

60 GHz Spatial Radio Transmission: Multiplexing or Beamforming?

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Abstract:

This TD reports a comparison of channel capacity improvement for spatial multiplexing and beamforming techniques for 60 GHz spatial transmissions in a multi-carrier radio system such as orthogonal frequency division multiplexing. The term beamforming in this TD refers to the conventional gain focusing, for the strongest propagation path, by narrow antenna beams. Our channel capacity metric depends only on the multipath richness of the propagation channel and the antenna aperture size, but is otherwise independent of the realization of antenna elements on the aperture. Our analysis also reveals the spatial degrees-of-freedom (SDoF) of the radio channel, which is the maximum number of antenna elements on the aperture for efficient spatial multiplexing. We evaluate the capacity and SDoF of single-polarized 60 GHz radio channels measured in a conference room environment. Our results show that the radio channel offers multiple SDoF even in line-of-sight (LOS) scenarios such that spatial multiplexing can improve the channel capacity. However, spatial multiplexing outperforms beamforming only rarely in LOS scenarios. Furthermore, if the LOS is blocked the SNR is insufficient to exploit the multiple SDoF. In such a case, recovery of the receive SNR is more beneficial to improve capacity, and therefore, beamforming is more robust than spatial multiplexing.