Building mmWave Wireless Systems

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**Significant Interest in mmWave**

- 50 billion connected devices
- 1000x increase in required bandwidth

**Too Many Devices, Too Little Spectrum**

mmWave frequency bands offer multi-GHz of unlicensed bandwidth

Significant interest in performing research on mmWave communications

**Problem**

Absence of any mmWave radio platforms with phased arrays in the networking community

**MiRa: Millimeter Wave Radio Platform**

- Built a mmWave phased array radio operating in the 24GHz ISM band
- Operates as a daughterboard for the USRP software radio

**MiRa’s Performance**

MiRa enables long-range and high-data-rate communication using phased arrays

MiRa delivers up to 256 QAM modulation and operates at distances that exceed 100 meters

**MiRa’s MU-MIMO**

MiRa enables all USRP-GNU functions to be performed in mmWave frequencies

- Example: coordinate multiple USRPs with a shared clock to act as a MIMO device

- MiRa’s MU-MIMO increases the network throughput by an average of 1.6x

**Research Opportunities**

**Application 1: 5G, 802.11ad**

Challenge: mmWave radios use highly directional antennas

How to find the best beam alignment quickly?

**Application 2: Virtual Reality**

Challenge: Line-of-sight can be blocked by obstacles

How to enable high data rate in the case of a blockage?