The recorded conversion spectrum (Fig. 5(a)) at this setting shows similar conversion efficiency compared to the second experiment. We observe open eye diagrams (Fig. 5(b) insets) on both pump and idler RZ-data signals and observe error-free operation for both. We record the pump back-to-back eye diagrams and BER curves (Fig. 5(b)) just before it is launched on the chip. After the chip we measure the idler's BER curve to have a sensitivity gain of 1 dB which is attributed to the modulation extinction ratio improvement that results from the quadratic pump-idler amplitude relation. As before, the APD wavelength-dependent sensitivity is adjusted for using the computed correction factor (we use the factor measured at 1312 nm since we could not directly measure the sensitivity at 1271 nm). To the best of our knowledge, this is the first reported demonstration of a unicast across such large probe-idler separations in silicon.

3. Summary and conclusions

In this work we have validated the silicon platform's capability for all-optical processing of data at record probe-idler separations within a continuous 3-dB bandwidth. Wavelength conversion was demonstrated to have near constant performance, with consistent sensitivity gains at all probe-idler settings, scaling even up to a record 545-nm separation. Furthermore, we have demonstrated a unicast functionality of high-speed data with a sensitivity gain at even greater probe-idler separation of 700 nm, which shows the device's flexibility for data manipulation with exceedingly large spectral range at our disposal using a single device.

Beyond data-validating the spectral bandwidth of the device for potential usage from 1300 to 2000 nm, it bears noting that these demonstrations also showcase the silicon's potential to perform all-optical processing with relatively low powers (< 100 mW launched on chip) and an ultra-compact footprint (< 1 mm^2), allowing potential integration into compact low power devices. In an era where both power consumption and size become limiting factors for many real-world systems, such advantages might come into play as silicon nonlinear devices develop into commercial components.

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