Optical Noise Suppression Techniques for Wavelength-Locked Fabry-Perot Laser Diode

Abstract We propose optical noise suppression techniques for wavelength-locked Fabry-Perot laser diode (F-P LD) and demonstrate high capacity WDM-PON at 2.5 Gb/s. The noise suppressor located only at the central office enables smooth upgrade of deployed WDM-PON without modification of the outside plant.

The wavelength division multiplexed passive optical network (WDM-PON) has been recognized among carriers and vendors as an ultimate solution that provides the high scalability with the high guaranteed bandwidth for a video-centric service of high-definition and ultra-high-definition TV quality [1]. In various WDM-PON technologies, the WDM-PON based on the wavelength-locked Fabry-Perot laser diode (F-P LD) has been deployed due to a low-cost colorless transmitter, which effectively replaces the wavelength specified optical sources in conventional WDM-PON. However, the wavelength-locked F-P LD suffers from the beat noise of the incoherent light source. Subsequently, the intensity noises limit the achievable transmission performances such as the data-rate and channel capacity. In order to overcome the drawbacks by the intensity noise, the intensity noise suppression techniques by using an additional F-P LD at the optical receiver have been proposed [2,3]. In this paper, we demonstrate optical noise suppression techniques to enhance transmission capacity of WDM-PON based on the wavelength-locked F-P LD. An additional F-P LD can suppress the intensity noise and enables 2.5 Gb/s per channel of WDM-PON or 1.25 Gb/s per channel of WDM-PON at 50 GHz channel spacing. The noise suppression is employed at the central office (CO) for both upstream signal and downstream signal. As a result, a smooth upgrade can be provided without modification in the infrastructure of already deployed WDM-PON.

Fig. 1 illustrates the WDM-PON network architecture employing the proposed intensity noise suppression. As a conventional PON, it consists of three main parts of an Optical Line Terminal (OLT) at central office (CO), a Remote Node (RN), and Optical Network Terminals (ONT’s). The OLT consists of two broadband light sources (BLS’s) for upstream and downstream seeding, the arrayed waveguide grating (AWG) for Mux/DeMux, the Optical Cannel Units (OCU’s), and the proposed noise suppressor. The noise suppressor is composed of an optical circulator, an AWG, and the F-P LD’s, as shown in the inset of Fig. 1. The noise suppressor can be located at the position of “S1” and “S2” to suppress the intensity noise of the upstream and downstream signals, respectively. To suppress noise in the injection seed light, the noise suppressor can be placed at the position of “B1” and “B2.”

Fig. 2, we compare upstream and downstream performances at 2.5 Gb/s data-rate and 200 GHz channel spacing when suppressing the intensity noise of the optical signals. Here the ASE-injection power into the transmitter was about –0.5 dBm and the signal-input power into the F-P LD 2 was about –18 dBm. For the upstream signal, we observed the power penalty of 1 dB in the comparison with the BER performance of back-to-back (BtB). However, the penalty increased to 2 dB incase of the downstream signal. When the optical noises of injection lights are suppressed, the measured BER curves at 10 km transmission for the upstream and downstream are plotted in Fig. 3. Here the optical power of ASE-injection into the F-P LD 2 was adjusted about –10 dBm and the ASE-injection power into the transmitter was about –15 dBm. It is worthy to note that the ASE-injection power into the transmitter can be reduced up to –15 dBm for 2.5 Gb/s data-rate. It is also found that the power penalty is exhibited about 0.8 dB for the upstream and 0.5 dB for the downstream, respectively.
Also we demonstrated 1.25 Gb/s transmission at 50 GHz channel spacing with the proposed noise suppression technique. The measure BER curves are shown in Fig. 4. The BER curves exhibit the error-free performances and the receiver sensitivity is changed about 1 dB over all detuning conditions.

In this work, we have proposed the noise suppression methods for wavelength locked F-P LD and have demonstrated high capacity WDM-PON at 2.5 Gb/s data-rate. The noise suppressors enable error free transmission of 2.5 Gb/s signal with considerably reduced injection power into the transmitters. Therefore, the optical noise suppression techniques of wavelength-locked F-P LD provide high scalability for high capacity WDM-PON without modification of the outside plant.

REFERENCE