Cooperative Relay in IEEE 802.16j MMR

IEEE 802.16 Presentation Submission Template (Rev. 8.3)

Document Number:

IEEE C802.16j-06/006

Date Submitted:

2006-04-.30

Source:

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Venue:

IEEE 802.16 Session #43 Tel Aviv, Israel

Base Document:

None

Purpose:

. Propose cooperative relay schemes in IEEE82.16j

Cooperative Relay in IEEE 802.16j MMR

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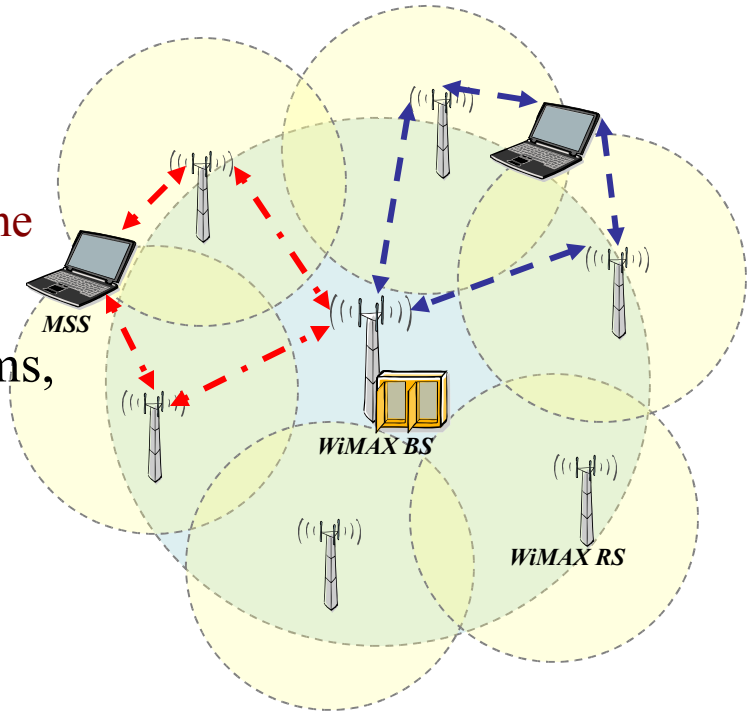
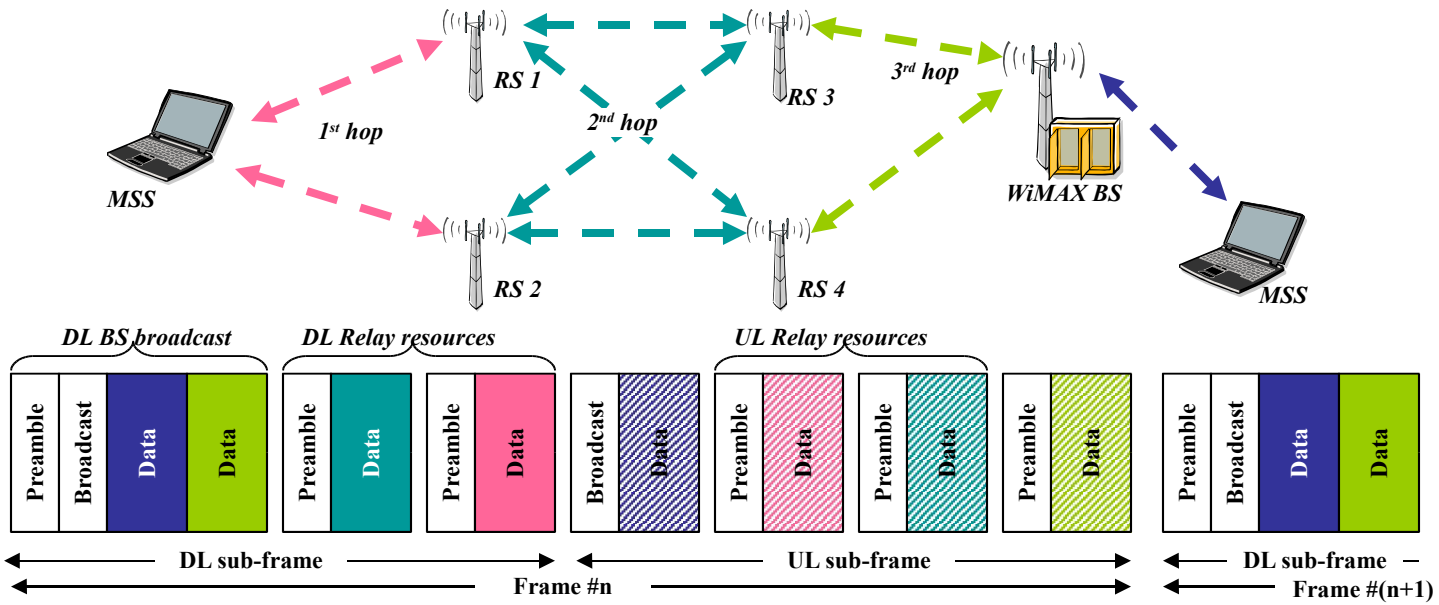
Requirements

- Cooperative relaying for higher throughput and link robustness
  - Relay resources such as time-slots and sub-carriers can be saved
  - Better performance is expected because of the higher SNR
- Compatible with transparent relaying systems, such as frame structure
- No additional requirements of mobile subscriber stations (MS)
- Little update in base station (BS)



Cooperative Relaying

- Cooperative relaying allows for
  - Better BER performance due to spatial diversity
  - Fewer resources used for relaying owing to spatial multiplexing



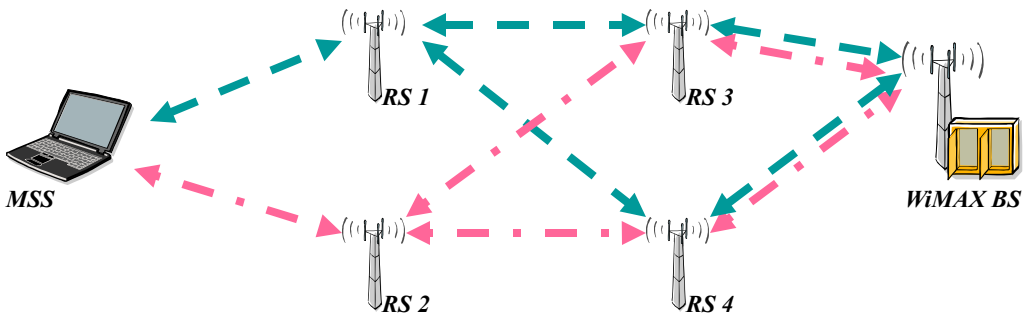
Method 1: Interleaving-based Macroscopic MIMO

- RS-specific interleaving located between FEC and QAM mapping performs RS differentiation

  - Macroscopic spatial diversity and multiplexing are alternative respectively for
    - Either better BER performance
    - Or saving relaying resources such as time-slots and sub-channels
  - Robust against the near-far problem
  - Loose requirement for power balance and synchronization due to joint detection
  - MIMO for spatial diversity is optional at RSs such as STBC, SFBC and interleaving-based MIMO, etc.

Method 1: Interleaving-based Macroscopic MIMO

- Information bits are detected and decoded hop-by-hop, and then regenerated and retransmitted to the next with specific interleaving
- Expect the 1st hop, macroscopic MIMO processing is performed hop by hop
  - For spatial diversity, copies of the same packet are retransmitted from multiple RSs simultaneously and soft combining is used for diversity gain
  - For spatial multiplexing, different packets or different parts of the same packet are relayed from several RSs simultaneously



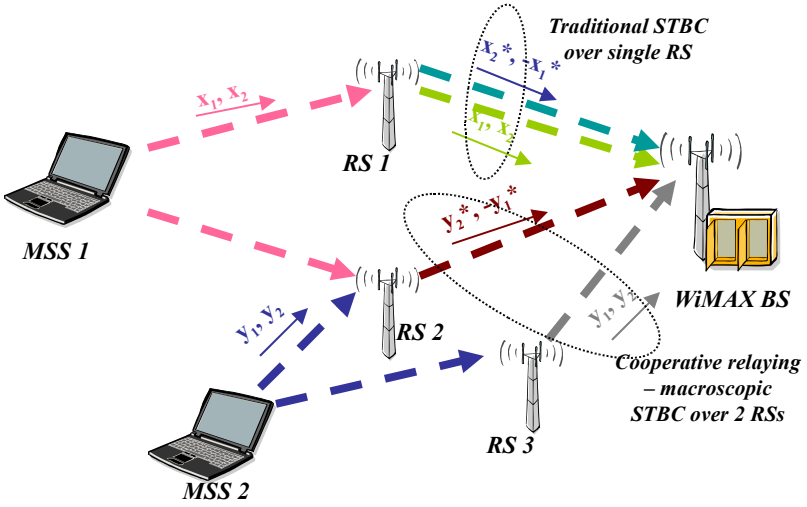
• Both "**green**" and "**red**" dash links work for uplink cooperative relaying
• One or both of these two links are expected in the cooperative downlink

Features of interleaving-based macroscopic MIMO

- Good performance
  - BER performance as good as non-interference transmission
  - Spatial diversity or multiplexing alternative
  - No near-far problem and loose requirements of power balance and synchronization due to joint detection
- Lower computational complexity
  - No matrix operations, i.e., inverse and multiplication
  - No RS pairing or dynamic allocation
  - Lower interaction overheads
- Simple RS design
  - Only an additional RS-specific bit-level interleaver required in each RS

Method 2: Macroscopic STBC MIMO

- Macroscopic STBC for potential spatial diversity
  - Macroscopic STBC over different RSs or traditional STBC over single RS are alternative according to the scattering environments
  - The setup of macro-STBC is up to the interaction between BS and RSs
  - Power control/balancing is expected to avoid the near-far problem
- Maximum ratio combining (MRC) at BS for receive diversity



Features of Macroscopic STBC MIMO

- Low complexity and high compatibility
  - Similar to the traditional STBC, e.g. Alamounti Code
  - No significant modification is required in PHY of BS
- Good performance is expected due to spatial diversity, but no spatial multiplexing is available
- Strict synchronization and power balance between cooperative RSs are required
- Diversity measurement is expected in BS for selection between macroscopic or traditional STBC
- Simple RS design
  - Only an additional RS-specific bit-level interleaver required in each RS

Summary

- Macroscopic MIMO is one of the main features of cooperative relaying
- 2 approaches of cooperative relaying are proposed
  - Interleaving-based macroscopic MIMO
  - Macroscopic STBC MIMO
- Interleaving-based macroscopic MIMO
  - Good performance due to joint detection
  - Spatial diversity and multiplexing are alternative and available
  - Multi-hop cooperative relaying can be implemented easily
- Macroscopic STBC MIMO
  - Spatial diversity is expected, but no spatial multiplexing is available
  - No significant modification of PHY of BS is required
  - Strict requirements on multi-RS synchronization and power balance
- Macroscopic STBC approach can be used in throughput improvement
- The use of interleaving-based approach is expected to extend the coverage as well as improve the capacity