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Research Article

Realization of 25-GHz spaced Ultra densed Spectrum-Sliced WDM PON with 3-spectrum sliced channels using 50-GHz AWGs

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Abstract

We used three spectrum sliced even and odd channels using a pair of 50-GHz Arrayed-waveguide gratings (AWGs) demonstrating the possibility of 25-GHz spaced ultra densed spectrum-sliced wavelength-division-multiplexed passive optical network. Those AWGs have an offset of 25 GHz with respect to each other. For the demultiplexing of the channels, we used a pair of 50-GHz AWGs. We intended to use these AWGs as it gives better bit-error rate performances and has two times larger channel bandwidth than conventional 25-GHz AWGs . Moreover, the increased spectral overlap between adjacent channels produces relatively small crosstalk since the channels are incoherent and theirintensity noise is absorbed by the reflective semiconductor amplifiers. The 25-GHz spaced spectrum-sliced spectrum-sliced WDM passive optical network can be realized more easily using 50-GHz AWGs since 50-GHz AWGs are more available in the market than 25- GHz AWGs.

Keywords:*Optical fiber communication, optical fiber LAN, semiconductor optical amplifiers, wavelength division multiplexing.*

1. Introduction

Broadband access networks [1] are more economic with the implementation of passive optical networks (PON).Wavelength division multiplexed (WDM) PONs can provide dedicated high capacity sevices such as high quality videos and large volumes of data [2]. Spectrum-sliced incoherent channels have been investigated extensively as their optical sources for WDM PON systems [3]. Reflective semiconductor optical amplifiers (RSOAs) [4] have been major benefits in implementing spectrum-sliced WDM PONs at 1-GbE. The RSOA provides a polarization-insentive modulation and suppresses the relative intensity noise up to a few GHz enabling the wavelength reuse [5]. Previously, spectrum-sliced WDM PONs having

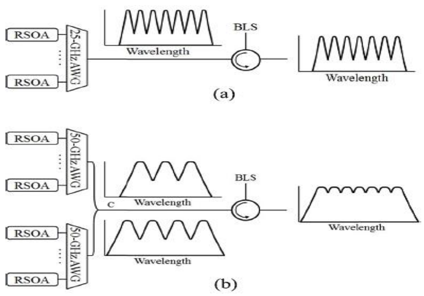

Figure 1. (a) Conventional method to obtain 25-GHz spaced spectrum-sliced WDM PON channels using a 25-GHz AWG. (b) purpose method to obtain 25-GHz spaced spectrum-sliced WDM PON channels using a pair of 50-GHz AWGs. RSOA: reflective semiconductor optical amplifier, BLS: broadband light source, C: 3-db optical coupler

100-GHz [6] and 50-GHz channel spacing values have been demonstrated with 1-GbE speed for both downstream and upstream directions. Here, we have used a pair of AWGs for the spectrum slicing of even and odd channels separately for 25-GHz spaced spectrum-sliced WDM PON.

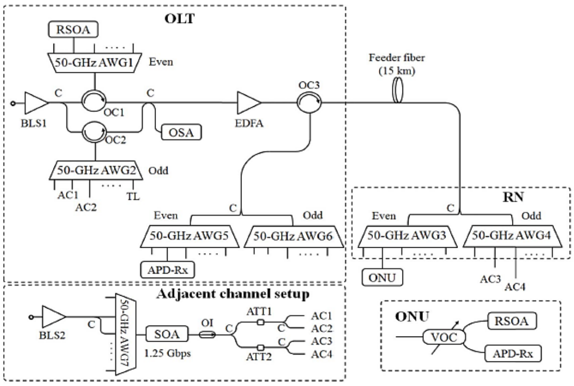

Figure 2. Experimental setup. BLS: broadband light source. OSA: optical spectrum analyzer. C: optical 3-dB coupler. OC: optical circulator. AWG: arrayed waveguide grating. RSOA: reflective semiconductor optical amplifier.

2. Structure for Ultra densed 25-GHz WDM PON using 50-GHz AWGs

The 25-GHz WDM PON using 50-GHz AWGs is shown in Figure 2. AWG1 is used for even channels and AWG2 for odd channels. AWGs have 80 ports covering the wavelengths from 1532 nm to 1564 nm. They had losses of 4~6 db loss with a 3-dB bandwidth of 0.32 nm. In the experiment, we used three spectrum-sliced channels centered at 1533.3, 1533.5, and 1533.7 nm. The central channel was provided by a broadband light source, BLS1 from an erbium diped fiber amplifier (EDFA) without input producing an amplified spontaneous emission of 15 dBm. The input power to the RSOA was -15 dBm. The RSOA’s output power was -7 dBm.The two other adjacent channels were provided by the BLS2 as is shown by the adjacent channel setup in Fig. 2. The adjacent channels were modulated simultaneously using a semiconductor optical amplifier (SOA).AC1 and the AC2, were applied to the AWG2 for downstream channels. AC3 and the AC4, were applied to thhe AWG4 for upstream channels. The SOA’s input power was -7 dBm.All these channels were modulated in 1.25 Gbps with a 231-1 pseudorandom bit sequence (PRBS). The extinction ratio of the downstream channels was about 3.5 dB [11]. To simulate the presence of the other channels for the EDFA input, we also applied a 14-dBm tunable laser to the AWG2. After transmission, the downstream channels were demultiplexed within the remote node (RN) using the AWG3 and the AWG4. The demultiplexed central channel was sent to an optical network unit (ONU).

3. Results and Discussion

From experiment setup we measured the BER curves in three conditions, back-to-back (BTB) without adjacent channels, BTB with adjacent channels, and after the feeder fiber with adjacent channels. The 50-GHz AWG case has better BER performaces than the 25-GHz AWG case. This is confirmed by a single channel BTB experiment for the 25-GHz AWG case without using the 25-GHz AWG at RN.The BER decreases to $8x10^{-6}$from $1.5x10^{-5}$at -23 dBm APD received power. However, this BER value is still higher than the BTB result of the 50-GHz AWG case with adjacent channels, 2.0x10-7, at -23 dBm APD received power.

4. Conclusion

We replaced conventional 25-GHz AWGs using 50-GHz AWGs for a 25-GHz spaced spectrum-sliced WDM-PON. A pair of 50-GHz AWGs are used to separate even and odd channels. Using those pairs, we observed better BER performances in both downstream and upstream directions than the case of using 25-GHz AWGs. The error floors that are inherent in our 25-GHz spaced spectrum-sliced WDM-PON can be removed using Forward error correction (FEC) techniques.

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