Leveraging Machine Learning and Sensor Fusion Systems in Distributed Networks of mm-Wave Phased Array APs

Jacob A. Freking, Joshua T. Ruff*, Daniel G. Carey, Vincent V. Nguyen,
Jean-Francois Chamberland, and Gregory H. Huff
Texas A&M University, College Station, TX 77843

E-Band communication and sensing systems are poised to enter industrial application spaces and consumer markets, and they are expected to emerge as a game-changing wireless communication technology. These millimeter-wave (mm-wave) systems will be used in access points (APs) for edge computing networks in high data rate applications using line-of-sight (LOS) wireless communication links. The development of mm-wave phased arrays for these systems is critical because of the limited signal bounce and increased attenuation and shadowing these systems will incur when compared to lower frequency bands. These constraints are imposed on the system by the physical interaction of the waves with the local electromagnetic (EM) environments, and they point to high-density distributed deployment strategies for APs used jointly with new networking protocols, access schemes, and other innovative approaches implemented at the media access and control (MAC) and physical (PHY) layers. These may involve multi-band systems for adaptive spectral allocation, providing a linkage to network-driven resource allocation strategies, and other more exotic coding and interference techniques, but it is likely that any scheme will need to leverage the localization, tracking, and handoff capabilities that care required by the mm-wave phased array system. This includes the ability to detect and deploy resources based on user actions, network connectivity scheme, and interactions within the local EM environment since it can impact wave propagation and the communication link. This work reports on the use of machine learning techniques and sensor fusion in these mm-wave systems. This includes experiments investigating beamforming, tracking, and handoff using a 60 GHz prototype system.