System performance of new types of dispersion compensating fibres

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CFA 8:00 am–9:45 am
Room 318/320

Dispersion Managed Solitons

Walter I. Kaechele, *CODEON Corp., USA, Presider*

CFA1 (Tutorial) 8:00 am

Linear and nonlinear effects in lightwave transmission: Dispersion management in terrestrial and submarine systems

Jean-Pierre Hamaide, *Alcatel, France*

Summary not available.

CFA2 9:00 am

System Performance of New Types of Dispersion Compensating Fibres

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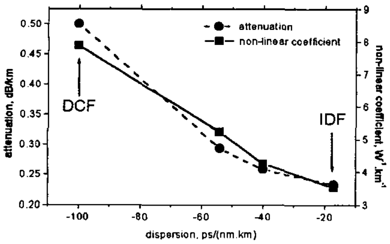
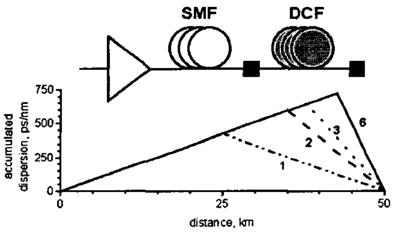
The management of dispersion and non-linearities is of prime importance in WDM systems. Dispersion compensating fibres (DCF) are extremely attractive when used in conjunction with standard single mode fibres (SMF). New types of DCFs compensating for the dispersion of SMF in a 1:1 length ratio have been recently presented[1,2] and intermediate types of DCF (compensating for SMF in a 1:2 or 1:3 length ratio) have also been designed and fabricated in the present work. The properties of the various types of available DCFs with dispersion of –17, –40, –54 and –100 ps/(nm.km), corresponding to SMF to DCF length ratios of about k = 1 (inverse dispersion fibre - IDF), 2, 3 and 6 (conventional DCF) respectively are shown in Fig. 1. All these fibres also provide dispersion slope compensation. It can be seen that when the absolute value of the dispersion is reduced from DCF to IDF values, both attenuation and non-linear coefficent are significantly reduced. As all these new fibres are designed to be cabled (therefore the DCF is part of the span length), and as it has also been shown that conventional DCF can be cabled successfully,[3] their use in real systems needs to be compared.



CFA2 **Fig. 1.** Evolution of the dispersion compensating fibres attenuation and non-linear coefficient as a function of dispersion (based on average measurements on manufactured fibres).



CFA2 **Fig. 2.** Dispersion maps under investigation for SMF to DCF length ratios between 1 and 6.

In spans like the ones in Fig. 2, and assuming a constant span length, the DCF will be placed closer to optical amplifiers when the absolute value of its dispersion is reduced from conventional DCF to IDF values. Therefore a trade-off has to be found between increased input power and decreased non-linear coefficient, resulting in an optimal dispersion map. Numerical simulations based on the split-step method have been performed to compare the different dispersion maps in Fig. 2 for a fixed span length of 50 km and for NRZ modulation at 10 Gbit/s. The interaction of dispersion, Kerr-effect non-linearities and amplifier noise is included in the simulations. WDM simulations have been performed on an 8 channel system with 35 GHz spacing in order to investigate the effects of cross-channel non-linear effects. Pseudo random sequence lengths of 1024 bits were used in the simulations for realistic penalty calculations, and WDM channels were uncorrelated.

Fig. 3 shows the maximum number of spans which can be cascaded for 3 dB power penalty (PIN receiver) as a function of SMF average input power per channel. For WDM transmission, only the worst-case channel is represented (one of the innermost channels). In the single channel case, k = 1 performs the best whatever the power level and proves to be more robust to self-phase modulation. Owing to increased span loss, k = 6 shows degraded performance at low power levels where the system is limited by noise. The poorer performance seen in the WDM case is attributed to cross-phase modulation which reduces the efficiency of the k = 1 span when the system is no longer noise limited. Therefore k = 2 and 3 appear as good compromises for WDM, offering lower span loss than conventional DCF while still being resistant to cross-phase modulation.

References

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CFA3 9:15 am

10 Gb/s uncompensated transmission in transparent optical metropolitan area networks using electroabsorption modulators over negative dispersion fiber

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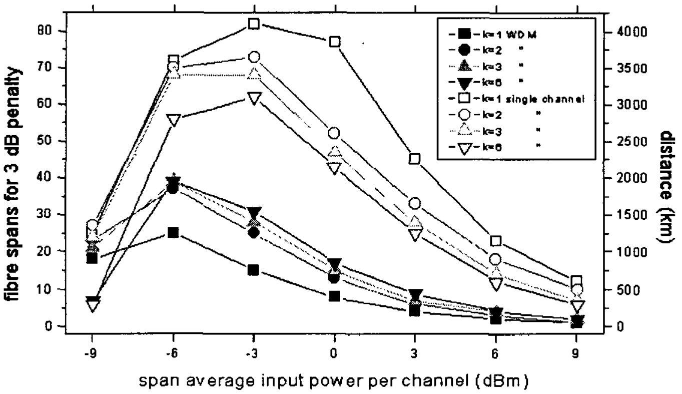
Integrated electroabsorption modulator-DFB lasers (EA-DFBs) are attractive candidates for 10 Gb/s transmission due to their low cost, compact size, high output power, and good extinction ratio. This paper presents, for the first time, a theoretical and experimental study of the performance of EA-DFBs for WDM 10 Gb/s NRZ transmission in transparent optical metropolitan area networks (MANs)[1] using negative dispersion fiber.

In the simulation, a phenomenological model of the EA-DFBs based on measurements of the absorption and the alpha parameter as a function of the applied reverse bias voltage is used.[2] Fig. 1(a) shows the absorption and the alpha parameter characteristics for a commercially-available EA-DFB operating at 1548.7 nm, measured using the method described in.[3] For the same device,



CFA2 **Fig. 3.** Number of cascaded spans for 3 dB penalty as a function of span average input power per channel for single and 8 channel WDM transmission (worst channel)