Tunable dispersion compensating grating in a 10Gbit/s 100-220km step index fibre link

R.I. Laming, N. Robinson[1], P.L. Scrivener[2], S. Barcelos, L. Reekie, J.A. Tucknott, M.N. Zervas
Optoelectronics Research Centre, Southampton University, SO17 1BJ, UK
[1]MCI Telecommunications Corporation, 1201 Arapaho Road, Richardson, Texas, USA
[2]Pirelli Cable Corporation, R & D Centre, Lexington, South Carolina 29072, USA

Chirped fibre gratings[1,2] are of particular interest for compensating the dispersion (~17ps/nm.km @ 1.55μm) of installed step index (SI) fibre links since they are compact, low-loss, polarisation-insensitive and offer high negative-dispersion. In this paper we present a detailed investigation of the bandwidth-dispersion trade-off for a fixed (40mm) length tunable linearly-chirped fibre grating[3]. In addition we demonstrate that such a grating can precisely compensate the dispersion in a 10Gbit/s transmission experiment for SI fibre lengths in the range 103-216km.

The basic link is shown schematically in Figure 1 and was established such that compensation of linear dispersion for total span lengths up to 216km could be investigated. A 10Gbit/s externally modulated transmitter was employed. This exhibited negative chirp ($\alpha=1$) to maximise transmission distance over step index fibre. Receiver sensitivity was measured by varying the input to the commercial preamplifier with integral narrow band ($\Delta\nu=50$GHz) tracking ASE filter. Dispersion compensation of the link was provided by incorporating the grating between the transmitter and power amplifier. The grating was mounted such that its centre wavelength could be mechanically tuned to match that of the transmitter whilst a linear chirp could be applied via a linear temperature gradient as indicated in Figure 1. For temperature differentials in the range 5-60°C a wide range of bandwidths, 0.13-0.54nm, and dispersion, 1700-500ps/nm.km, could be obtained and as anticipated, the bandwidth- dispersion product is near constant and given by the grating length.

Figure 2 plots the receiver penalty, compared to the back-to-back sensitivity of -27dBm and measured for a 2^{31}-1 data pattern and a 10^{-11} BER, for varying span lengths. Results are compared with and without the grating. Without the grating the receiver sensitivity is observed to improve (-ve penalty) for short span lengths and exhibit a minimum around 50km due to the negative-chirped transmitter. For increasing span lengths, the penalty increased sharply with 0 and 3.5 dB penalties being observed for 80km and 102.6km spans, respectively. In the case of the dispersion compensated link, by variation of the grating dispersion and hence bandwidth as indicated, a large span variation, 102.6-185.3km, where a receiver improvement of 4.5-5dB is obtained. For the increased span of 215.8km a reduction in the dispersion compensation is observed. In the case of the 185.3 and 215.8km spans the grating 3dB-bandwidth of 0.144nm corresponded to the transmitter 11.5dB-bandwidth and thus setting of the grating centre wavelength was critical ($\pm$0.005nm) but well within the tolerance of possible active stabilisation.

1. D. Garthe et al, Proc. ECOC Vol. 4 (Postdeadline papers), pp.11-14, Sept.25-29, 1994,
2. P.A. Krug et al, Proc. OFC'95, Postdeadline paper PD27, February 26-March 3, 1995.
3. S. Barcelos et al, submitted to Electronics Letters.

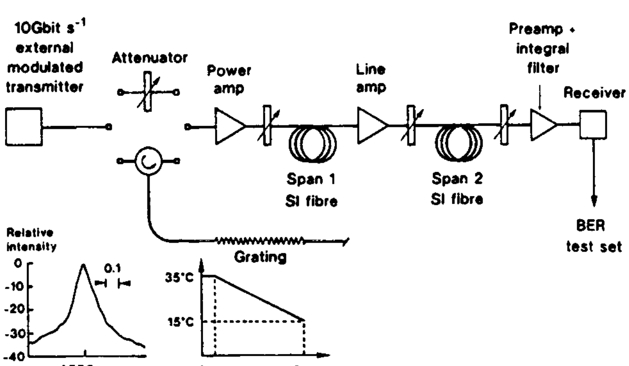

Figure 1: Experimental setup.

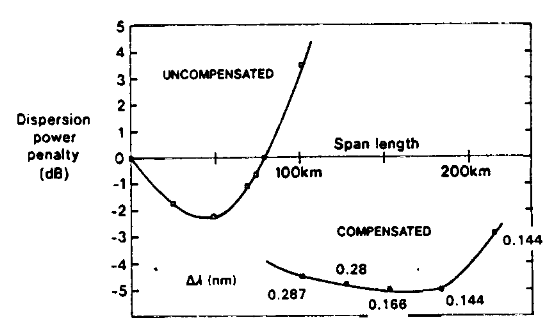

Figure 2: Receiver penalty compared to the back-to-back sensitivity of -27dBm at 10^{-11} BER for varying span lengths.