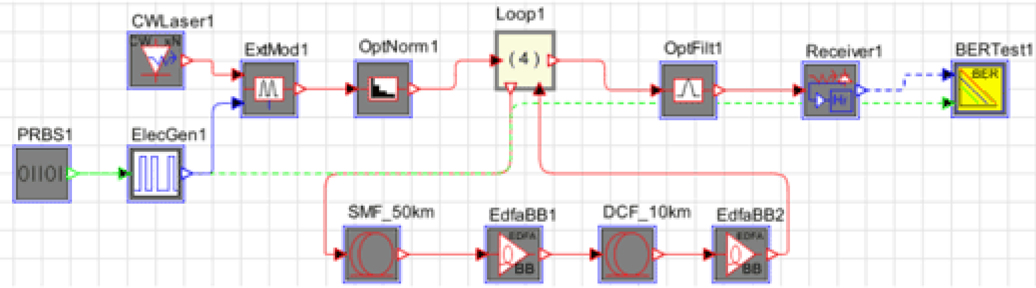
Fiber Nonlinearity and Performance of NRZ- and RZ-formats in High-Speed Links

Tools Used: OptSim

This example studies impact of fiber nonlinearity on NRZ- and RZ-formats in high-speed links. Topology layout for both NRZ and RZ cases is similar to the one shown below:

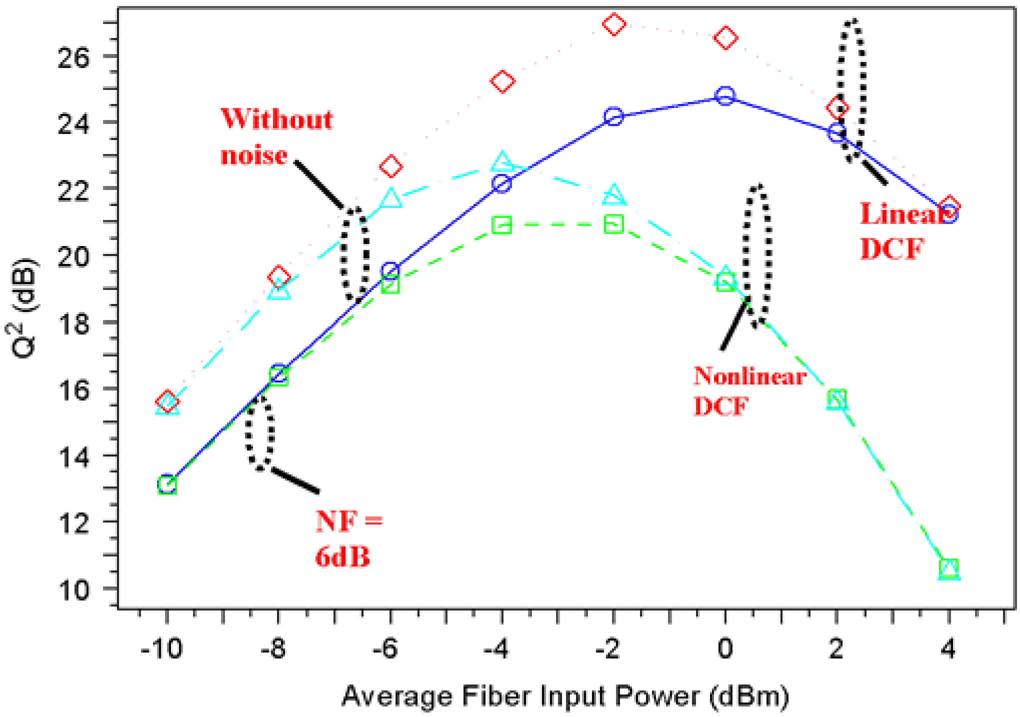


In both cases, we consider link with noise and without noise. In case of RZ, the number of spans simulated is double than that in case of the NRZ.

PART I: NRZ

The following figure shows Q-factor vs. average fiber input power plots at 240-km transmission for this topology with linear and nonlinear DCF, with and without amplifier noise. As the launched power increases, the performance keeps on improving until the launched power becomes high enough to cause nonlinearities adversely dominate the overall link performance. For our topology, if we examine the curves corresponding to the cases with and without amplifier noise, we see that until the launched power is low enough, the link noise plays a dominant role. However, at higher launched powers, the nonlinearities dominate the performance impairments as compared to the influence of link noise. Because of the smaller core diameter of the DCF, optical intensities are enhanced thereby resulting in higher nonlinear effects in the DCF section. The nonlinearities in the DCF, as seen in the following figure, can deteriorate the Q-factor by 6 to 9 dB depending upon the launched power.

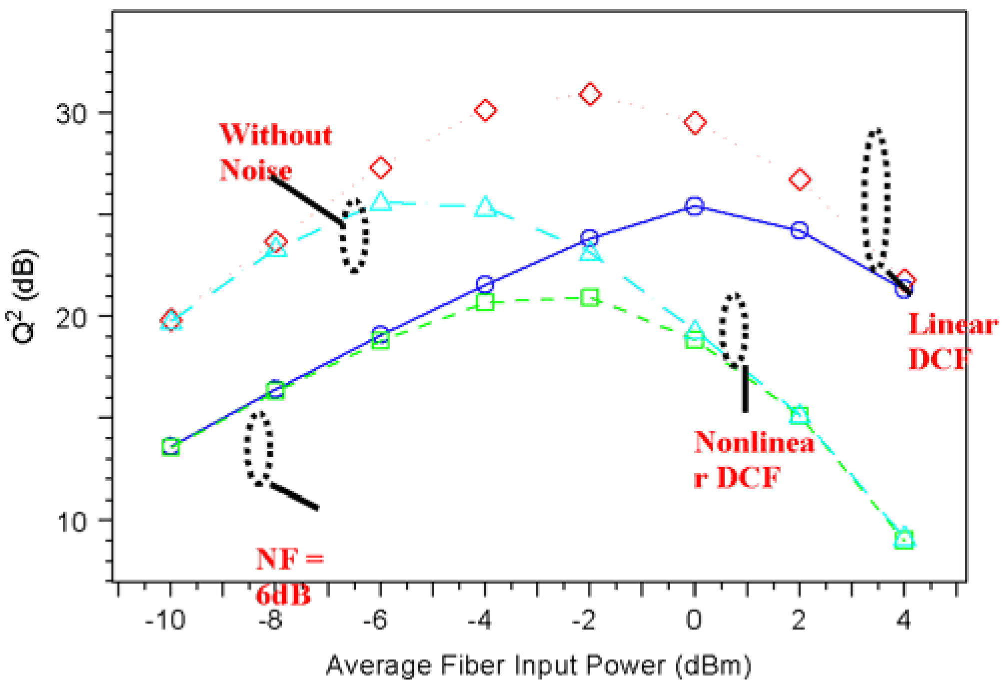
Q^2 (dB) vs. Transmitted Power (Distance = 240km)



PART II: RZ

The following figure shows Q-factor vs. average fiber input power plots at 480-km transmission for this topology with linear and nonlinear DCF, with and without amplifier noise. As the launched power increases, the performance keeps on improving until the launched power becomes high enough to cause nonlinearities adversely dictate the overall link performance. The RZ and NRZ cases qualitatively show resembling behavior except that the transmission distance is now double for RZ.

Q^2 vs. Transmitted Power (Distance = 480km)



In general, there are various factors that affect performances of various modulation formats. These factors broadly include whether the system is power limited or dispersion limited, whether it is a single channel system or a multi-wavelength link, and whether the system operates in linear or non-linear region of the BER (or Q) curve. Other relevant factors are the dispersion management scheme employed, average power per channel, inter-amplifier spacing, dominant type of non-linearity, and polarization mode dispersion (PMD) characteristics of the link. The user with definitive OptSim license is encouraged to test various simulation scenarios based on these factors.