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The beam alignment problem in THz wireless networks

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Terahertz (THz)-band communications are a key enabler for ultrahigh bandwidth and ultralow latency communication paradigms. When integrated with other THz-band applications, such as localization, sensing, and imaging, THz technologies may lead to the deployment of intelligent wireless communication systems. However, communications at THz are quite challenging due to the severe attenuation of signal power caused by high diffraction and penetration losses, as well as atmospheric absorption. To compensate for the severe path loss, high-directional beamforming with large antenna gains both at the transmitter and at the receiver is mandatory. Designing such a highly directional beamforming requires an initial beam alignment procedure prior to data transmission, in order to maintain a desired signal-to-noise ratio (SNR) level. However, fast and accurate acquisition of beam directions is quite challenging for THz-band communications due to the very low SNR available before properly aligning the beams with the dominant signal propagation paths. In this paper, we develop a receiver-assisted beam-alignment algorithm by which the receiver and the transmitter collaborate to identify the angle-of-arrivals and angle-of-departures associated with the strongest paths of the THz channel.

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