Massive Millimeter-wave MIMO for 100G Wireless
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Motivation
The Mobile Backhaul Problem

- High initial investment.
- High repair cost.
- Difficult to scale to multiscell.

The mmWave Spectrum

Feature-size

Massive MIMO for Wireless Backhaul

Massive mmWave MIMO to replace fiber-optics for flexible high-data-rate backbone links.

Massive MIMO requires novel mmWave Tx circuits and architectures with low-power TRx signal processing.

High-power, Efficient mmWave "Digital" MIMO Tx
Prior Work: Stacked mmWave CMOS Watt-Class PAs

- Stacked mmWave TXA
- Supply-adaptive biasing
- Tail transistor switching

Proposed mmWave Digital Massive MIMO Tx

- High-power Stacked Class-E-like power DAC.
- Digital Polar Tx Architecture.
- Switched-capacitor supply modulation for efficiency under back-off.
- Adaptive biasing to maintain Class-E operation.
- Tail transistor switching for high resolution.

Supply Adaptive Biasing

Adaptive biasing for stacked Class-E operation across supply voltages.

Hybrid mmWave Power DAC

High-resolution supply-modulated mmWave DAC with high back-off efficiency.

Cross-layer Aspects

Tx Preceding

1-bit uniform sampling makes channel estimation challenging.

MIMO Channel Estimation

Event-driven Massive MIMO Channel Estimation

Sequential Channel Estimator

- Exploit 1-bit sequence generated by level-triggered sampling.
- The approach lends itself to a low-power circuit implementation based on simple analog front-end processing.
- Asymptotically optimal sequential estimator with a novel sequential framework.
- Benefits over fixed-time approach include higher estimation accuracy and availability of early estimates.

Level-triggered Signal Processing*

Circuits for 1-bit level-triggered estimation is a topic for future research.

Extension to Multicell

- Pilot contamination occurs during channel estimation via pilot superposition.
- Pilot contamination is a major challenge in point-to-point massive MIMO as all channels use the same pilot.
- For multicast, pilot contamination can be resolved.

Multicell Multicast Network

New training scheme to resolve pilot contamination for multicast.