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Improving Sustainability of Mobile Broadband

by

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Mobile Broadband: Scorching Growth

- Has connected the unconnected
  - 800M in India, despite low per-capita GDP
  - Affordable
- At the same time, broadband speed has gone from 10s/100s Kbps in 2000 to 10s/100s Mbps today
- Energy consumption has been steady
  - A few kW per tower in 2000, mainly for air-conditioning
  - Similar power consumption level now, but for RF transmission

Moving towards Higher Sustainability

- Now that we have got rid of air-conditioning at the tower, can we lower energy consumption further?
- How can we reduce the embodied energy per life-year in the electronics and packaging?
  - reduce embodied energy or increase life
- A lot of the mobile connectivity is to data centers
  - where there is even more energy consumption, but we will focus today on the connectivity part

Reducing RF Power Consumption - I

- Focus useful RF power towards served users at any given time => Beamforming
  - Reduce radiation in unwanted directions
- However, the speed improvement due to MIMO comes from transmitting in “unwanted directions”
  - and harvesting the rich multipath reflections towards the receiver
- One challenge in 6G is to balance this trade-off in a win-win manner

Reducing RF Power Consumption - II

- OFDM allows us to mould the RF transmission in real-time to the RF channels between tower and various uswers
  - But OFDM requires PA backoff resulting in ~ 5-6 x transmit power wasted as heat in Pas
- Single-carrier modulation can overcome this
  - But cannot squeeze the same data rate into it
- Second challenge in 6G is to balance this trade-off in a win-win manner

Reducing Embodied Energy / Life-year

- Order-of-magnitude decadal improvement in electronics
  - Improved compute capability
  - Reduced power consumption in the ICs => lower thermal dissipation leading to lesser / no air-conditioning load
- However, full replacement of tower electronics every decade increases embodied energy / life-year
  - Life of electronics is at least x2, x3 but being discarded early in favour of better performance
- The standard needs to evolve such that at least a part of the electronics can be used over a 20-30 year lifetime
- Third challenge in 6G is to increase focus on this aspect just as we do for backward compatibility
- Same holds true for phones too – need to increase lifecycle of the phone!

Thank You