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[illegible] We propose and experimentally demonstrate a simple and cost-effective bi-directional radio-over-fiber (RoF) system for simultaneous transmission of downstream baseband, microwave (MW) and millimetre-wave (MMW) signals based on a single-drive Mach-Zehnder modulator (MZM). Upstream data transmission is realized by re-modulation of the downstream signals.

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Multiband optical transmission technology enables flexible applications in future access networks, where save light sources at the BS, we use a pass-band filter to filter out the baseband and the right band of the MW signal, to generate a frequency shifting keying (FSK) signal, which is on-off keying (OOK) re-modulated by upstream data.

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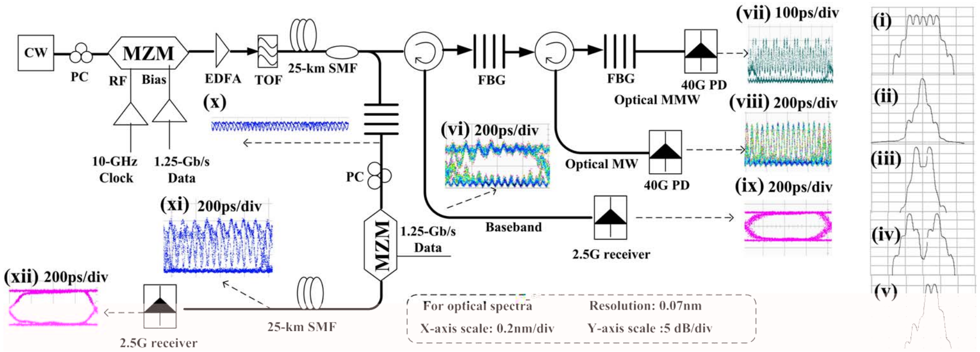

Fig. 3 Experimental setup and results.

To verify the proposed scheme, we perform an experiment with its setup depicted in Fig. 3. At the CS, a CW light from a tunable laser at 1550.99 nm is fed into a single-drive MZM. The MZM is driven by a 10-GHz clock at the RF port and a 1.25-Gbps pseudorandom bit sequence (PRBS) data with a word length of 2^{31}-1 at the bias port. The output of the MZM (inset (i) of Fig. 3), consisting of baseband, 20-GHz MW and 40-GHz MMW, is amplified to reach a power level of 6 dBm using an erbium-doped fiber amplifier (EDFA). After the transmission of 25-km standard single-mode fiber (SMF), at the BS, the signal is separated by a fiber Bragg grating (FBG) with a 3-dB bandwidth of 0.106 nm and a reflection ration of 90%. The baseband signal is reflected and its spectrum and optical eye diagram are shown in insets (ii) and (vi) of Fig. 3. The passing signals are injected into a second FBG with a 3-dB bandwidth of 0.203 nm and a reflection ratio of 96% to separate the MW and MMW signals, whose spectra are provided in insets (iii) and (iv) of Fig. 3, respectively. The baseband signal is detected by a 2.5-GHz photo-detector (PD) and inset (ix) of Fig. 3 depicts the recovered electrical eye diagram. A 40-GHz PD is used to receive the MW and MMW signals respectively and their electrical eye diagrams are shown in insets (vii) and (viii) of Fig. 3, respectively. A part of the multiband signal is tapped by a 50:50 optical coupler and filtered by an FBG to generate a FSK signal, whose spectrum and optical eye diagram are provided in insets (v) and (x) of Fig. 3. After passing through a polarization controller (PC), the generated FSK signal is OOK re-modulated using a MZM driven by a 1.25-Gbps upstream data with a PRBS length of 2^{31}-1. After transmission through 25-km SMF, at the CS, the upstream data is detected by a 2.5-GHz receiver, insets (xi) and (xii) of Fig. 3 show its optical and electrical eye diagrams, respectively.

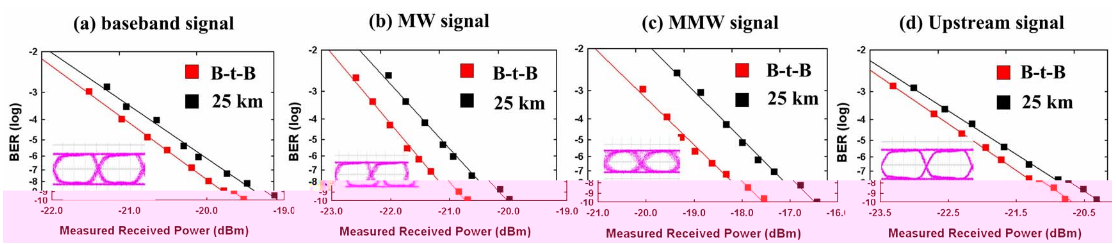

Fig. 4 BER performances and electrical eye diagrams.

The BER performances and electrical eye diagrams of the downstream multiband signals and upstream data are shown in Fig. 4. Error-free performances are achieved for all the data.

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We have proposed a simple, cost-effective and scalable RoF architecture and experiments verify that our scheme could be a desirable candidate for future wireline and wireless converged networks. This work was supported by the 863 High-Tech program (2009AA01Z257).

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