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DISPERSION COMPENSATION IN OPTICAL COMMUNICATION SYSTEM BY EMPLOYING 16-QAM MODULATION USING OFDM

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ABSTRACT

Next generation communication network will be required to provide increased data rate efficiently along with the flexibility to adapt to various dynamic traffic patterns in a cost effective manner. The optical fiber communication system can do the same along with low losses and good quality of transmission. In the recent past, the enormous growth of network traffic on deployed optical communication networks forced the demand for a more constructive utilization of the channel capacity of the optical fiber communication channel. In near future, the next generation optical links are going to carry 10 / 40 Gbps per wavelength. The two windows at 1310 & 1550 nm provide low attenuation with transmission bandwidth of approximately 50 Tbps. Optical fiber communication system are primarily operated at wavelength near 1550 nm in order to match with the minimum loss point of silica fiber and hence maximize transmission distance. Unluckily, at this wavelength, there is a considerable quantity (typically 17ps/nm/km) of dispersion that restricts the achievable transmission distance. As the data transmission rate keeps increasing, the dispersion causing pulse broadening results in Inter-Symbol Interference (ISI), this becomes an important limiting factor for signal degradation of fiber optical network. The dispersion restricts the highest transmission data rate and longest transmission distances for the repeater less optical communication link [1]. Many efforts have been drawn to the development of dispersion compensating devices / techniques to recover or prevent the broadening of signal pulse. The basic solution for this is to use an efficient equalizer.

Orthogonal Frequency Division Multiplexing (OFDM) is a very auspicious data transmission process for the high data rate transmission due to its capacity to handle ISI, resilience to the dispersive channel, high bandwidth utilization efficiency and superior performance. It overcomes the problem of inter-symbol interference due to dispersion, by simultaneously modulating and transmitting a number of orthogonal sub-carriers at a low symbol rate, which makes the symbols period much longer than the channel impulse response. The OFDM is a multiple sub-carrier modulation technique which is highly spectral efficient and have a dynamic tolerance to dispersion, thereby making it an excellent dispersion compensation scheme for using the exiting optical communication networks for next generation dynamic traffic pattern. Therefore, the combination of optical communication system and OFDM is the highly efficient technique for the next generation long haul high capacity communication network.

This work investigates the use of OFDM as a technique to fulfil these needs for next generation optical communication system. These involve design, modelling, simulation and comparative performance analysis of the optical communication system with and without using OFDM for dispersion compensation. A novel scheme of tuneable dispersion compensation using OFDM is presented in this work. The system performance has been analysed in terms of BER, constellation diagrams and OSNR for optical communication system with and without using OFDM. OFDM is shown to

outperform in high data rate optical communications system for the long haul high data rate transmission with high bandwidth utilization efficiency.

KEYWORDS: OFDM, Dispersion, Optical Fiber, SSMF, PMD, GVD, IFFT, FFT