The current time-division multiple access (TDMA) passive optical network (i.e., EPON and GPON) would evolve toward wavelength division multiplexing PON (WDM-PON). Meanwhile, UWB over fiber (UWBoF) technology is proposed to increase the area of coverage of a UWB communication system and to offer the availability of undisrupted service across different networks. Therefore, it is of great interest to integrate a UWBoF system into a WDM-PON due to the high potential to provide high data-rate and flexible wired and wireless services with a favorable cost. The key challenges for implementing UWBoF and WDM-PON converged systems are the generation of optical UWB signals and the provision of UWB service without affecting the existing wired service. Several techniques were proposed to provide UWB downstream service in a WDM-PON network, but the UWB service is provided at the cost of sacrificing the wired service in the same wavelength channel. In this talk, we will give a comprehensive review of our recent work on a UWBoF over WDM-PON system that can simultaneously provide UWB wireless and baseband wired services using a centralized light source. The optical on-off keying (OOK) and bi-phase modulation (BPM) UWB signals are generated by feeding electrical return-to-zero (RZ) or dark RZ signals into a dual-drive Mach-Zehnder modulator (MZM) placed at the center office. The MZM is also used to convert an electrical non-return-to-zero (NRZ) signal to an optical wired signal. Although the two signals have spectral overlap in the optical spectrum, they are located at different frequency bands when converted to electrical signals at a photodetector (PD) in the optical network unit (ONU), which can still be separated by an electrical filter. Therefore, the optically generated UWB signal and the wired signal can be used to provide wireless and wired services on a single wavelength. An experiment is performed. 1.25-Gb/s Optical UWB signals with OOK and BPM formats are successfully generated. The performance of the generated 1.25-Gb/s UWB signals and 1.25-Gb/s wired signals is evaluated by transmission the signals over a 36-km single mode fiber (SMF) in a WDM-PON. The eye diagrams, electrical spectra and BER measurement showed that the provision of UWB wireless service had negligible impact on the co-channel and inter-channel baseband wired signal. In addition, the 36-km SMF transmission introduced less than 2 dB power penalty to both the UWB and wired signals. These results demonstrated that a conventional WDM-PON can be upgraded to provide additional UWB services without affecting the existing services by modifying the modulators in the center office and inserting UWB antennas in the optical network units ONUs. The technique may find application in the future wired and wireless converged networks. Other techniques on UWB over WDM-PON are also reviewed. The advantages and limitations of these techniques are discussed. The challenges in implementing these techniques for practical UWBoF and WDM-PON converged networks are also discussed.

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