Performance analysis of 20 Gb/s QPSK modulated dual polarization coherent optical OFDM systems

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Abstract—In this study, 20 Gb/s Dual Polarization Coherent Optical Orthogonal Frequency Division Multiplexing (DP-CO-OFDM) system is studied to obtain the relation between the Bit Error Rate (BER) and launch power for different transmission length and polarization mode dispersion (PMD) coefficient. DP-CO-OFDM system is simulated by designing a Monte Carlo simulation. In this simulation, the effects of chromatic dispersion, launch power and PMD coefficient on received signals are demonstrated with constellation diagrams and results are given in form of BER-Launch Power variations.

Keywords—OFDM; optical communication; dual polarization; launch power

I. INTRODUCTION

OFDM is a suitable solution due to its many advantages known in wireless communications. Moreover, it is also used to transmit and receive large data rates in optical communications.

In 2005, the demonstration of the coherent receivers has been caused the increase of interest in coherent optical communications [1]. The main point of coherent communications is to improve sensitivity of the receiver. In addition, it allows the detection of both amplitude and phase increasing the detection capabilities, and combined with advance modulations formats [2].

Recently, the coherent optical communication and OFDM method are combined to obtain both advantages in a communication link. CO-OFDM technique is proposed for long haul transmission to remove inter-symbol interference (ISI) caused by chromatic dispersion in optical communication [3]. CO-OFDM systems allow for equalization of dispersive effects of optical channel.

The first CO-OFDM transmission was reported in 2006 [4, 5]. Dual polarization CO-OFDM has been experimentally demonstrated at 1 Tb/s over 600 km transmission [6]. In conventional coherent optical OFDM systems, training symbols (TSS) are added at the transmitter to facilitate channel estimation, which provides crucial channel information and enables efficient digital compensation of linear fiber impairments such as chromatic dispersion (CD) and polarization mode dispersion (PMD) [7].

In this study, the bit error rate (BER) performance of DP-CO-OFDM system is investigated for different launch powers with the increase in the transmission length under the effect of CD, PMD and the fiber nonlinearity. Also it is shown in constellation diagram the effect of CD, PMD and the higher launch power on optical signals before or after the conventional TS based channel equalization. In section 2, a general dual polarization coherent optical OFDM system is described. In section 3, the TS based channel equalization is described. In section 4, the results of simulated system are reported and finally in section 5, the conclusion is made.

Fig. 1. Block diagram of a DP-CO-OFDM system. PBC : polarization beam combiner, PBS : polarization beam splitter, LO : local oscillator.