Integrated Photonic Front Ends for Short-Range Mobile THz Communications

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In the recent decade, photonic assisted THz wireless systems have been attracting more and more attention to satisfying the explosively increased demand of high-capacity wireless communications. Various approaches have been demonstrated for fixed point-to-point wireless communications in the THz domain [1]. To enable mobile THz communications, beam steering is necessarily required. In our previous work [2], we reported on a photonic assisted integrated InP-based THz leaky-wave antenna (LWA) for 1-D THz beam steering, an approach that does not require any complex phase shifters or true time delay for beam steering. In this work, we demonstrate photonic assisted front ends for mobile THz communications using the InP LWA.

The advantage of using THz frequencies for short-range wireless communications is the enormously available bandwidth in the THz domain which supports wireless scenarios requiring a high capacity (Fig. 1). In [3], we already reported on a photonic assisted 100 Gbit/s V-band wireless system. By utilizing optical heterodyne up-conversion in the front ends and envelope detection by Schottky barrier diodes (SBD), we demonstrated the system's robustness against carrier frequency drift [3]. In this work, we report on a photonic assisted mobile 0.3 THz system. The system is also insensitive against the carrier frequency drift, and thanks to our InP-based THz LWA, it furthermore provides beam steering. To our knowledge, this is the first demonstration of a photonic assisted mobile THz communication system featuring beam steering technique. In our system set-up, the intermediate frequency orthogonal frequency-division multiplexing (IF-OFDM) waveforms are generated by an arbitrary waveform generator (AWG). Using a Mach-Zehnder modulator (MZM), the waveforms are then modulated on an optical carrier. After the IF-over-fiber transmission, the IF-signal is upconverted to THz domain in the front ends by optical heterodyning using an unlocked free-running LO laser and a UTC-PD with an InP-based THz LWA. The directive THz beam generated by the LWA is steered by the wireless carrier frequency which in turn is controlled by the wavelength of the LO laser in the THz front ends. The THz receiver consists of a horn antenna, a low noise amplifier (LNA) and THz SBD. Referring to experiments, the THz wireless receiver is mounted on a goniometer to study the beam steering performances.

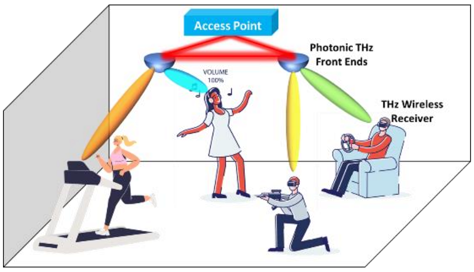

Figure 1. Conceptual scenario of indoor mobile THz communications using photonic front ends.

Experimentally, the developed THz front ends support a bandwidth of 10 GHz and 4-QAM-OFDM modulation. The overall beam steering range covers a sector of 33°. For each angle, the measured BER is lower than 2.2×10^{-3}. Considering 7% overhead and hard decision forward error correction (FEC), an error free data transmission of 20 Gbit/s is achieved. The experiment is carried out at short-range of 6 cm. Longer distance of THz communications up to 32 cm will be shown at the conference.

References

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