Demo: Experimentation with Mobile 28 GHz Phased Array Antenna Modules

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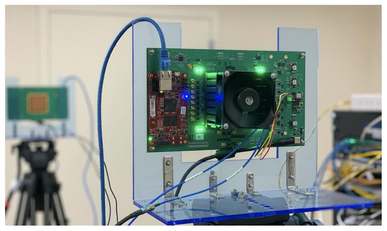
Abstract

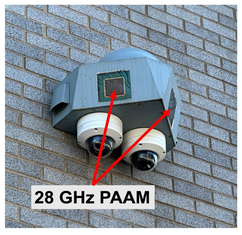
- Massive MIMO has the potential to support demands of next generation networks and emerging applications such as V2V/V2X communication and augmented reality.
- Millimeter-Wave (mmWave) frequencies allow for larger bandwidth as well as compact form factor of antenna arrays with many elements.
- The COSMOS testbed has deployed indoor and outdoor 28GHz phased array antenna modules (PAAMs) to support experimentation with these emerging technologies.
- Mobile PAAMs have been developed to enable experimentation anywhere and with mobility.

NSF PAWR COSMOS Testbed

- FCC innovation zone. Allows for outdoor wireless experimentation without the need for an experimental license by the FCC [1-2].

- Open programmable platform in NYC that enables researchers to evaluate Beyond-5G wireless systems [3-4].
- Emphasis on low latency applications and mmWave technology

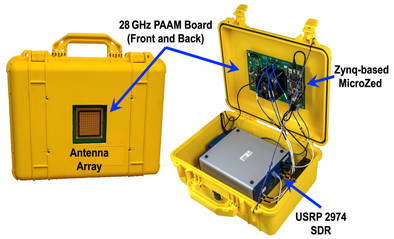




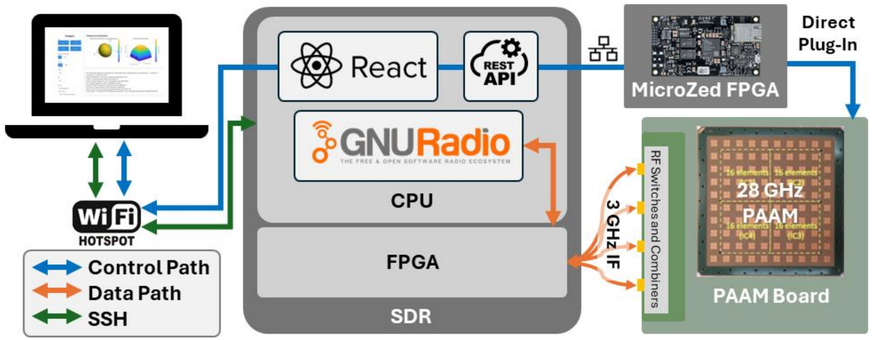
- Deployments in the indoor “sandbox” environment allows for rapid development.
- Outdoor deployments allow for real world experimentation and evaluation.

The Mobile PAAM

- The mobile PAAM consists of a USRP-2974 software defined radio (SDR) and a 28GHz phased array antenna front end developed by IBM research.
- The USRP-2974 SDR contains an on-board CPU which is utilized to perform control of the antenna array in addition to utilizing the FPGA for baseband signal processing.
- Configuration of PAAM settings are done via calls to a REST API service.

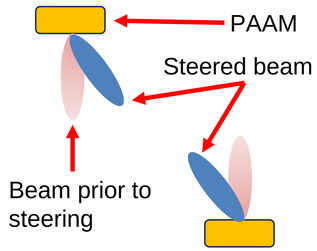


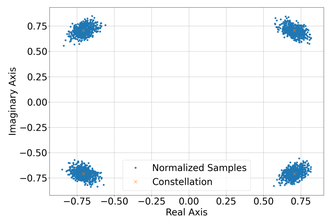
- The antenna front end contains 64-elements and is capable of massive MIMO.
- A Mi-Fi hotspot is used to ssh into the on-board CPU of the SDR. From there, processing and control scripts can be run.

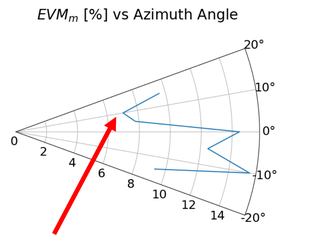


Demo

- We form a link utilizing two mobile PAAMs. GNURadio, an open-source signal processing framework, is used to perform baseband processing of the 10MHz OFDM signal with QPSK data carriers.
- Initially, the PAAMs are unaligned. We electronically steer the beams to align them and observe the EVM has improved.
- We demonstrate a GUI to enable easy configuration of the PAAM settings.







Minimum EVM when beams are aligned

Example Use Cases

- We utilize the mobile PAAMs to emulate a 5G base station (BS) and investigate the effect of 5G transmissions on existing passive weather sensors. See our poster, “28 GHz Phased Array Interference Measurements and Modeling for a NOAA Microwave Radiometer in Manhattan.”
- Mobile PAAMs are used to emulate 5G BS’s and user equipment in “Wall-Street: Smart Surface-Enabled 5G mmWave for Roadside Networking.” See corresponding demo: “Demo: Metasurface-Enabled NextG mmWave for Roadside Networking.”

PAAM Tutorials via COSMOS

- Go to the https://www.cosmos-lab.org/ and register under “Portal” or scan the QR code below.
- Read the wiki (https://wiki.cosmos-lab.org/wiki) while awaiting account approval.
- Once approved, follow tutorials at https://wiki.cosmos-lab.org/wiki/Tutorials#SDRandWireless
  There are tutorials for use of indoor PAAMs and mobile PAAMs.
- Last step, design, develop, and execute your experiment.

References

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[6] Cho, Kun Woo, et al. "Wall-Street: Smart Surface-Enabled 5G mmWave for Roadside Networking." arXiv preprint arXiv:2405.06754 2024.

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