GreenMO: Enabling Virtualized, Sustainable Massive MIMO with just a Single RF Chain

WCSNG

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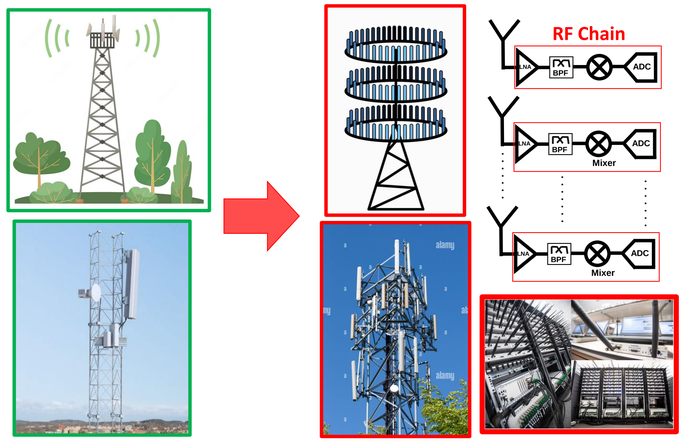
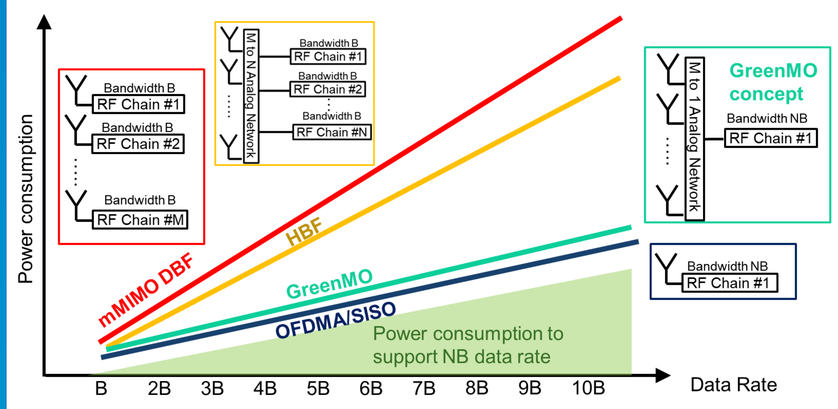
Motivation: Curse of Numbers



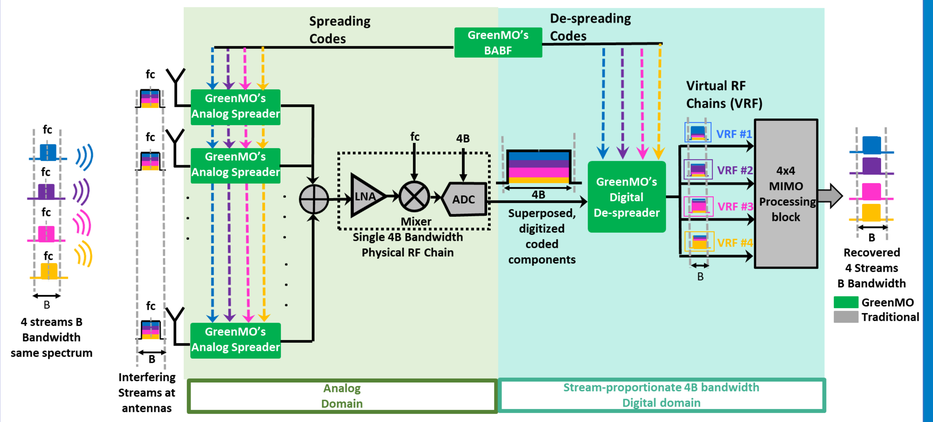
Traditional Massive MIMO needs one RF chain per-antenna, leads to massive antenna proportionate power consumption

GreenMO builds MIMO with just 1 RF Chain



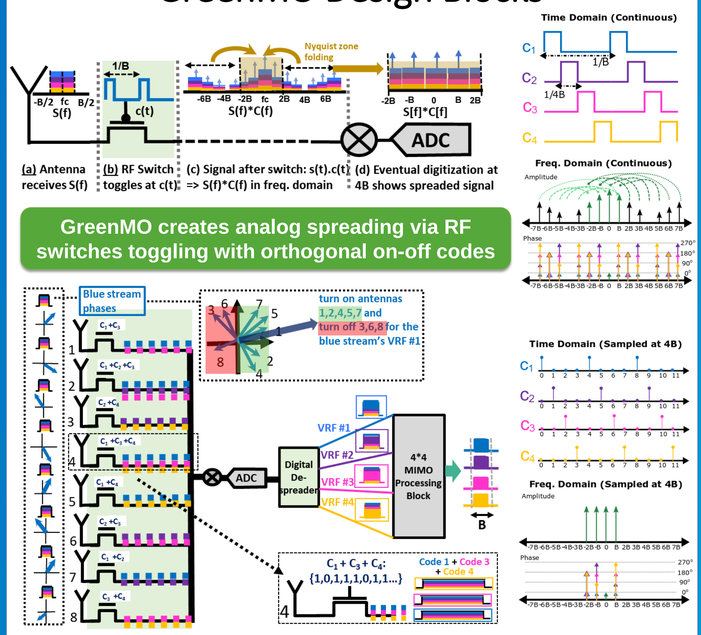
GreenMO key idea: N mMIMO spatial streams can be interfaced via a 'single' Nx bandwidth RF chain instead of N/M separate physical RF chains.

GreenMO Design Overview



GreenMO's analog spreader, digital de-spreader carve out multiple virtual RF chains (VRF) atop the single physical RF chain, BABF groups antennas strategically per VRF

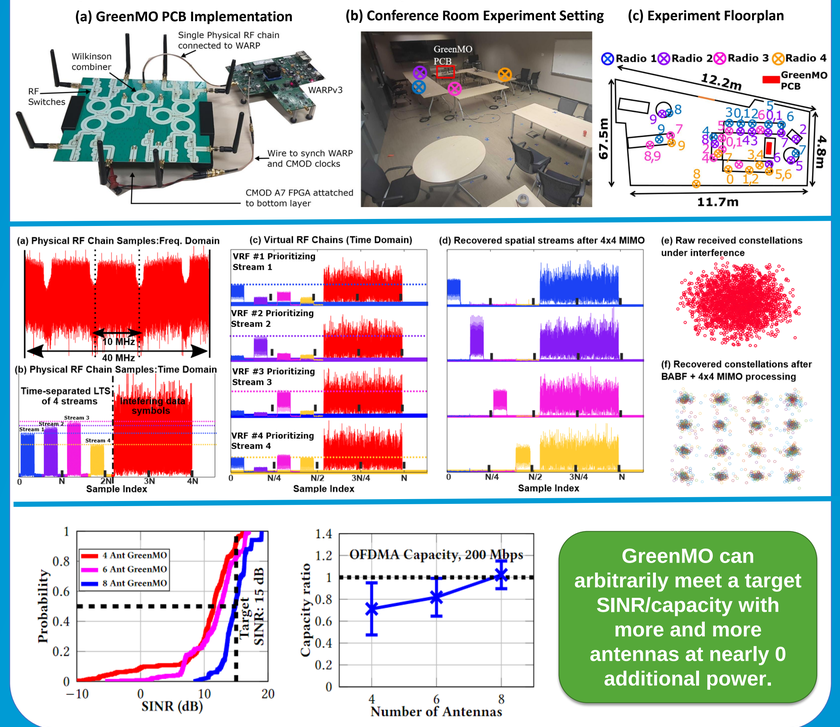
GreenMO Design Blocks



GreenMO creates analog spreading via RF switches toggling with orthogonal on-off codes

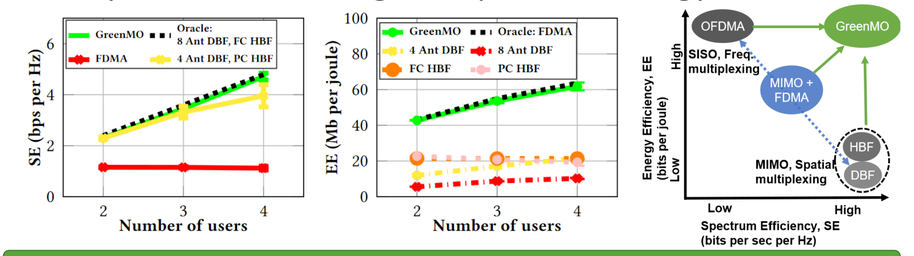
GreenMO's de-spreader splices the orthogonalized coded samples to create virtual RF chains (VRF). BABF beamforms selects maximally co-phased antennas for one stream per VRF

Implementation, Example Trace and Evaluations

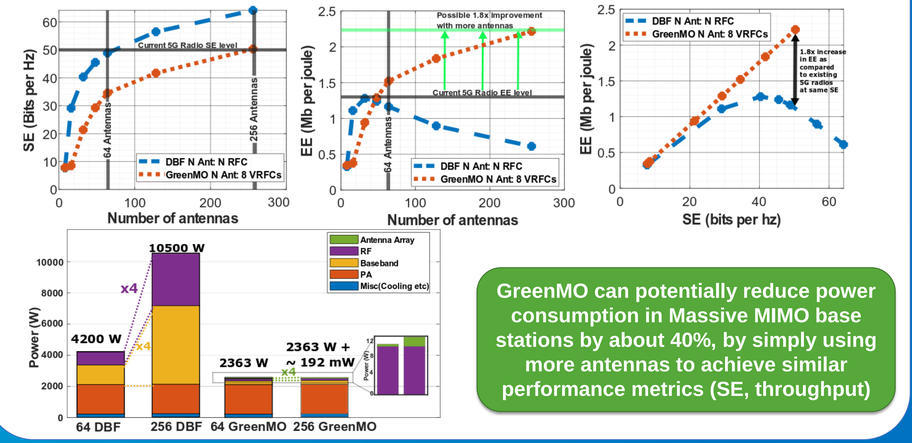


GreenMO can arbitrarily meet a target SINR/capacity with more and more antennas at nearly 0 additional power.

Key Result: Breaking the spectral-energy tradeoff



GreenMO meets both mMIMO Spectral Efficiency (SE) and FDMA Energy Efficiency (EE)



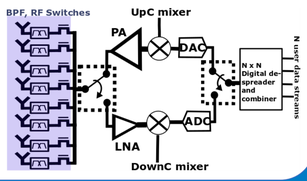
GreenMO can potentially reduce power consumption in Massive MIMO base stations by about 40%, by simply using more antennas to achieve similar performance metrics (SE, throughput)

Summary, Possible Applications

GreenMO presents and architecture capable of enabling MIMO with just a single physical RF chain. Aside from saving power consumption in existing base-stations, GreenMO can bring benefits of MIMO to power constraint communication settings, like Smallcells, or upcoming Drone Base-Stations.

Future Work

- Improved GreenMO PCB to handle both uplink+downlink
- Testing robustness to neighbour band signals/jammers
- Finer control over antenna DoFs with cascaded switches
- Joint optimization of antenna grouping, digital precoding



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