OPINION

Performance evaluation of various modulation formats in a 40 gbps hybrid optical CDMA/DWDM system against ISI and FWM

Jennifer Stewart

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ABSTRACT

In this study, three alternative modulation formats—Carrier Suppressed Return To Zero (CSRZ), Modified Duobinary Return To Zero (MDRZ), and Return To Zero—are investigated numerically (RZ). Using an Electro-Optic Phase Modulator (EOPM) and a hybrid optical code division multiple access-dense wavelength division multiplexing (CDMA/DWDM) system with a data rate of 40 Gbps per channel, a transmitted power of 22 dBm, and a transmission distance of 105.075 km, the goal of this investigation is to determine the best modulation format. The outcomes showed found CSRZ was more resistant to optical fiber nonlinearity than MDRZ and RZ. Additionally, the suggested hybrid system based RZ format performed better than MDRZ, in contrast to DWDM systems. Because of its great performance, the CSRZ modulation format is the ideal choice for the optical CDMA/DWDM with EOPM module.

Key Words: *Tractionless; Thermo diffusion*

INTRODUCTION

According to a recent Cisco projection estimate, by 2023, there will be more internet-connected gadgets than people on the planet. In order to meet the ever-increasing capacity needs, high-capacity and high-speed optical transmission technologies have developed in response to the rise in demand for limitless bandwidth. The necessary high-speed transmission has been provided via a number of multiplexing techniques. One benefit of employing the Temporal Division Multiplexing (TDM) method, for instance, is speed. However, TDM limits the ideal bandwidth for a particular user by using one wavelength for downstream and another for upstream. As a result, the single fiber's capacity is not being used to its maximum potential. The Wavelength Division Multiplexing (WDM) system, which is regarded as the most effective method in optical networks, assigns a particular wavelength for a certain subscriber to make up for this .WDM lacks wavelength sharing and has nonlinear effects despite its benefit in expanding capacity. Contrarily, optical Code Division Multiple Accesses (optical CDMA) have a number of important characteristics, chief among them being their highly flexible and effective asynchronous access for multiple users in a busy network, fast scheduling without buffering time, and simpler expansion in network implementation. However, there are a number of noise sources that affect optical CDMA, including Multiple Access Interference (MAI), which is the major cause of bit error. Hybrid systems have been presented as a solution to the drawbacks and inefficiencies that each of the aforementioned systems brings about. The optical CDMA/DWDM hybrid system combines the benefits and strengths of the two multiplexing strategies, but it also has drawbacks including Chromatic Dispersion (CD), Laser Phase Noise (LPN), and nonlinear effects, much like the other systems. The signal quality is significantly impacted by these restrictions, which also reduce system performance. It has been suggested to use a number of techniques to account for chromatic dispersion, such as digital filters like the time-domain least mean square adaptive filter, a frequency-domain blind look-up filter, and by adjusting the Fibre Bragg Grating's (FBG) grating length. Coherent systems using high order modulation formats are severely hampered by the phase noise caused by transmit and receive lasers. It is exceedingly challenging to distinguish between transmit phase sounds and receive phase noises when they both exist. Giulio et al. devised a Digital Coherence Enhancement (DCE) method that considerably decreased the phase noise of transmit or receive lasers by combining an interferometric device with very basic electronic processing. However, when the chromatic dispersion and laser phase noise interacted, a new problem arose that was extremely challenging to correct for. Equalization Enhanced Phase Noise (EEPN) is the name of the interaction. Split-step Fourier simulations have been used to undertake a thorough research of the effects of EEPN on nonlinear optical fibres. Furthermore, nonlinear effects include intra- and inter-channel Four Wave Mixing (FWM) are viewed as a significant source of degradation in high data rate and high capacity networks using optics. In reality, the consequences of inter- and intra-channel FWM are well-known. Considered one of the most important applications of pure WDM systems optical fibre network problems. On the other hand, the hybrid optical CDMA/DWDM system's impacts of intra and inter-channel FWM have not been discussed. Analytical model predictions have been made for both single and multiple channels of a dual-polarization DP-16QAM system over the long term. The analysis demonstrated that lowering the EEPN has a significant influence on enhancing system performance. There is no discussion of annel FWM in the hybrid optical CDMA/DWDM system. A hybrid optical CDMA/DWDM system has recently been presented, taking into account the effects of inter- and intra-channel FWM and Inter-Symbol Interference (ISI). The research showed that the created inter-channel FWM effect causes various noise terms, such as signal-FWM, Multiple Access Interference (MAI-FWM), and FWM-FWM noise, in addition to contributing as an extra crosstalk component. It has been demonstrated that the inter-channel FWM effect may be reduced by using CDMA technology, which distributes the bit's energy throughout the identification code sequence. In the hybrid optical CDMA/DWDM system, the Electro-Optic Phase Modulator (EOPM) is also employed to reduce the intra-channel FWM effect. The emphasis should be focused on modulation formats and line coding, which are employed to reduce the linear and nonlinear impairments of fibre optic transmission, in order to create systems that can sustain a high data rate. Different modulation formats, including Differential Phase Shift Keying (DPSK), Carrier Suppressed Return to Zero (CSRZ), Modified Duobinary Return to Zero (MDRZ), and Differential Quadrature Phase Shift Keying (DQPSK), have been used to analyse DWDM under the influence of the FWM effect. As alternatives to Return To Zero (RZ) and non-return to zero, all modulation schemes were suggested.

CONCLUSION

In conclusion, it was discovered that the EOPM module was more effective utilizing the CSRZ modulation format than the MDRZ and RZ modulation formats after the theoretical study on the hybrid optical CDMA/DWDM system. This results from the phase shift that the EOPM between the pulses introduced. Due to the fact that destructive interference between various pulses may be accomplished by adjusting the phase shift, the phase shift is responsible for minimizing the intra-channel FWM impact. The simulation findings showed that the optical signature code parameters, specifically the length of the code, affect how strong the FWM impact is. The most important factor in eliminating the impact of intra-channel FWM is the phase deviation of the EOPM module.

Editorial Office, Journal of Modern and Applied Physics, UK.

Correspondence: Jennifer Stewart, Editorial Office, Journal of Modern and Applied Physics, UK, E-mail appliedphysics@pulsusjournal.com
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