

# HW-CSP Interface: Hardware, Circuits, Antennas

Arun Natarajan (Oregon State), Michael Marcus (Virginia Tech)

Jeyanandh Paramesh (Carnegie Mellon)

# Device & System Issues

- **CMOS or SiGe or GaN:** Do we need SiGe or is CMOS sufficient at near or above 100 GHz? Does GaN have a meaningful role? With GaN we can get higher power per PA and therefore fewer elements, but this also means that the mean is broader.
- **Repeater/Relays for 5G:** Is it meaningful to explore simple analog repeaters for 5G? Does the repeater need the same functionality as a basestation, or can it have simpler hardware requirements? How do we get channel state information of the network including the relays?
- **Do new/emerging applications for mm-wave have specific hardware challenges?** E.g., radars for indoor sensing applications, cubeSATS etc. we may need lowest size or weight or power, but may not need very large numbers of elements.

# Antenna Issues -1

- **Antenna array design:** Every array design project becomes a new project because the antenna is different even if the rest of the hardware is not. Can we standardize the antenna geometry?
- Need better CAD tools for arrays, even though single antenna EM tools are mature.
- **Do new/emerging applications for mm-wave have specific hardware challenges?** E.g., radars for indoor sensing applications, cubeSATS etc. we may need lowest size or weight or power, but may not need very large numbers of elements.

# Antenna Issues -2

- In order to enable practical access to more than 26 GHz contiguous spectrum antennas with high suppression of high elevation sidelobes are needed to allow interference-free spectrum sharing with passive environmental/weather satellites
  - At some point can channel bonding be implemented as a cost effective alternative
  - Possible technologies:
    - quasioptical technology
    - MIMO variant with null on satellite (Az,El)
- **Thermal issues:** Currently, arrays are designed for -40 to 110 deg. C. Can this be relaxed? Unfortunately, thermal issues are not well understood during the system design and electronics development. We need better CAD tools that include thermal issues during electronic design (“thermal-aware” CAD flow)

# Antenna Issues -3

- **Packaging of large mm-wave phased arrays:** Packaging/integration yield is very poor. How to improve yield? Can commercial packaging houses handle the needs of mm-wave array packaging at 60 GHz and above? If not, how can we make changes? Can a one-size-fits-all packaging approach work for a huge frequency range from 28 GHz to 200 GHz?
- **Testing:** Testing is very expensive. How to reduce? Other test constraints: can't have large numbers of anechoic chambers, so is on-air testing the only viable option?