Modeling of wavelength multiplexed lightwave systems

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Very-high-capacity optical communication systems have been demonstrated by wavelength-division multiplexing (WDM) of several high-bit-rate channels. Large distances have been achieved using optical amplifiers to compensate the fiber loss. The performance of these systems is determined by the interplay of several limiting factors: optical signal-to-noise ratio, fiber chromatic dispersion, and fiber nonlinearities. The transmitted optical power, amplifier spacing, and fiber dispersion map must all be simultaneously optimized. Accurate modeling is essential not only to optimize the design of WDM systems, but also to gain a better understanding of the limiting effects and to devise techniques to ameliorate their impact. Theoretical modeling and split-step simulations are complementary techniques to understand the performance of WDM lightwave systems. Their strengths and weaknesses are discussed, and a synergistic approach to their use is described. Comparisons with experimental results are provided.