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대용량 완전광 통신에서 광섬유의 선형/비선형 특성이 미치는 효과

Major Technical Impacts of Optical Fibers' Linear and Nonlinear Properties on High-Capacity All-Optical Communications

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This paper will discuss results of theoretical and experimental researches performed in identification of how the optical fibers' linear and nonlinear properties will make a limitation in high-speed and high-capacity lightwave communication systems and how we can positively utilize those properties in achieving such high-speed and high-capacity lightwave communication systems. Since the lightwave communication technologies tend to be developed to achieve high-speed and high capacity optical transmission. systems. every efforts are being made to make the maximum utilization of the potential capacities of all the involved devices and lightwave information carrying media up to their physical limitation. In optical transmission systems, the silica fiber is currently one of the well-developed optical materials transporting information from one place to another. Its ultimate transporting capacity can be achieved through a combined use of temporal and spectral properties optical signals. Time-division multiplexed (TDM) systems involved with short optical pulses can be used to utilize the temporal properties, and wavelength-division multiplexed (WDM) or frequency-division multiplexed (FDM) systems involved with optical signals of a narrow linewidth can be used to utilize the spectral properties. In high speed TDM systems, the chromatic and polarization-mode dispersion effects are major limiting factors for the high-quality performance, while the nonlinear optical effects, such as optical Kerr effect and phase conjugation, can be utilized as effective principles performing the functional devices or schemes of high-speed all-optical demultiplexing, dispersion compensation, and short pulse generation. In high density WDM (or FDM) systems, nonlinear optic effects, such as self-phase modulation, cross-phase modulation, stimulated Raman scattering, stimulated Brillouin scattering, and four-wave mixing are the major limiting factors for high performance. At the same time, all or parts of those effects can be utilized in supercontinuum light generation, wavelength conversion, and so on. This paper is focused on report of how those effects are effectively utilized in high-speed all-optical fiber switches, all-optical wavelength and signal pattern conversions, optical clock recovery, mode-locked fiber lasers, supercontinuum pulse generation, and all-optical signal add and drop devices for high-speed TDM and high-density WDM all-optical communication systems. In addition, experimental results obtained in those areas and theoretical analysis performed in the optical chromatic dispersion and nonlinear phenomena affecting such large capacity optical communication systems will be presented based on our research results.