Existing Technologies Consideration

Date: 2024-01-02

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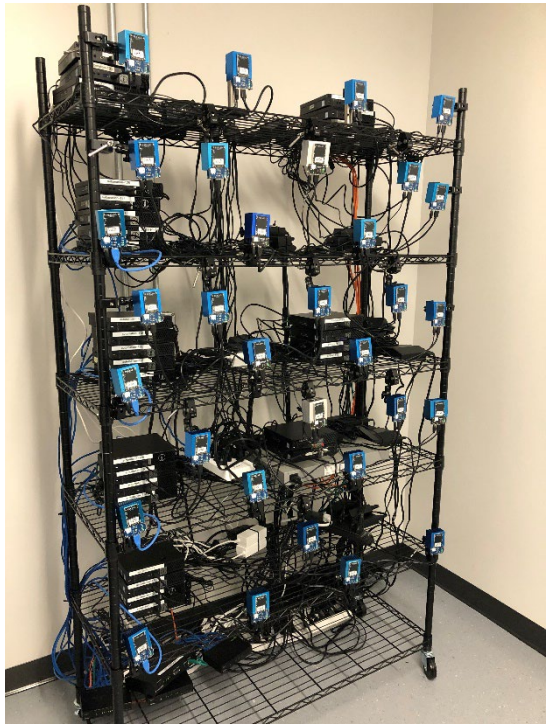
Abstract

- **IMMW SG can be viewed as a renewed purpose for 60 GHz spectrum.**
- **There's a strong desire to leverage existing MAC/PHY from sub-7 GHz.**
- **Renewed interest in 60 GHz is greatly appreciated!**
- **From November's Plenary, there was much discussion of what we think was wrong with 11ad/11ay. However, there is a growing number of devices deployed around the world.**
  - This is evidence we got at least some things right.
- **In defining a new TG we must consider what *does* work with mmWave.**
- **Our roadmap here should include both interoperability and lessons learned.**

“The reports of my death are greatly exaggerated.” – *Mark Twain*

Existing Applications: Point-to-Point (PtP) and Point-to-Multipoint (PtMP) Networking



- **Largest application space for products based on IEEE 802.11ad**
  - Many deployments around the world.
- **Multi-gigabit last mile connectivity at a much lower cost than copper or fiber**
- **Requires *both*:**
  - Extremely high throughput (AP, PtP backhaul)
  - Low throughput (dense networks, low-cost CPEs)
- **Long range is critical: fewer APs, larger coverage, lower costs**

PtP, PtMP Networking: Things We Got Right

- **Directivity at 60 GHz. Benefits of channels 5, 6.**
  - Deployments exist for ranges from 30 km (backhaul, repeater) down to less than 100 m (last mile and CPE applications).
  - Higher directivity increases spatial reuse. Adaptive features maximize parallel transmission between multiple BSSs in dense networks.
  - Directivity is the balance to pathloss. Channels 5, 6 are awesome at longer distances even with relatively small antennas.
- **Beamforming**
  - Higher directivity means training beams. Trading off coverage for gain also means training beams.
  - Bi-directional BRP lets us resolve beams quickly. Very useful for changing conditions, where “conditions” also includes interference, multipath, and many other factors.

PtP, PtMP Networking: Things We Got Right, Things to Consider

- **More *and* Less throughput**
  - APs, being an aggregation point, generally need to use as much bandwidth as the medium will allow.
  - In general, bigger pipes mean smaller bursts of traffic will count more. This is especially useful in dense networks. It's one way we avoid contention.
  - ½ and ¼ bandwidth modes are very useful for dense networks. (Not part of .11ad/.11ay but worthy of future consideration).
  - North America: Market demand is for >1 Gb links.
  - The rest of the world: Market demand is for lower throughput links. Density and deployment cost (simplicity) are key factors.
    - Number of clients and spatial diversity are critical.

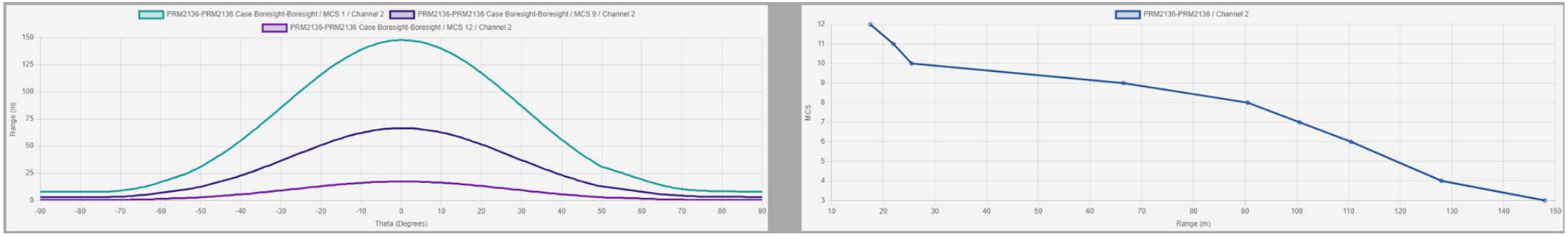
PtP, PtMP Networking: Things We Got Right, Things to Consider

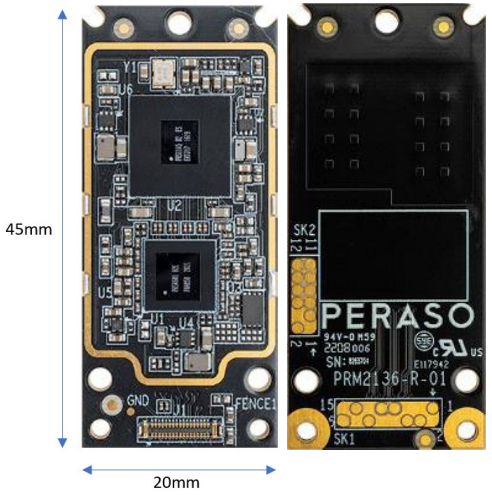
- **Simplicity of 11ad Single Carrier PHY**
  - Leads directly to cost savings.
  - < MCS 9 can employ transmitters in the non-linear region. (More EIRP, no predistortion required)
  - Great for maintaining connectivity, good throughput, and link reliability.
- **Reverse direction data transfer. Helps to reduce contention in networks with many STAs.**

Indoor Applications That Work

- The “Directive” part of DMG is crucial to indoor applications, even at short distances.
- The balance is coverage (how wide we can make a beam) versus range.
- In almost all indoor applications, and especially dynamic scenarios, rapid beamforming is critical to maintaining a good link.
- These applications often require high continuous throughput or bursty traffic.

Indoor Applications That Work [1]





- **29 dBm EIRP**
- **Polarization diversity with Horizontal and Vertically polarized arrays.**
  - Beamforming done across both arrays individually to find best link.
- **22 – 47° HPBW**
- **Up to 120˚steering range**

Indoor Applications That Work

- **Classroom/lecture hall projection.**
  - Bursty traffic. Longer ranges (to 20 m). Partially occluded STAs. Fast beamforming to adapt for STA movement. Power savings critical.
- **Fast sync for users entering/exiting vehicles.**
  - Huge bursts up and downlink for short periods. Short range. Quick connect/disconnect. Dynamic beamforming.
- **Wireless conference room.**
  - Multiple devices with steady stream of low- to high-throughput. Medium ranges (10-15m).
- **VR/XR [2].**
  - Extremely high beamforming rate. Constant medium to high downlink throughput. Ranges up to 20 m.

Things to Keep: Preamble, PHY Header Compatibility

- **The current 11ad/11ay preamble is the primary method of detection and interference mitigation.**
- **Coherent detection (as opposed to just Energy Detection (ED)) is used because**
  - Correlation based methods are more sensitive than ED when pulling packets out of the noise.
  - Coherent detection allows us to gain knowledge of other BSSs, improve interference mitigation, and improve spatial reuse.
- **We view this as an important requirement for backward compatibility, not to only rely on ED.**

References

[1] https://shop.richardsonrfpd.com/docs/rfpd/PRM2136X_brief.pdf

[2] https://xcom-labs.com/xcom-labs-demonstrates-wireless-xr-iitsec2022/