interaction in the silicon photonic nanowire produces three wavelength-multicasted output idlers, each encoded with the 160-Gb/s pulsed-RZ data [Fig. 5(a)]. Here, the input signals span 9.9 nm (1550.9 nm to 1560.8 nm), the pump is placed at the 1542.7-nm wavelength, and the wavelength-multicasted output idlers span 11.4 nm (1524.0 nm to 1535.4 nm), producing a conversion bandwidth ranging from 15.5 nm to 36.8 nm. Similarly, a two-way [Fig. 5(b)] and one-way [Fig. 5(c)] multicast is achieved by turning off two input signals (leaving C21 and C27) and one input signal (leaving C21), respectively. The conversion efficiency remains constant at –22.8 dB for each wavelength multicasting configuration. We further examine the temporal properties of the generated optical pulses [Fig. 5(d)], as well as the wavelength-multicasted optical pulses for wavelength channel C33 in the three-way multicast configuration [Fig. 5(e)]. The eye diagram (with a 100-ps temporal window) of the wavelength-multicasted pulsed-RZ data remains open during the three-way multicasting operation. After the OTDM stages, the amplitudes of the individual tributaries of the signal are not perfectly uniform due to asymmetrical insertion losses within each OTDM stage [Fig. 5(d)]; this is exacerbated by wavelength multicasting due to the quadratic relationship between conversion efficiency and pump power [Fig. 5(e)]. The tributary uniformity can be improved by further normalizing the insertion losses in each OTDM stage. To the best of our knowledge, this work represents the first on-chip wavelength multicasting demonstration using pulsed-RZ data.

5. Conclusion

We have shown and evaluated an efficient and scalable method of wavelength multicasting high-speed optical streams encoded with both 40-Gb/s NRZ data and 160-Gb/s pulsed-RZ data. We have verified up to a sixteen-way multicast of 40-Gb/s NRZ data using spectral and temporal responses, and quantified the resulting wavelength-multicasted data integrity degradation using BER and power penalty performance metrics. We then evaluated the effect of this wavelength multicasting scalability on the dependence of conversion efficiency on average pump power. We further evaluated spectrally and temporally up to a three-way multicast of 160-Gb/s pulsed-RZ data. Every quantifiable experimentally-verified metric that we examined suggests that this method for wavelength multicasting is a truly scalable process. The massive bandwidth offered by this dispersion-engineered silicon photonic nanowire, combined with the platform's CMOS compatibility and capability of ultra-dense integration with complex photonics and electronics, materializes this wavelength multicasting method for full-scale parametric systems such as photonic routers-on-chip (RoCs) for ultra-broadband high-performance optical networks.

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