Abstract

In this thesis, a consolidated effort has been made to assess the impact of various nonlinear effects and the compensation techniques in a sub-carrier multiplexed optical communication system.

An attempt has been made for exact analytical evaluation of the simultaneous effects of clipping induced distortion and statistical fading effect at the access interface of a sub-carrier multiplexed radio-over-fiber system has been carried out. The clipping induced distortion has been modeled as a complex Poisson process involving clipping rate and clipping duration. The exact analytical expression for the bit error rate involving clipping process as mentioned above and the fading effect has also been carried out.

To evaluate the performance of the chirped fiber Bragg grating as a dispersion compensating module for a sub-carrier multiplexed system, a novel design optimization process for fiber Bragg grating , involving energy content in a signal bandwidth, has been adopted. Optimization of the apodization profile of fiber Bragg grating has also been investigated. The performance of optimized fiber Bragg grating as dispersion compensating module for various SCM based systems has been investigated in details through simulation and analytical study.

Simulation and analytical studies of the performance of Optical phase conjugation in conjunction with distributed Raman amplifier (OPC-DRA combination) towards mitigation of joint effect of fiber dispersion and the non-linear effects has been carried out. In addition performance of various Raman amplification schemes for optimized performance of OPC-DRA combination in SCM systems has also been investigated in details.

Finally, analytical and simulation based evaluation of effects of polarization mode dispersion induced timing misalignment jitter on the bit error rate performance of an IM-DD tributary in SCM system has been carried out. The analytical model takes into account the statistical behaviour of PMD as well as both symmetric and asymmetric pulse perturbations due to PMD. The results generated through this analytical model fits well with the experimental results of jitter penalty due to PMD effect.

Overall, this thesis provides a range of analytical tools to assess the performance of SCM networks in the presence of various non-linear effects as well as design optimization techniques for compensating these effects.