

Quantum-Inspired Downlink MU-MIMO Vector Perturbation Precoding

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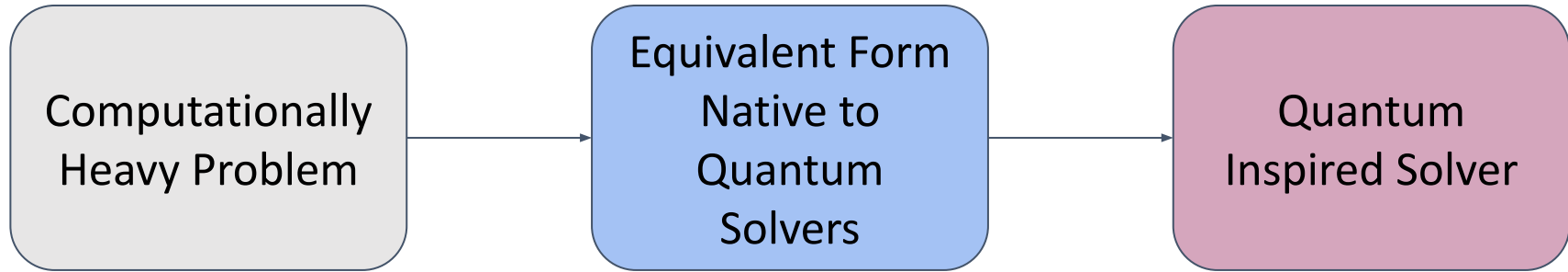
Motivation

Conventional algorithms are fast but are far from optimal performance

Optimal methods are too slow for real-time systems

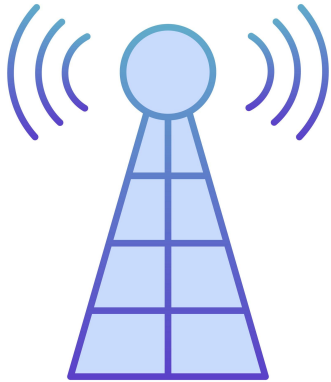
Quantum computing is fast AND optimal

Quantum-Inspired Approach

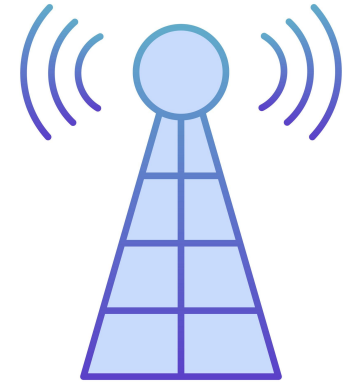
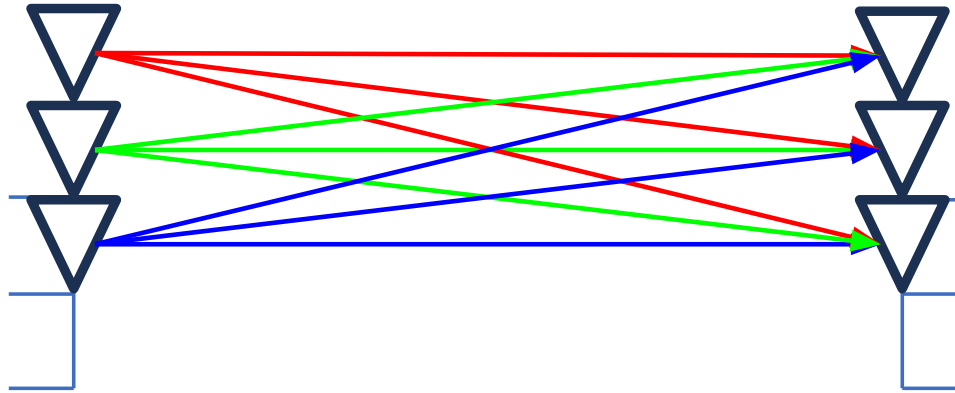


Quadratic Unconstrained
Integer Optimization (QUIO)

Background: MIMO

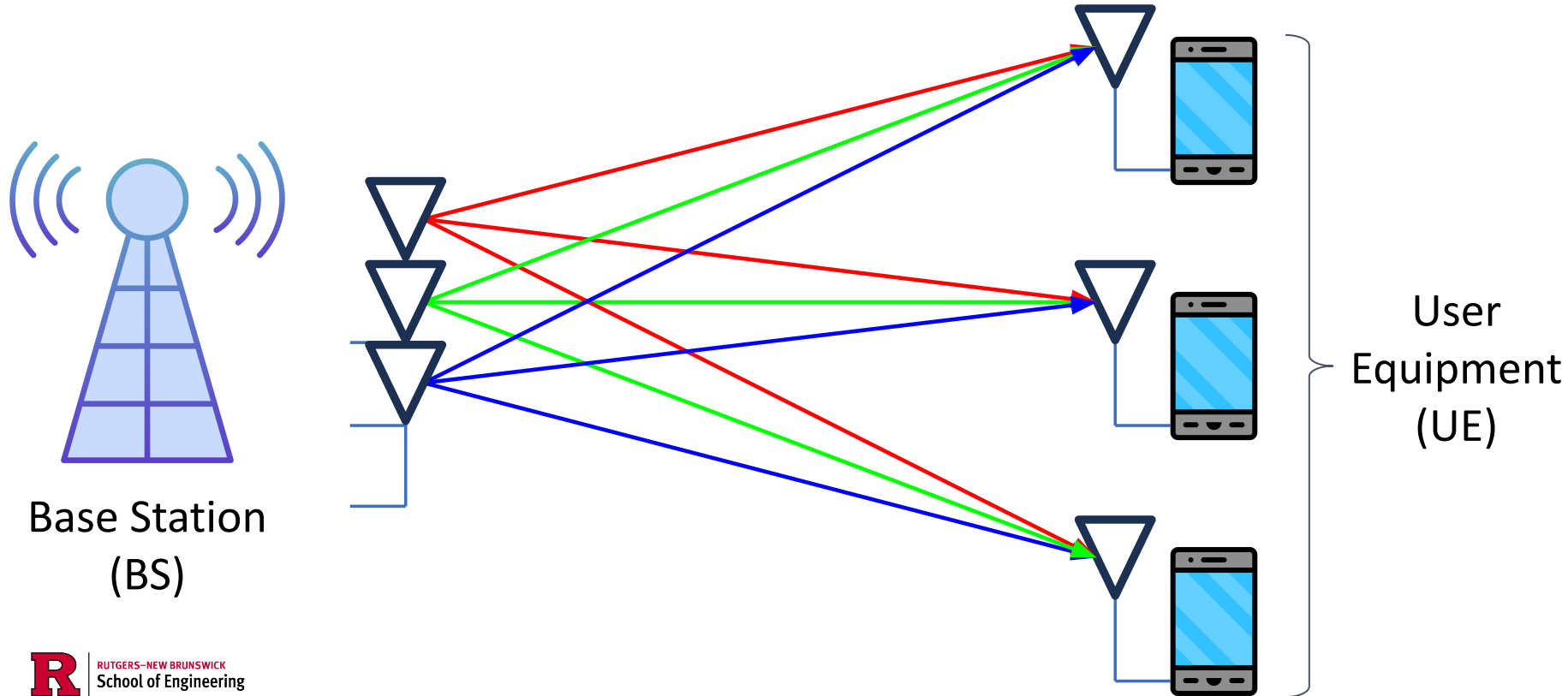


Transmitter

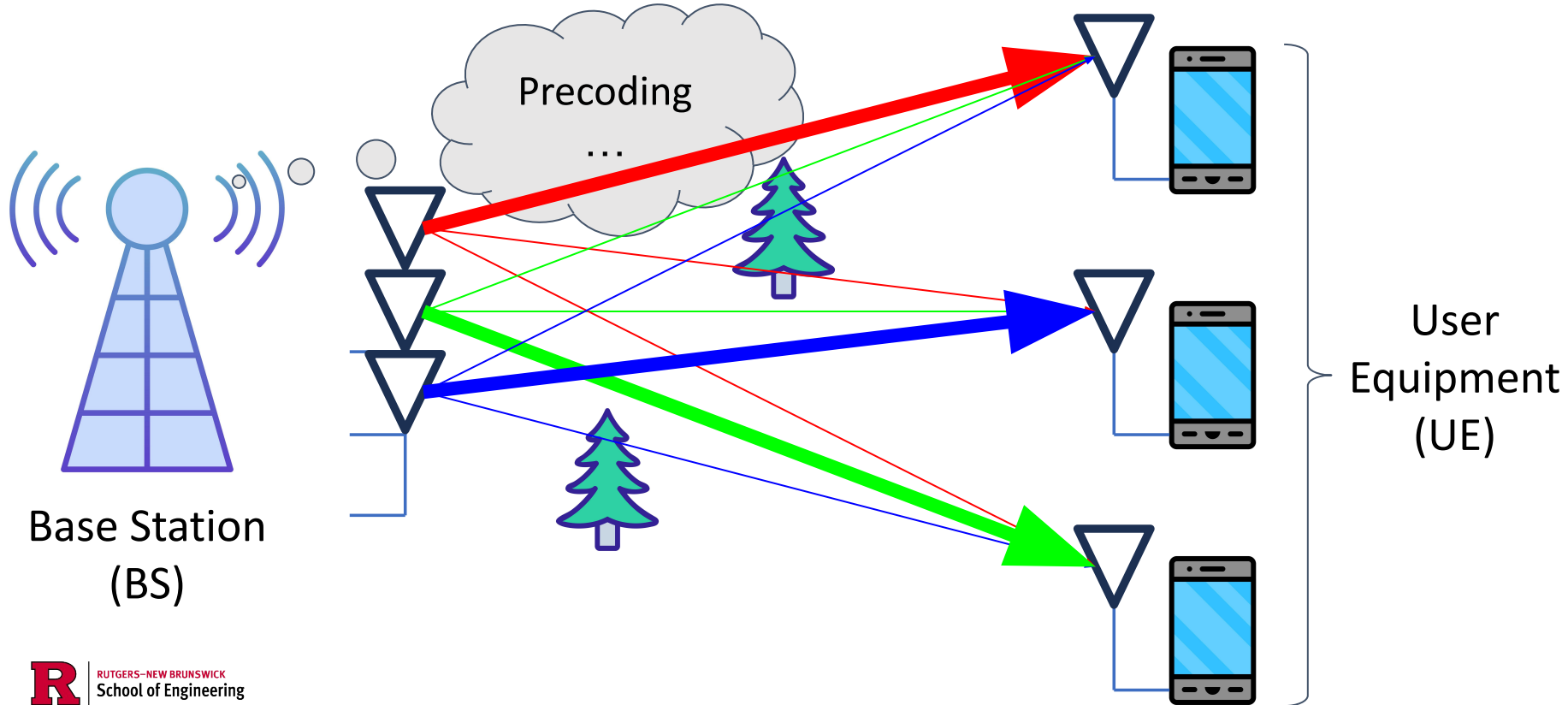


Receiver

Background: MU-MIMO Downlink

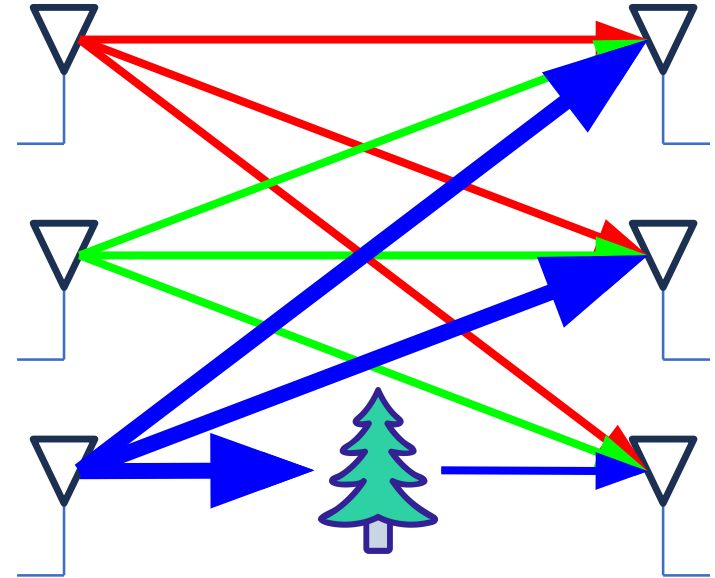


Background: Precoding



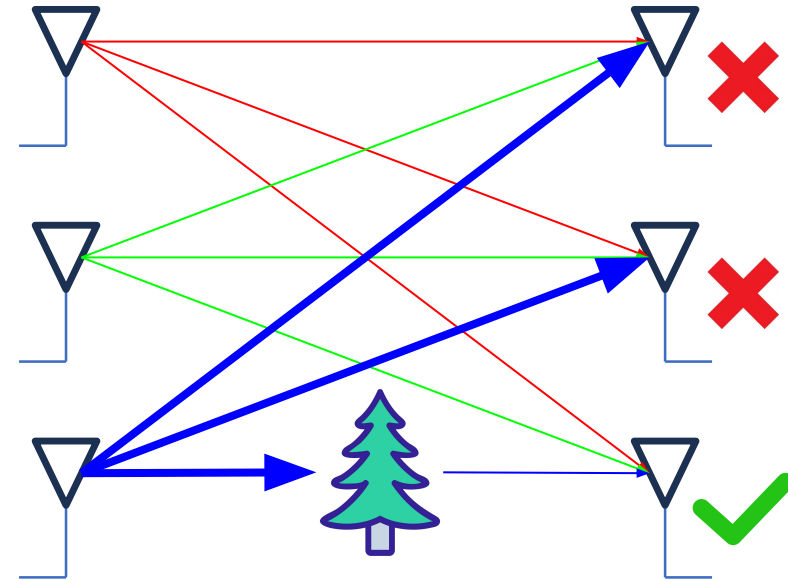
Downlink MIMO Precoding

- Conventional Precoding
 - cancels interference
 - transmission power penalty

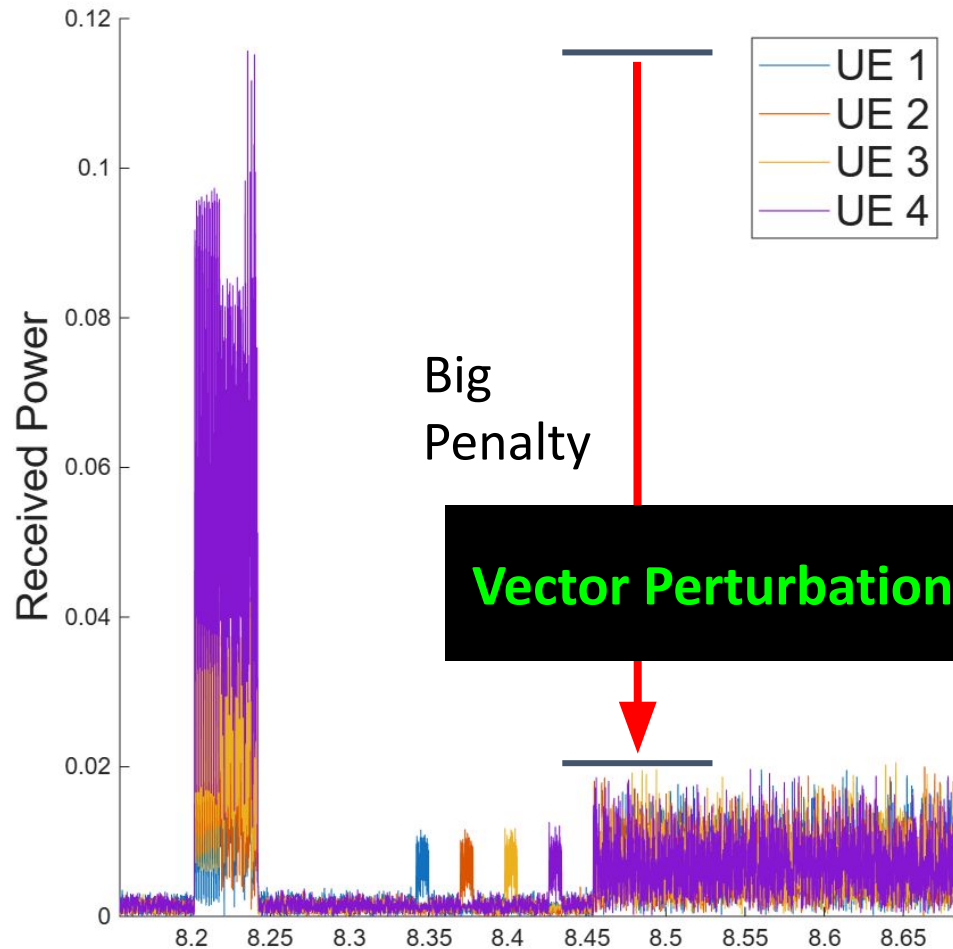


Downlink MIMO Precoding

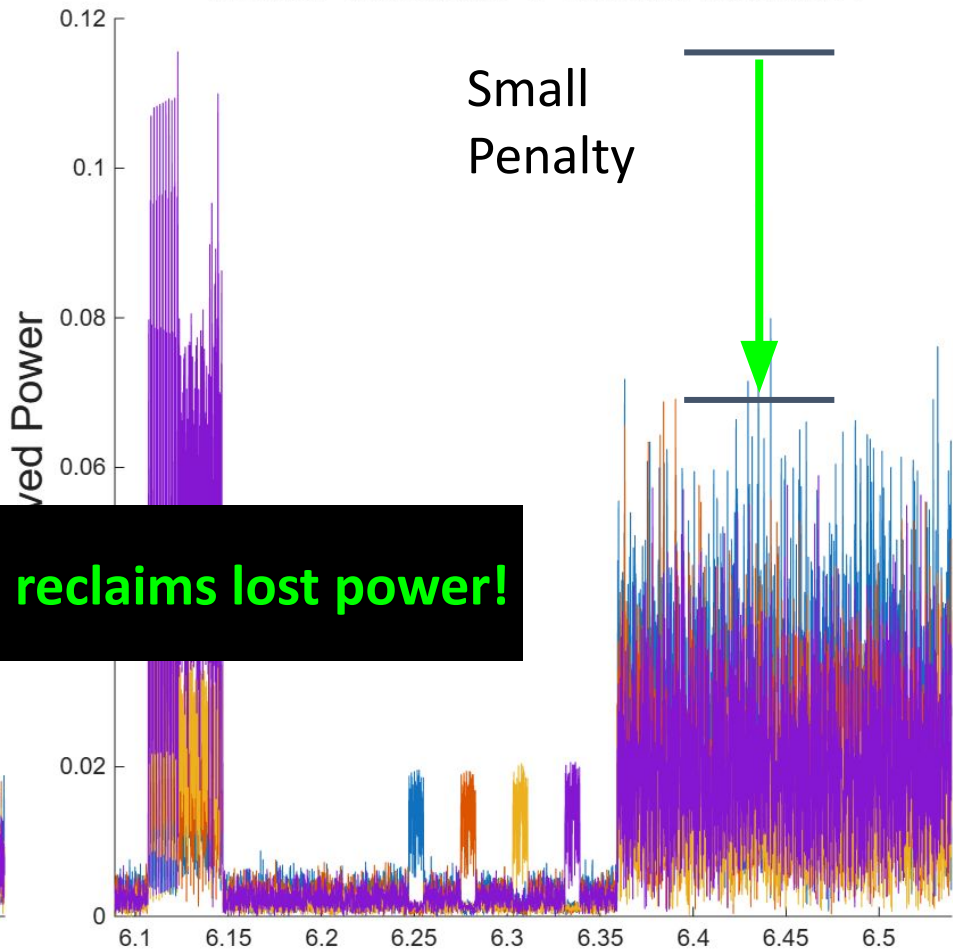
- Conventional Precoding
 - cancels interference
 - **transmission power penalty**
- Vector Perturbation Precoding (VPP)
 - minimize precoder power penalty
 - **optimal solver takes too long**



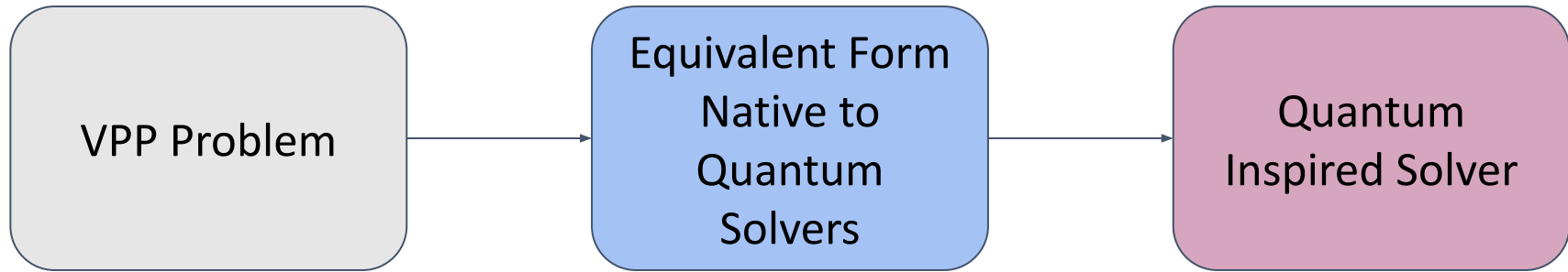
Conventional Precoder



With Vector Perturbation

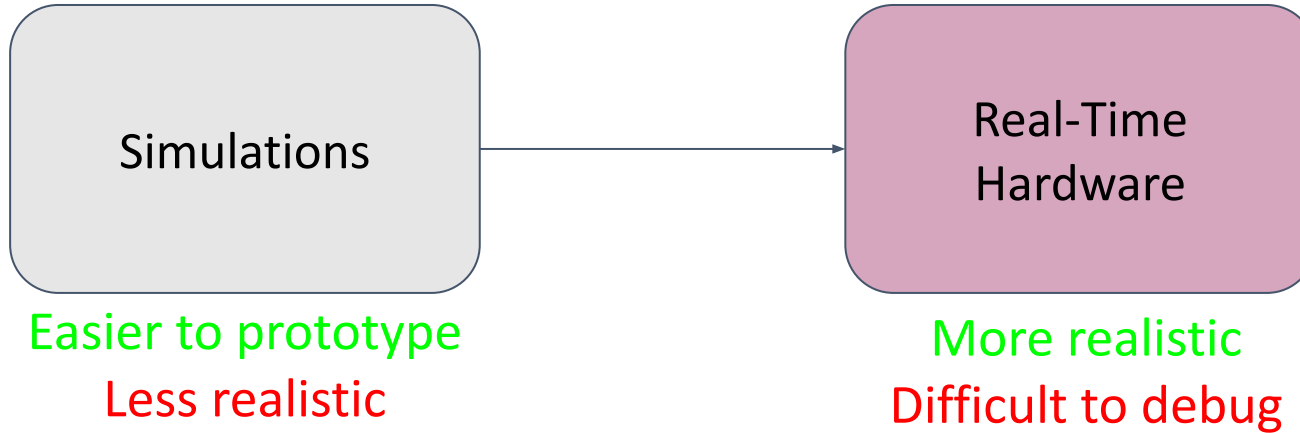


Quantum-Inspired Approach

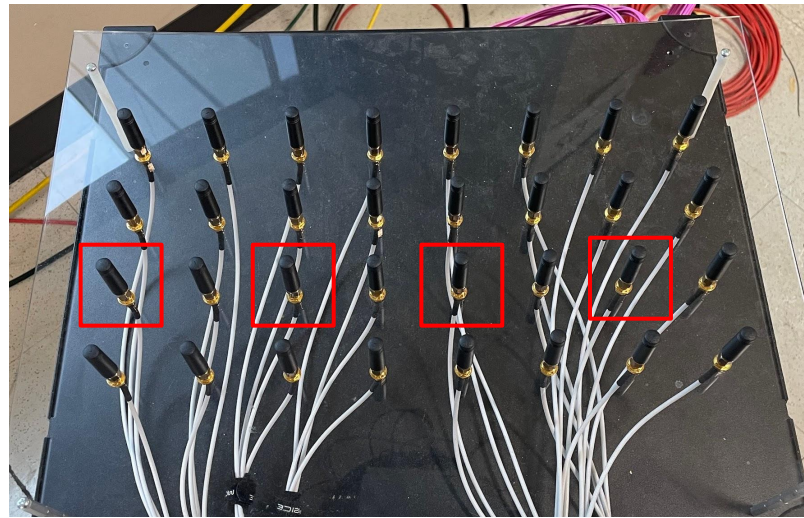


Quadratic Unconstrained
Integer Optimization (QUIO)

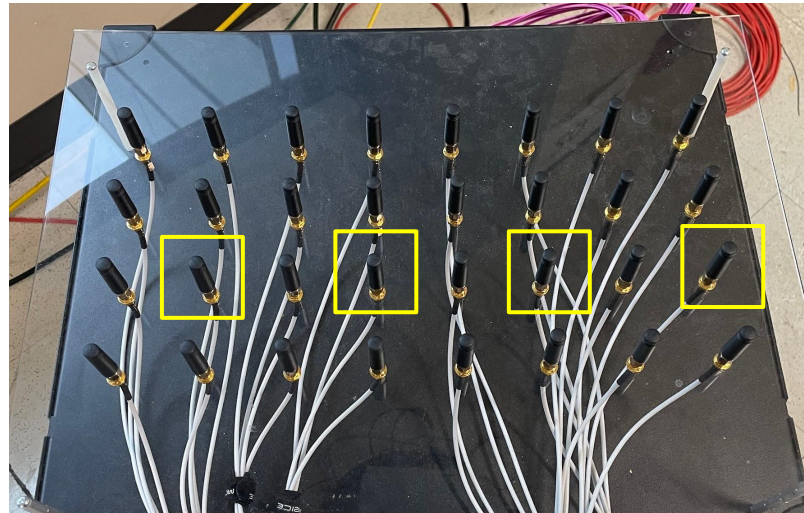
Project Overview



Project Setup



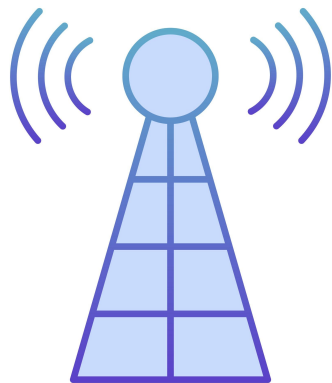
Transmitter
BS



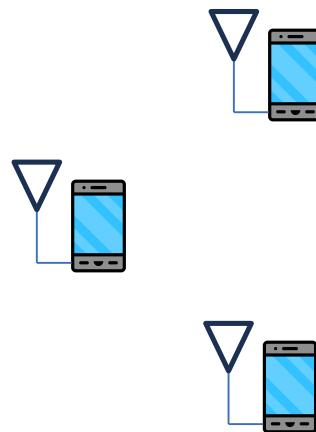
Receivers
4 UEs

Architecture

Base Station
(BS)



User
Equipments
(UEs)



Calculate
Precoder

Perturb
Vector

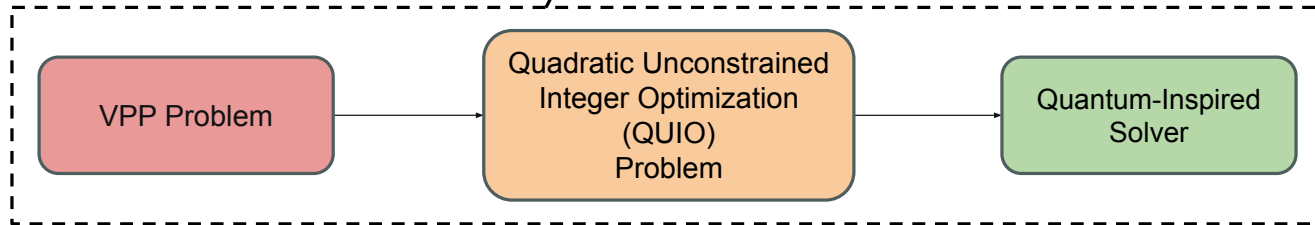
Undo
Perturbation

Demodulate
and Decode

VPP Problem

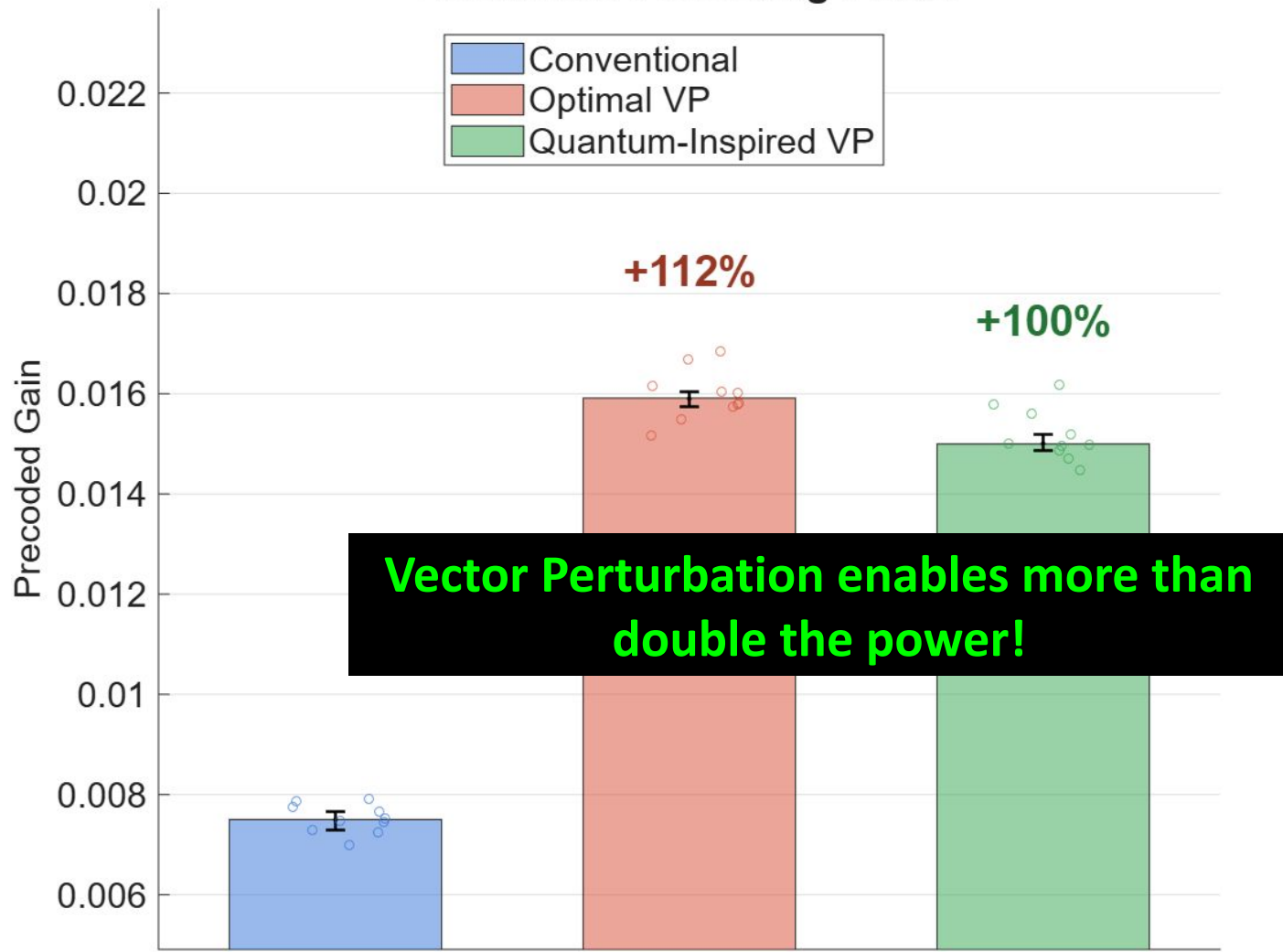
Quadratic Unconstrained
Integer Optimization
(QUIO)
Problem

Quantum-Inspired
Solver

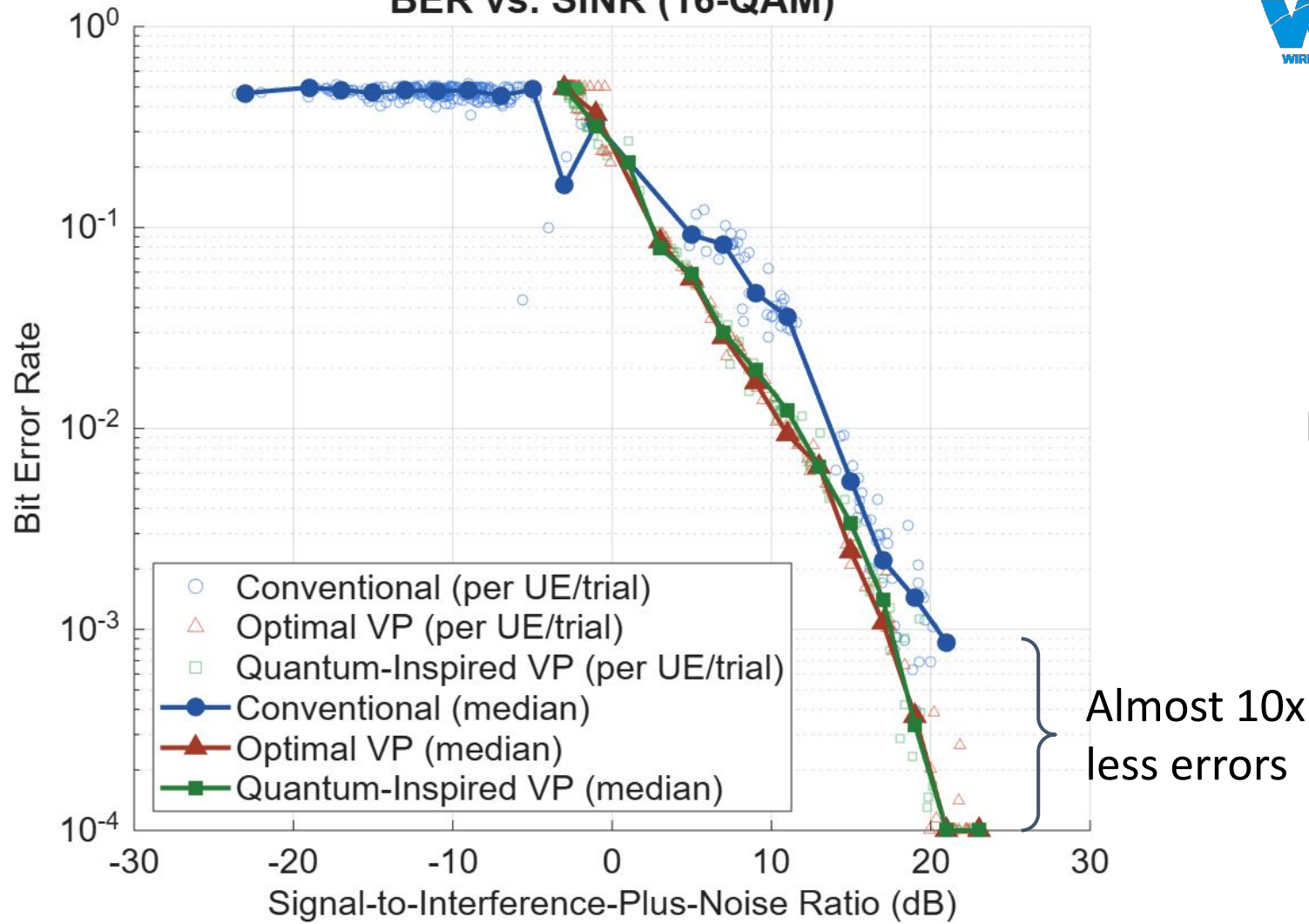


Results

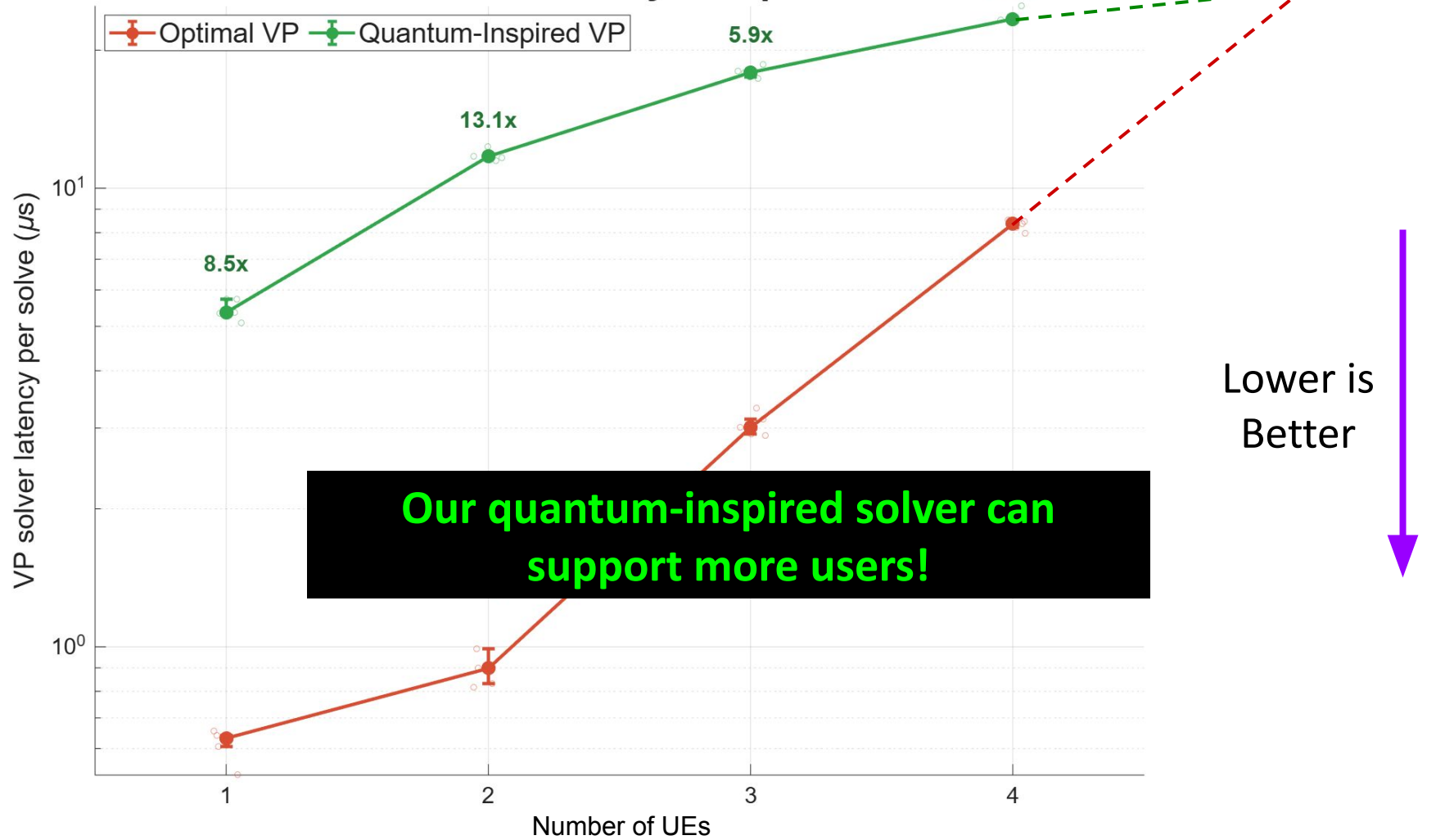
Reclaimed Precoding Power



BER vs. SINR (16-QAM)



VP Solver Latency Comparison



Conclusions

- Vector Perturbation enables power-efficient precoding
- Our quantum-inspired solver is optimal AND fast (for large MIMO)
- Future Work
 - Evaluate latency at larger MIMO sizes (8x8, 16x16)
 - Solver optimizations for latency reduction

Any Questions?

Wiki Page

