PhaseMO

A Universal Massive MIMO Architecture for Sustainable NextG

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Software Control over the Radio Hardware

Beamforming	Data Streams	Energy Efficiency	Adaptability Future-Proof
Digital	Multiple	Low	No
Digital + AM	Multiple	Medium	Yes
Hybrid	Multiple (Restricted)	High	No
PhaseMO	Multiple (Unrestricted)	High	Yes

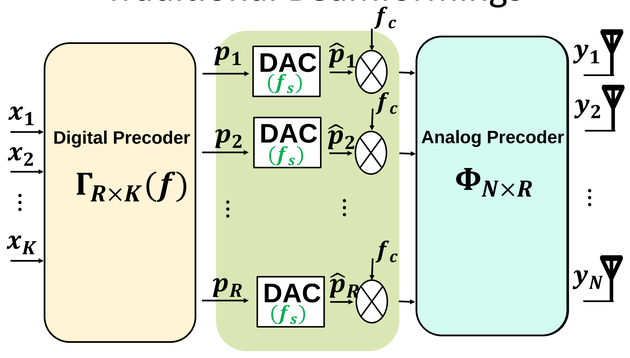
Digital + AM: Flexible reduction of power, adaptive to network load (Universal)

Reducing the user throughput and coverage and increasing the UE power

Hybrid: Having the ability to use the entire antenna array while reducing the RF chains (Sustainable)

Lack of flexibility and future-proofing

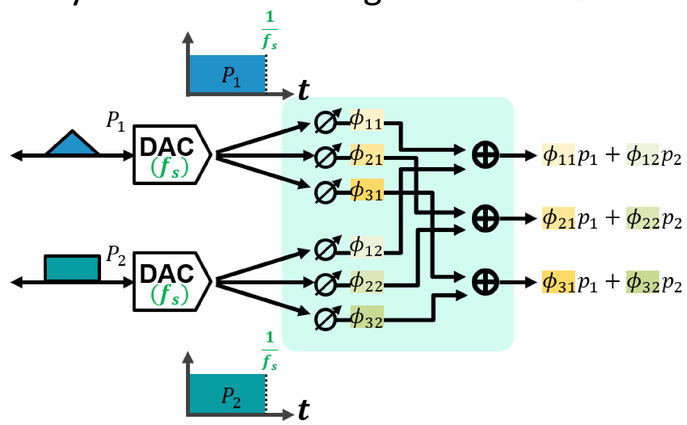
Traditional Beamformings



- **Hybrid Beamforming:** $Y_{N\times 1}(f) = \Phi_{N\times R}\Gamma_{R\times K}(f)X_{K\times 1}(f)$
- **Analog Beamforming ($R = 1, \Gamma_{1\times 1} = 1$):** $Y_{N\times 1}(f) = \Phi_{N\times 1}X_{1\times 1}(f)$
- **Digital Beamforming ($R = N, \Phi_{N\times N} = I_{N\times N}$):** $Y_{N\times 1}(f) = \Gamma_{N\times K}(f)X_{K\times 1}(f)$

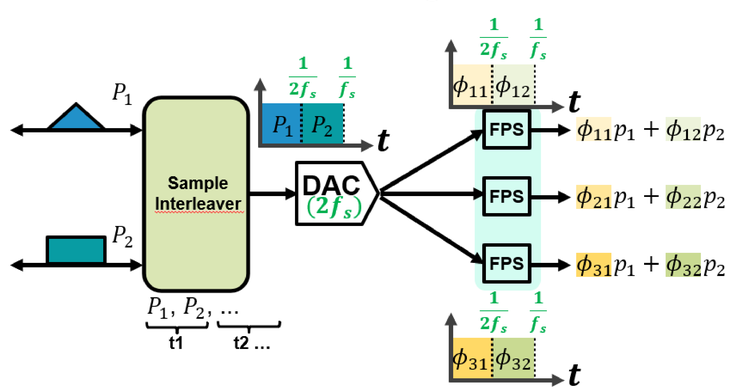
Software control over hybrid beamforming leads to a Universal and Sustainable Massive MIMO architecture

Hybrid Beamforming in a Closer Look



Hybrid Beamforming uses a network of Phase Shifters ($2 \times 3 = 6$) summing 2 RF chain streams for 3 antennas

PhaseMO Design

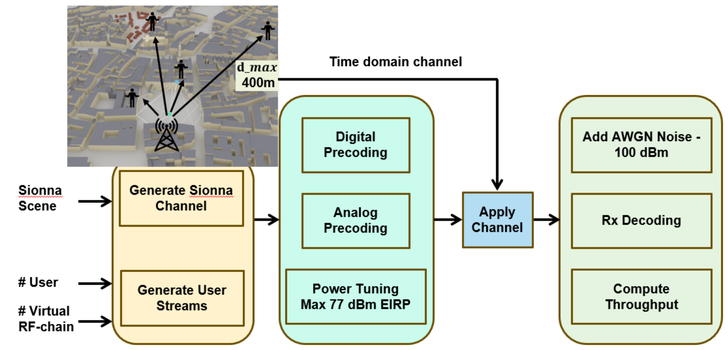


1. Utilizing a **Single High Bandwidth RF Chain**
2. Replacing Phase Shifters with **Fast Phase Shifters**

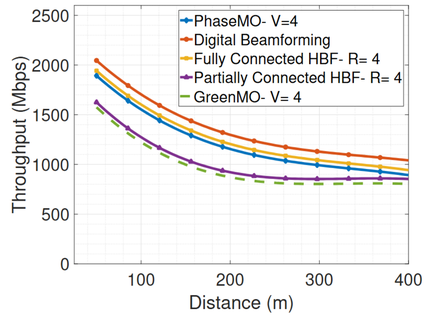
PhaseMO proposes a Universal and Sustainable Massive MIMO Architecture

Evaluation

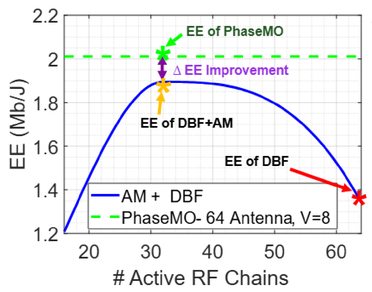
Experiment Setup

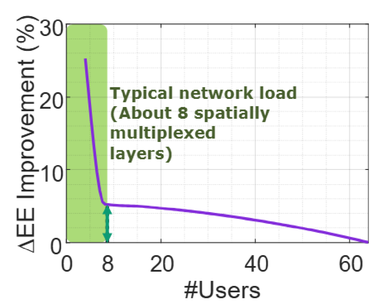


Throughput Evaluation



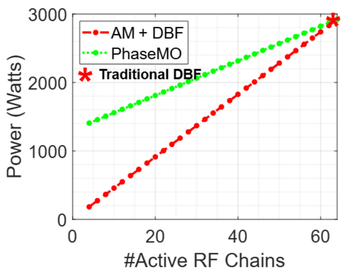
PhaseMO vs. AM+ DBF (Software control))

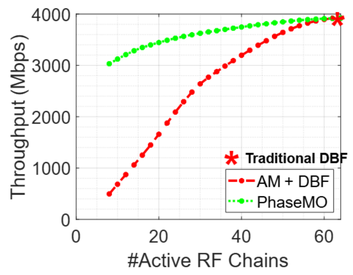


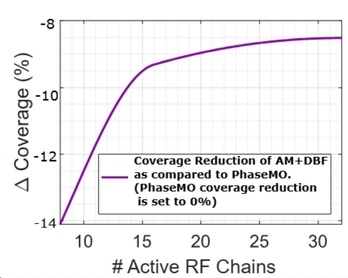


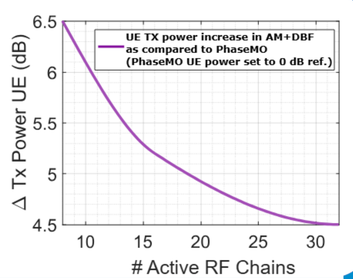
PhaseMO shows better software control over AM+ DBF

PhaseMO vs AM+ DBF









Summary

PhaseMO provides **software control** over Massive MIMO, compensating for **UE power, throughput, and coverage** impairments of AM+ DBF

Paper website: