

Bidirectional Lightwave Transport Systems Based on Optical Free-Space Transmission Scheme

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Abstract : Wireless communication network is a promising technology to provide broadband service to the end-user. However, due to high attenuation in the wireless band, using wireless communication to connect the head-end and the access point (AP) will place serious limitations on the allowed repeaterless distance. It is expected that fiber transmission link may be a solution to the issue. In optical fiber integration with optical free-space transmission systems, the transmitted signal is converted into the optical one and distributed to the remote APs by fiber link, by which providing broad bandwidth and low attenuation characteristics. Optical free-space transmission scheme is presently developed by researchers and engineers to create high-speed and high security communication networks, in which using optical light to replace modulated and un-modulated signals. It can provide many benefits, like providing communication link in specific areas in which RF communication is prohibited, such as in the hospital or airplane. Optical free-space transmission scheme can be divided into two categories: the divergence scheme and the convergence one. The former uses the divergence beam to provide the mobile service to the end-user. However, it is difficult to obtain good free-space transmission performance due to large service area and low optical power per unit area. On the other hand, the latter uses the convergence beam to provide the mobile service to the end-user. Nevertheless, it is also difficult to obtain good free-space transmission performance due to narrow light beam and laser light misalignment between the transmitter and the receiver.

A novel bidirectional lightwave transport system employing wavelength-division-multiplexing (WDM) and optical add-drop multiplexing techniques, as well as optical free-space transmission scheme is proposed and experimentally demonstrated. Over an 80-km single-mode fiber (SMF) transport and about 2.4 m free-space transmission, impressive and brilliant bit error rate (BER) operation is obtained for long-haul fiber link and finite free-space transmission distance. Such bidirectional lightwave transport system based on optical free-space transmission scheme has been successfully demonstrated, which can not only present its advancement in lightwave application, but also reveal its simplicity and convenience for the real implementation. Our proposed systems are suitably applicable to the lightwave communication systems in wire and wireless transmissions.