ONS Problem Set 5

Wednesday, December 20, 2018

Problem 0: Chromatic Dispersion (From problem set 4)

Chromatic dispersion leads to a pulse broadening of the optical time-domain signal and hence to inter-symbol interference (ISI). Calculate the maximum reach of an on-off-keying (OOK) data signal transmitted through an optical fiber. The optical carrier wavelength shall be 1550 nm and the data rates are R_1 = 10 Gbit/s and R_2 = 20 Gbit/s. Assume a hypothetical noise-free transmission system with a Gaussian Tx filter. Assume furthermore that the pulse broadening in the optical fiber due to chromatic dispersion can approximated by a Gaussian impulse response.

Problem 1: OSNR and achievable reach

From the optical amplifier lecture, we know the relation between OSNR, optical input power ($P_{\text{in,dBm}}$), amplifier noise figure (F_{amp}) and number of spans (N).

$$OSNR_{\text{dB}} = 58 + P_{in\,,\text{dBm}} - F_{\text{amp}} + L_{\text{span}}\alpha - 10\log_{10} N$$

Let us consider the launch power is 0 dBm for a long haul communication system and an optical amplifier with a noise figures of 6 dB used to compensate the fiber loss. Assume the required OSNR for error free detection at the receiver is about 15 dB. Consider that long haul communication systems use standard single mode fiber (SSMF) with a loss of α = 0.2 dB/km.

a) Calculate the maximum number of span for a fiber span length (L_{span}) of 150 km, 100 km, 50 km and 20km.
b) What is the optimal span length L_{span} for maximum reach?

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