



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



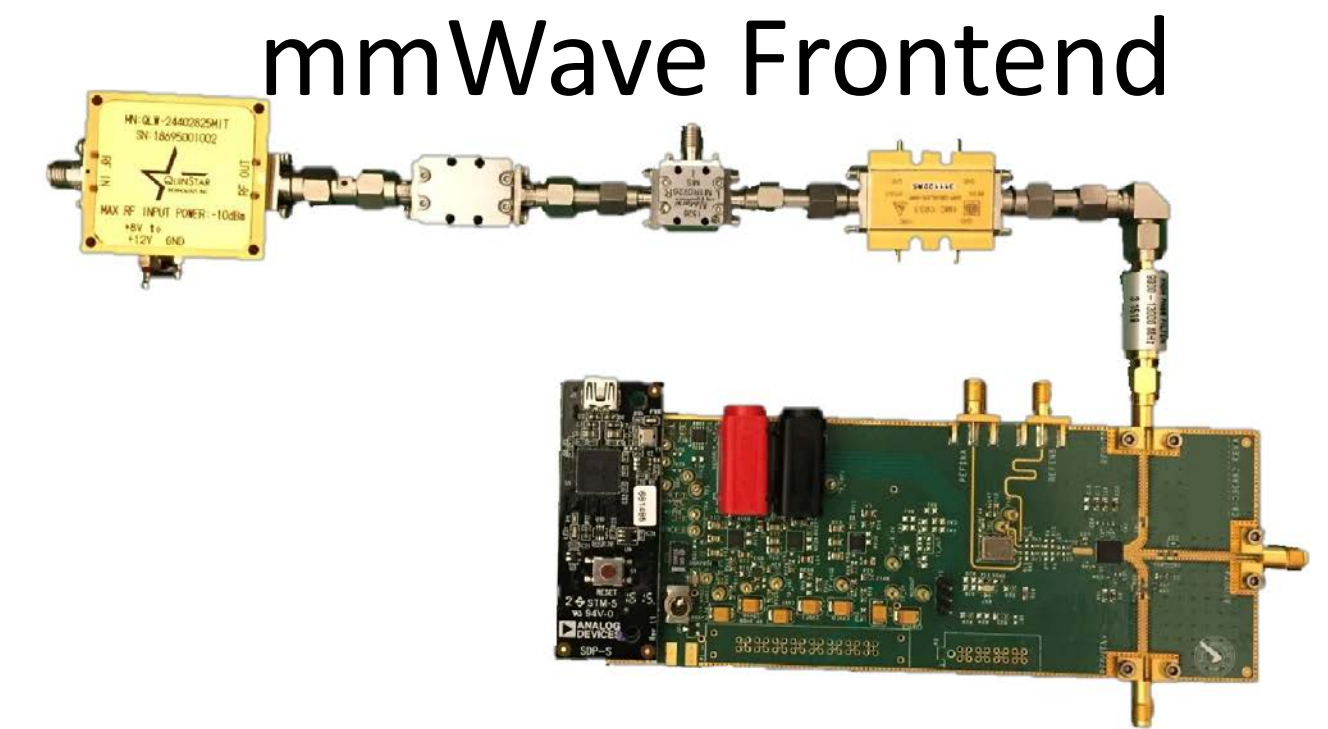
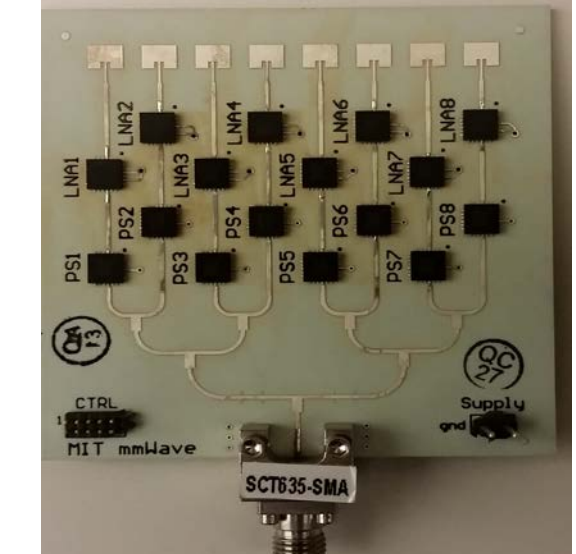
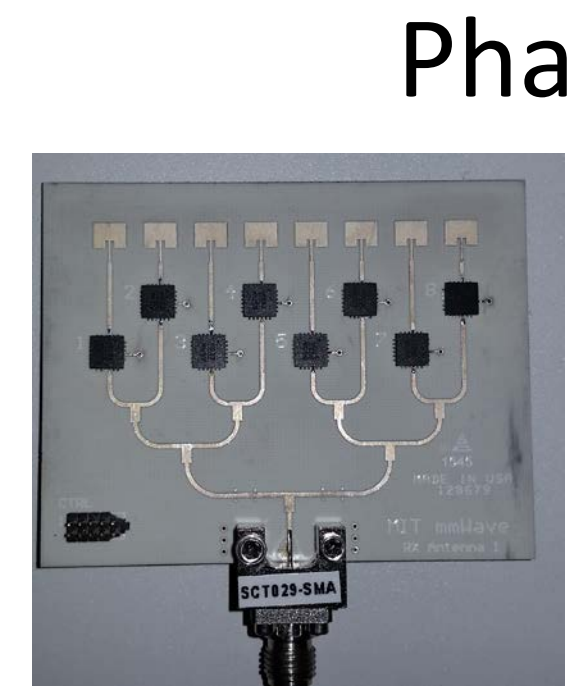
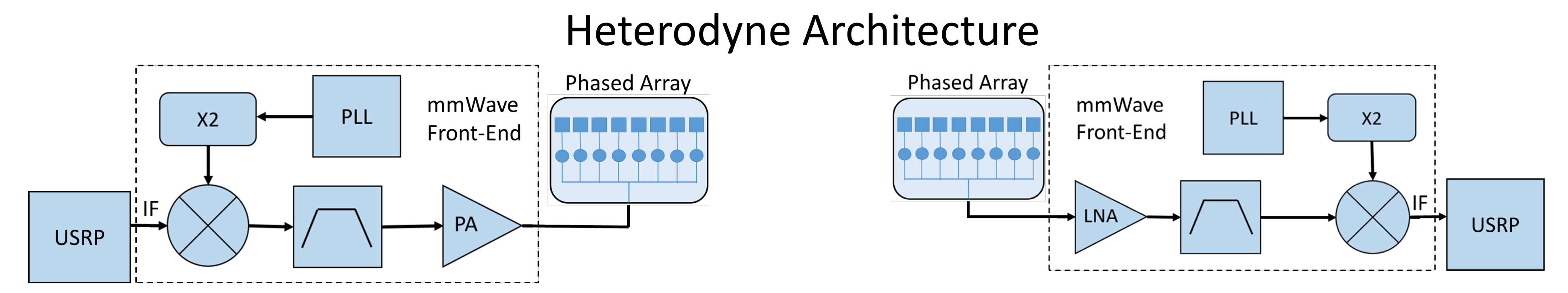
Significant interest in performing research on mmWave communications

Problem

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

MiRa: Millimeter Wave Radio Platform

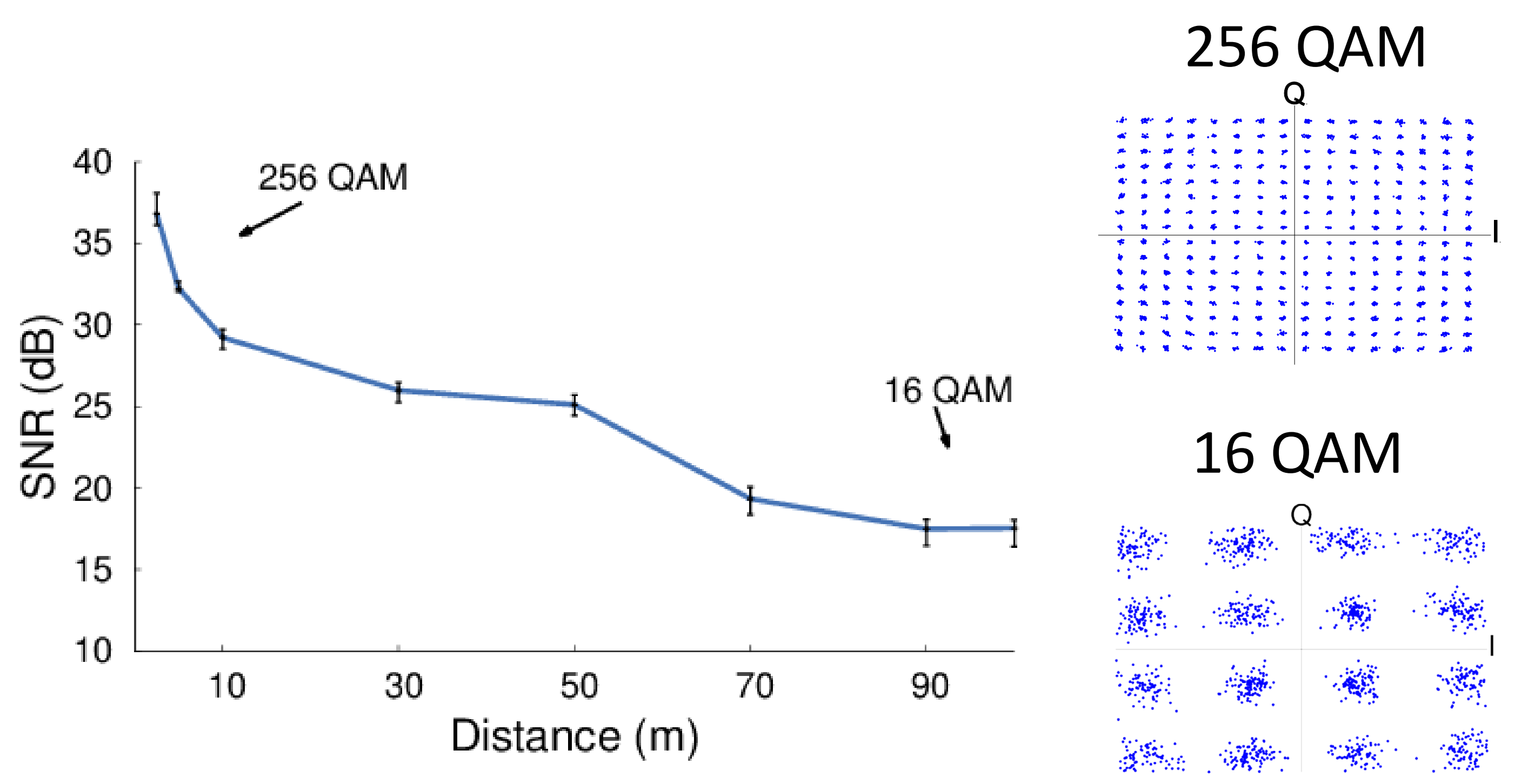
Built a mmWave phased array radio operating in the 24GHz ISM band



Operates as a daughterboard for the USRP software radio

MiRa's Performance

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

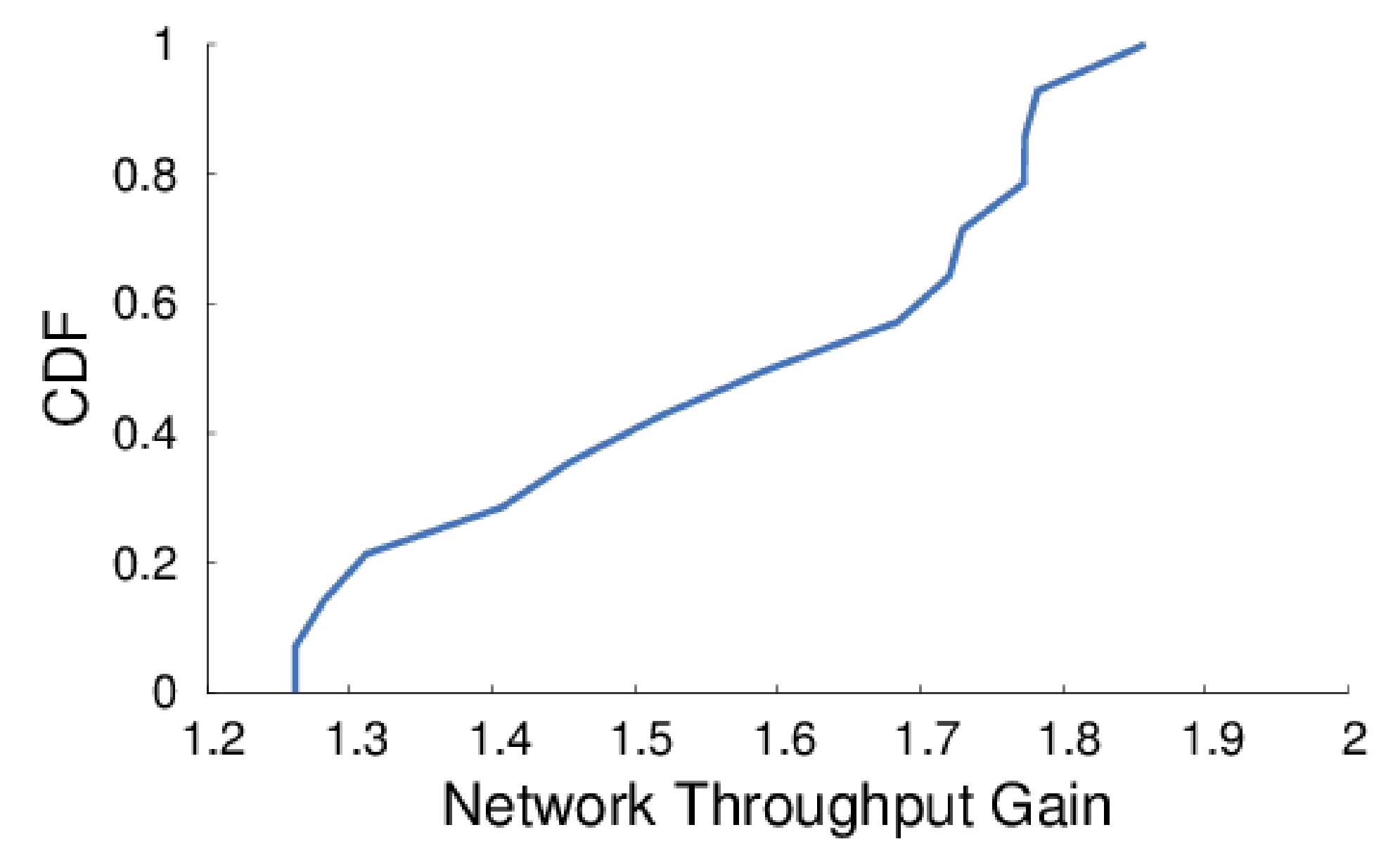


MiRa delivers up to 256 QAM modulation and operates at distances that exceed 100 meters

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

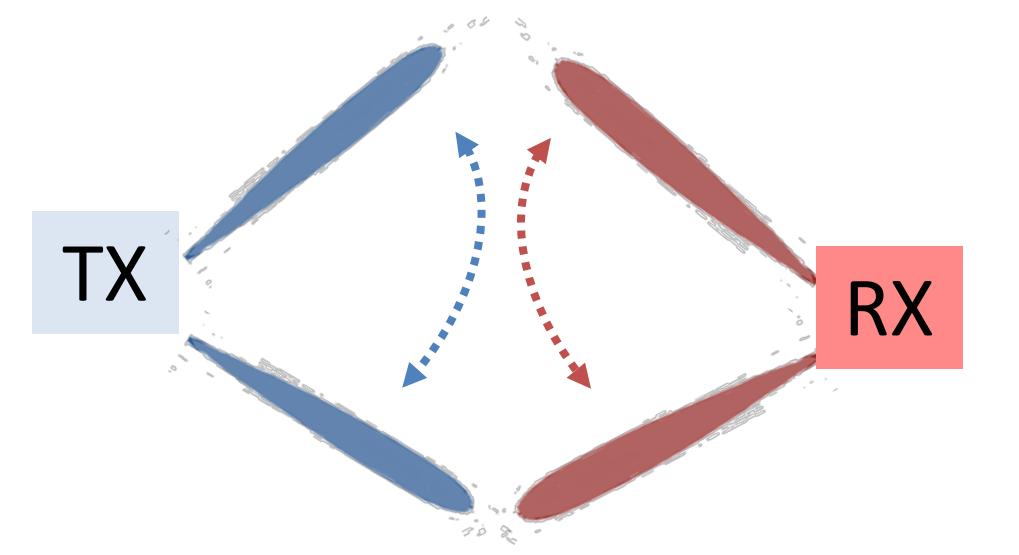


MiRa's MU-MIMO increases the network throughput by an average of 1.6x

Research Opportunities

Application 1: 5G, 802.11ad

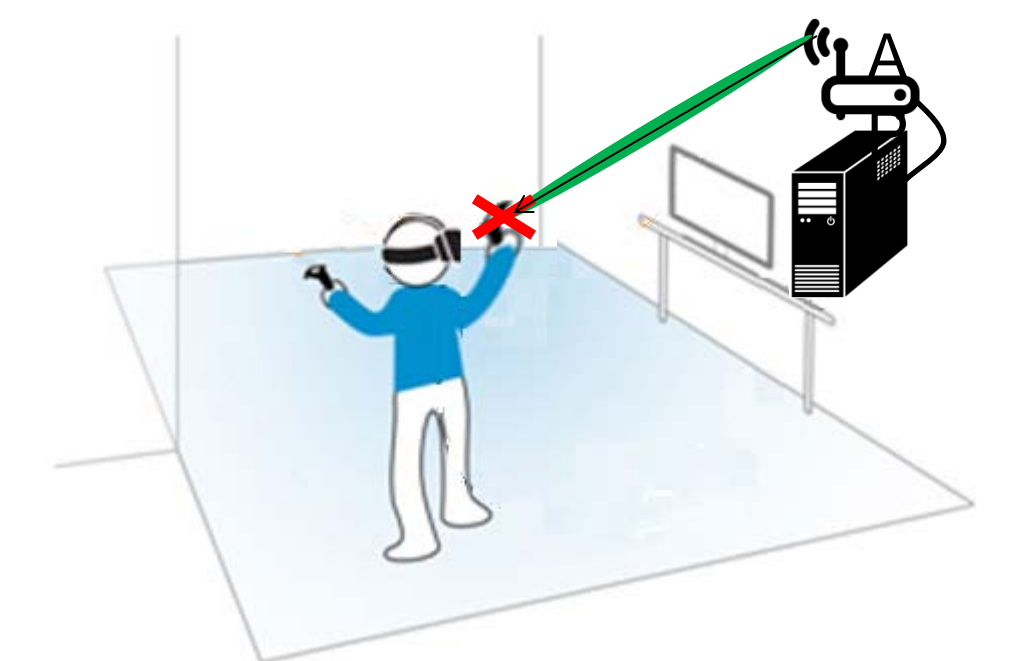
Challenge: mmWave radios use highly directional antennas



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?