BBC Research & Development

MBS Enhancements for Rel-18:

Optimal Multiplexing for Broadcast/Multicast and Unicast Superposition Transmission (BMUST)

BBC Input to 3GPP RAN Rel-18 Workshop (AI 4.2) [RWS-210132]

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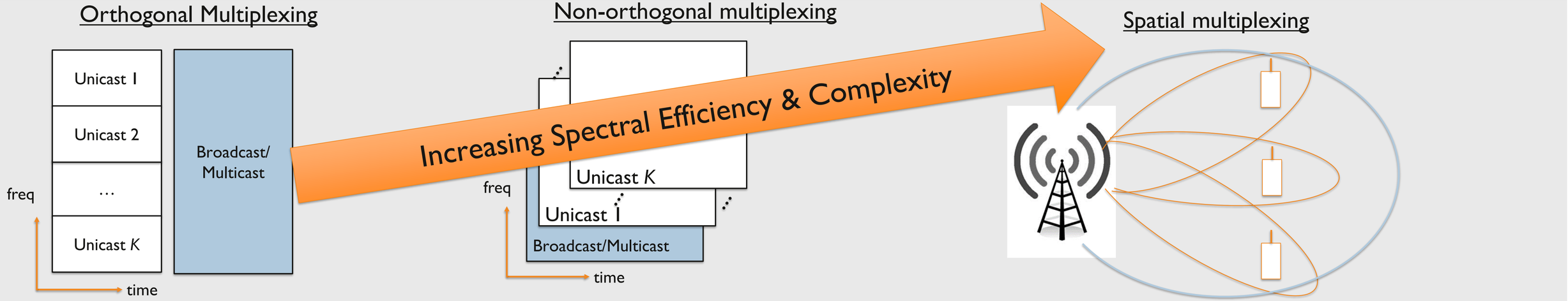
MBS ENHANCEMENTS FOR REL-18: OPTIMAL MULTIPLEXING FOR BROADCAST/MULTICAST AND UNICAST SUPERPOSITION TRANSMISSION (BMUST)

Multi-User Multiplexing approaches



- TDM/FDM
- **Feedback UE to gNB**
  - CQI (SNR), Rank (H)

- Superposition transmission
- **Feedback UE to gNB**
  - CQI (SNR) , Rank (H)

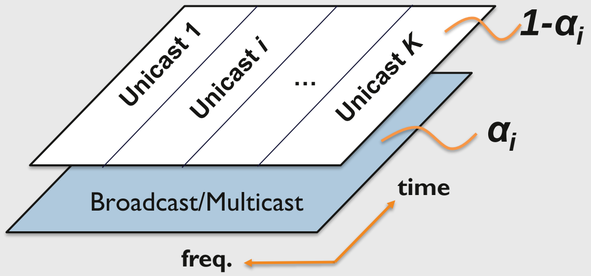
- Beamforming & precoding: requires large antenna array
- **Feedback UE to gNB**
  - CQI (SNR) , Rank (H)
  - **Instantaneous amplitude and phase of channel H**

- Non-orthogonal multiplexing (superposition) of broadcast/multicast and unicast signals has not yet been considered in 3GPP.
- LTE standardised Non-orthogonal multiplexing (superposition) of two unicast signals, i.e., MUST.
- NR MBS in 3GPP Rel-17 supports TDM between group-common PDSCH (broadcast/multicast) and unicast PDSCH.

MBS ENHANCEMENTS FOR REL-18: OPTIMAL MULTIPLEXING FOR BROADCAST/MULTICAST AND UNICAST SUPERPOSITION TRANSMISSION (BMUST)

Broadcast/Multicast and Unicast Superposition Transmission (BMUST) Simple Sum-rate Optimal Strategy

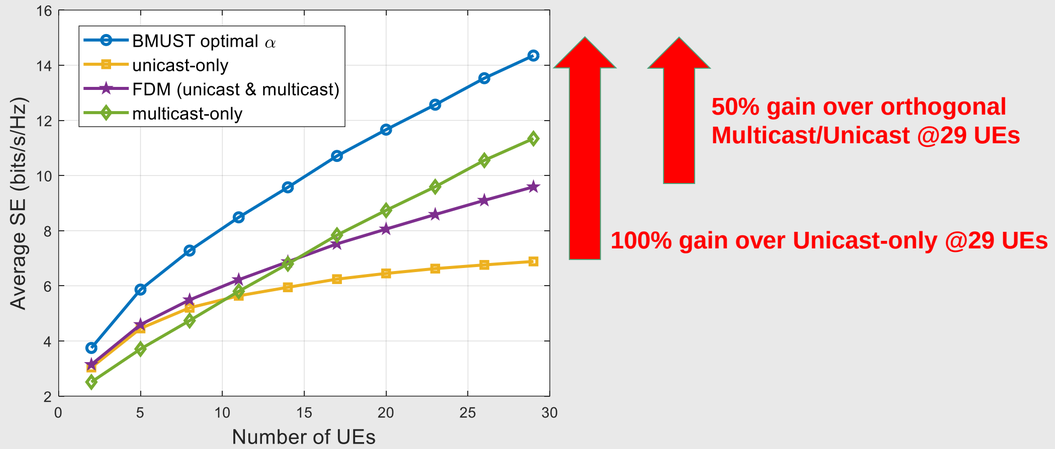
- **Two-layer** superposition shown to be sum-rate optimal scheme [1], i.e., **maximises cell throughput**.
  - SISO and MIMO diversity techniques
- Also optimal for multi-layer MIMO.
- Sub-optimal strategy for spatial multiplexing MIMO: Beamforming

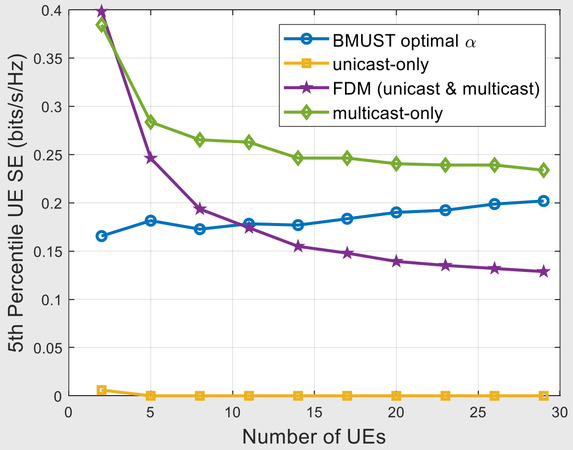


- **Two-layer simplifies the design. Decoding follows two steps:**
  - **1. Decode broadcast/Multicast first (while treating unicast as noise) then**
  - **2. Decode unicast after (soft-) cancellation of broadcast/multicast**
- **Backwards compatible with Rel-17 NR MBS UEs**
- **α_i factor can be optimised per parallel channel (e.g., RB)**

[1] D. Vargas and Y. J. D. Kim, "*Two-Layered Superposition of Broadcast/Multicast and Unicast Signals in Multiuser OFDMA Systems*," in IEEE Transactions on Wireless Communications, Feb. 2020 (IEEE, arxiv)

RI-2009238, Urban Macro-cell 2 GHz





- **Significant capacity gains** as compared to orthogonal approaches
- Consistent throughput to cell-edge users

Summary

- Two-layer BMUST shown to be sum-rate optimal scheme, i.e., maximises cell throughput.
  - SISO, MIMO diversity techniques [IEEE, arxiv]; and
  - multi-layer MIMO.
- Significant capacity gains as compared to orthogonal approaches (TDM/FDM) [R1-2009238].
- **Proposal: consider Broadcast/Multicast and Unicast Superposition Transmission (BMUST) as a technical enhancement for NR MBS in 3GPP RAN Rel-18.**