RF Power-Fading Mitigation using Optical mm-Wave Signal Generated by Silicon-Ring Modulator in Long-reach Radio-over-Fiber (ROF) Systems

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Abstract : Recently, the merging of passive optical network (PON) and radio-over-fiber (ROF) access network has received more attention, since it is expected to provide broadband and flexible Internet services for both mobile and fixed users in a single platform. Besides, long-reach PON (LR-PON) has been proposed for combining the separate metro and access networks into a single system to reduce network cost and power consumption. It is believed that the integration of the LR-PON and the LR-ROF can further reduce the cost by sharing the same optical components and extending the ROF network coverage. However, the transmission of optical millimeter-wave (mm-wave) signal in the LR-PON is challenging. When the optical mm-wave signal is transmitting in an optical fiber, chromatic dispersion causes a differential delay to be added to the sidebands and the carrier, causing length dependent power fading effect and code time-shifting.

In this work, we propose and demonstrate a LR-ROF signal transmission using single sideband (SSB) optical mm-wave signal generated by a silicon microring modulator. The silicon modulator provides the advantages of low power consumption and compact size. Besides, a unique feature of the silicon microring modulator is that it only modulates the signal wavelength in the resonant null, thus allowing it to encode data on only one of the sidebands of the optical signal in the generation of optical SSB mm-wave signal. Analysis is performed showing the SSB optical mm-wave outperforms the double-sideband (DSB) and optical carrier suppression (OCS) optical mm-wave signals. Error free 100 km single mode fiber (SMF) transmission is achieved experimentally.