " Understanding Optical Communications", International Technical Support Organization http://www.redbooks.ibm.com

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