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60 GHz Broadband Data Signal Generation with a Photonic Integrated Filter

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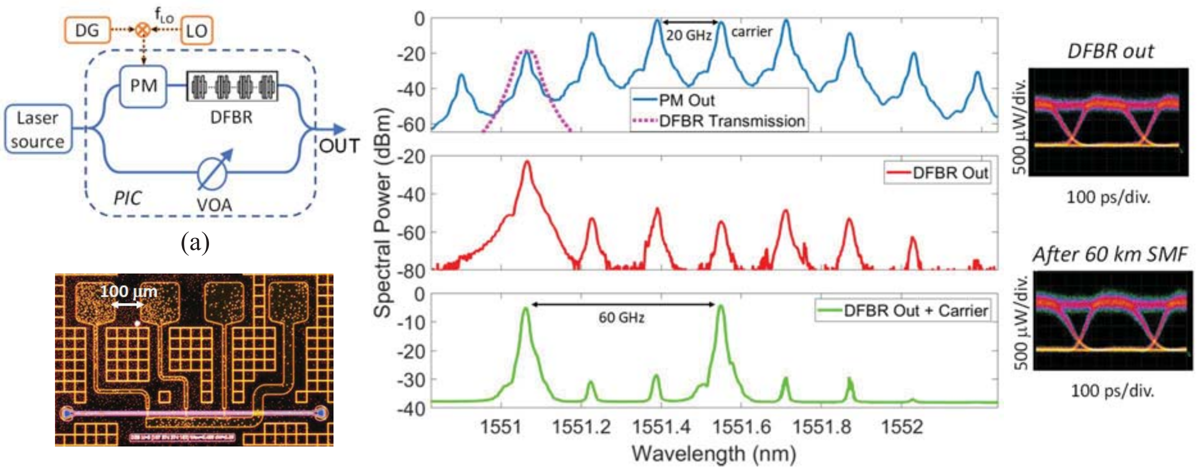
Radio over fiber (RoF) technology is an efficient mean for distributing broadband wireless services in emerging 5G/6G systems operating in the millimeter-wave range [1]. To keep the price of the services low, key photonic components and subsystems capable of handling data rates at several Gbit/s to be produced at low cost per unit are required. To this extent, the CMOS-compatible silicon-on-insulator (SOI) photonic integration platform offers the required reduction of size, weight, and power consumption as well as possibility of reduced fabrication costs. Here, we present a simple technique for generating a broadband mm-wave single-sideband (SSB) modulated optical carrier starting from a lower RF frequency using a distributed feedback resonator (DFBR) optical filter realized in SOI technology [2].

The operation scheme of the proposed photonic integrated circuit (PIC) is reported in Figure 1(a). An optical phase modulator (PM) is driven by an RF signal obtained by upconverting the output of a data generator (DG) at a local oscillator (LO) frequency f_{LO}, which is a submultiple of the desired wireless RF frequency. Next, the DFBR selects a high-order sideband from the phase-modulated optical spectrum. A replica of the laser carrier is then reinserted before PIC output with optimized amplitude level through a variable optical attenuator (VOA). In a concept demonstration, the DFBR alone has been tested and off-chip carrier reinsertion has been employed. A micrograph of the fabricated device is shown in Figure 1(b). In the experiment, a 2 Gbit/s ASK data signal at f_{LO} = 20 GHz is employed and the 3rd-order lower-wavelength sideband at PM output is filtered by the DFBR for generating a 60 GHz SSB-modulated signal after carrier reinsertion. The optical spectra at different stages of the scheme are reported in Figure 2(c), where the transmission of the DFBR filter is also illustrated, and the eye diagrams of the photo-detected filtered sideband at DFBR output and after transmission over 60 Km of single mode fiber (SMF) are shown in Figure 1(d).



(b) (c) (d)

Figure 1. (a): Operation scheme; (b): micrograph of fabricated 3rd-order DFBR; (c): optical spectra at different circuit stages; (d): 2 Gbit/s eye diagrams at DFBR output and after 60 Km fiber transmission.

Acknowledgments

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References

[1] D. Novak, *et al*., "Radio-Over-Fiber Technologies for Emerging Wireless Systems," IEEE J. Quantum Electron., **52**, 1, pp. 1-11, Jan. 2016.
[2] C. Porzi, G. J. Sharp, M. Sorel and A. Bogoni, "Silicon Photonics High-Order Distributed Feedback Resonators Filters," IEEE J. Quantum Electron., **56**, 1, pp. 1-9, Feb. 2020.