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Consideration on duplexing schemes for THz radio systems

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High-speed wireless transmission connecting vehicles and roadsides should be implemented in future smart transport systems. One of promising transmission media is THz radio which covers linearly shaped areas along main roads or highways. In conventional radio systems, FDD (frequency division duplex) or TDD (time division duplex) is commonly used for full-duplex protocol-based data transfer. However, performance of high-speed switches for TDD and filters for FDD would be limited in sub-THz bands. Combination of time domain switches and frequency domain filters would suppress crosstalk between transmission and received signals. We can also use polarization multiplexing to ensure signal separation. Space domain beam separation would be also useful when transmission distance is not so longer than the far field condition of the antennas used in the transmission. Crosstalk suppression in polarization/space domain duplexing or multiplexing depends on scattering due to surrounding objects, misalignment of antennas and raindrops.

Outdoor THz radio units equipped with weather condition loggers have been developed for long-term evaluation of impact of weather conditions on THz transmission. The outdoor radio units aggregate two IEEE 802.15.3e signals, upconverting them into a 300GHz TDD signal [1, 2]. V-band IF signals in two 802.15.3e channels (channels 2 and 3), whose center frequencies are 60.48GHz and 62.64GHz, are upconverted into channels 16 and 17 of IEEE 802.15.3d. The center frequencies are 286.20GHz and 288.36GHz. For TDD duplex operation, 300GHz power amplifiers and mixers are linked to two V-band modems. All system components are enclosed in a waterproof box. An antenna facilitates transmission and reception through a coupler with a band-pass filter. The output power at 300GHz is approximately 0dBm, with an antenna gain of 40dBi. A pair of outdoor radio units are installed on motor-controlled platforms, enabling automatic alignment. By changing LO frequencies, a combination of TDD and FDD can be configured for further evaluation on various duplexing schemes.

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1. T. Kawanishi, S. Hisatake, ThoR. In: T. Kürner, D. M. Mittleman, T. Nagatsuma (eds), THz Communications. Springer Series in Optical Sciences, vol 234. Springer, Cham. (2022).
2. ThoR Deliverables D2.2 Overall System Design