Interference Mitigation for 5G Millimeter Wave Communication Links

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There is growing interest in developing 5G communication links at the millimeter wave bands of 27.5 – 28.35 GHz, 37 – 38.6 GHz, 38.6 – 40 GHz, and in the unlicensed band of 64 – 71 GHz. Additionally, there is concurrent interest for secure, high data rate and long-range transmissions. Towards this goal, it is desirable to integrate ultra-wideband (UWB) techniques, and employ longer spreading codes to achieve higher throughput and interference mitigation. Such integrations require UWB RF back-ends and high-speed Analog-to-Digital (ADC) and Digital to Analog (DAC) Converters. Further, to overcome propagation losses, high gain millimeter wave antenna arrays are desirable.

To address the above goals, we propose a high data rate system that can operate across an instantaneous bandwidth of 10 GHz. To do so, we introduce multiple coding stages. More specifically, we propose a hybrid channel coding and a code division multiplexing (CDM) technique to achieve up to 40 dB of combined gain by minimizing Signal-to-Noise (S/N) degradation. We also propose a signal channelization process using many individual channels/bands, each spanning the spread bandwidth. This is achieved by up-converting the signals to different frequencies (channels) using a set of local oscillators (LO). At the front-end, these signals are amplified, and frequency multiplexed into a single ultra-wideband (UWB) signal for transmission.

In this presentation, in the paper we will demonstrate a high data rate secure communication system that exploits digital back-ends, spread spectrum coding techniques and ultra wideband hardware. Specifically, we will provide details of the design and measurements to assess the impact of Code Division Multiplexing (CDM) techniques under various interference scenarios using Gold code sequences. The employed test set-up configuration included multiple users sharing a single channel with and without interference. Using these tests, we examined the trade-offs of using different set of codes in presence of a number of simultaneous users. The presented results examine signal degradation in presence of intentional and unintentional interference.

At the conference we will present comparative measurement data of our developed experimental hardware setup that realized the proposed wideband communication link. Specifically, Bit-Error-Rate (BER) improvements, processing gain and interference margin data will be presented. For the latter, we show a processing gain of 16 dB in the Over-the-Air (OTA) transmission in presence is achieved in presence of a single high-power interferer.