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Priority-based parameter optimization strategy for reducing the effects of four-wave mixing on WDM system

Abstract

In order to meet the ultra high speed and ultra long-haul transmission distance in wavelength division multiplexing (WDM) systems, the nonlinear impairment affecting the overall spectral efficiency and system performance should be minimized. This paper proposes a strategy to mitigate the four-wave mixing (FWM) effect in WDM system. The strategy determines the effect of both single and combined effects of second, third, and fourth optimization priority parameters such as fiber length, input power, dispersion, channel spacing, and effective area on FWM power. A comparison study was made under different types of optical fiber such as single-mode fiber (SMF), dispersion shifted fiber, non-zero dispersion fiber, and non-zero dispersion shifted fiber. In addition, the system performance in term of bit-error-rate was calculated in the case of single priority (impact of effective area) and combined priority (impact of effective area, input power, fiber length and channel spacing). The results show that the FWM effect was reduced based on the transmission parameters order of optimization, i.e., priority selection proposed. Moreover, the results indicated that increasing sequentially the effective area, fiber length; channel spacing and decreasing the input power provide the most significant sequence in suppressing the effects of FWM. This priority sequence brought the suppression ratio to approximately 26.3% in SMF, which suppressed the FWM effects up to −50 dBm. In term of BER; the combined priority introduces improvement in BER of 2.31×10^{-25} in comparison with single priority that has value of BER 4×10^{-14}. Finally, this work suggests that the proposed priority-based parameter optimization strategy is an ideal solution for optimum performance of WDM system.

Keywords; Nonlinear effect, Four wave mixing, Wavelength division multiplexing, Fiber optics communication, Optical networks