Cooperative Relay in IEEE 802.16j MMR

IEEE 802.16 Presentation Submission Template (Rev. 8.3)

Document Number:

IEEE C802.16j-06_006r1

Date Submitted:

2006-05-08

Source:

Wei Ni, Gang Shen, Shan Jin, Torsten Fahldieck, Roland Muenzner

Voice: +86 21 58541240 8194

Alcatel, Research & Innovation — Fax: +86 21 50554550

388#, Ningqiao Road, Shanghai, P. R. C. — E-mail: Wei.ni@alcatel-sbell.com.cn

Venue:

IEEE 802.16 Session #43 Tel Aviv, Israel

Base Document:

None

Purpose:

. Propose cooperative relay schemes in IEEE82.16j

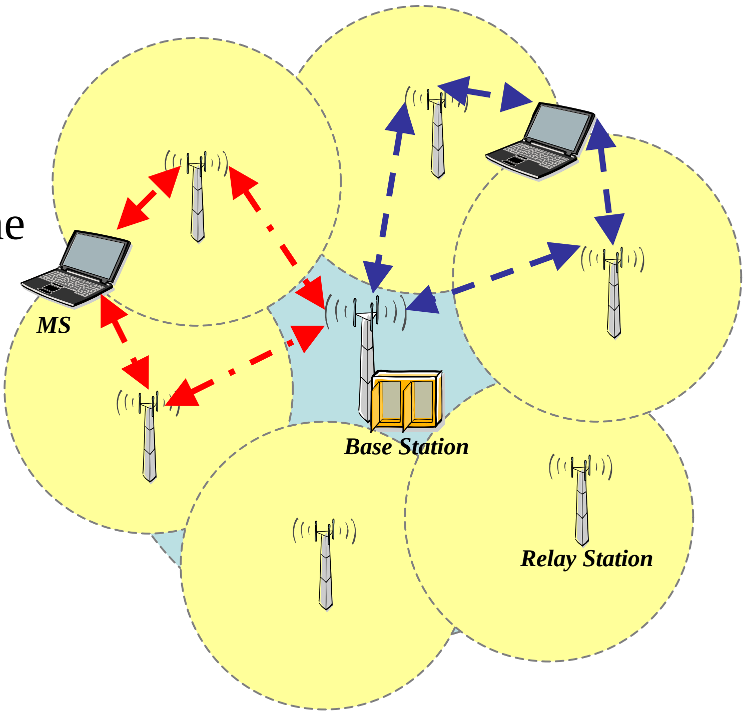
Cooperative Relay in IEEE 802.16j MMR

Wei Ni, Gang Shen, Shan Jin,
Torsten Fahldieck, Roland Muenzner

Alcatel, Research & Innovation

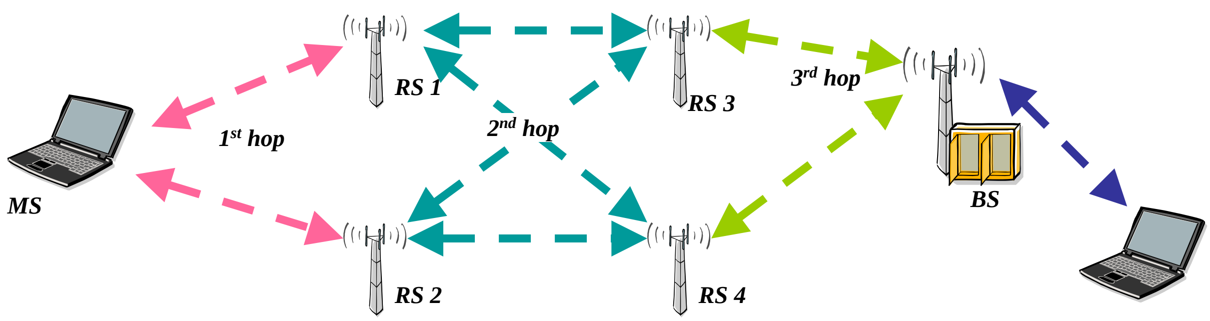
Requirements

- 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
- MS specification is not changed
- Little update in BS



Cooperative Relaying

- Original signal is received by several RSs, and forwarded to the destination through different paths
  - Share the same radio resource
  - Therefore multiple synchronized and orthogonal transmissions
- Cooperative relaying provides
  - Better BER performance due to spatial diversity
  - Higher efficiency due to spatial multiplexing

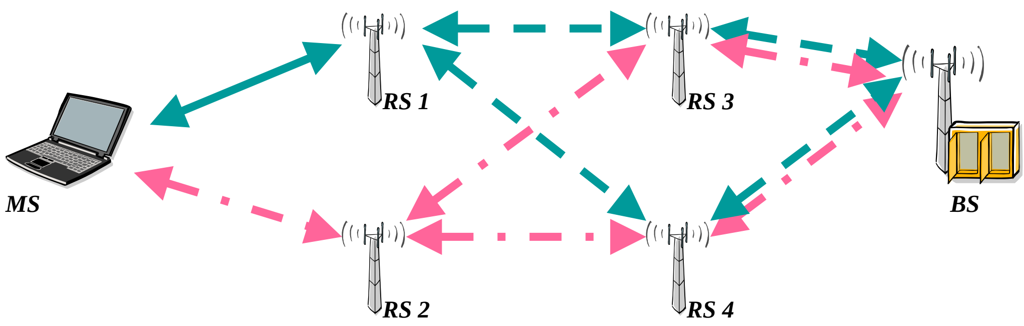


Method 1: Interleaving-based Macroscopic MIMO

- RS-specific interleaving is added after FEC block
  - Interleavers are used for RS separation
  - RS forward certain parts of information after its own specific interleaving
  - Macroscopic spatial diversity and multiplexing are alternative respectively for
    - Either better BER performance
    - Or saving relaying resources such as time-slots and sub-channels

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
- 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

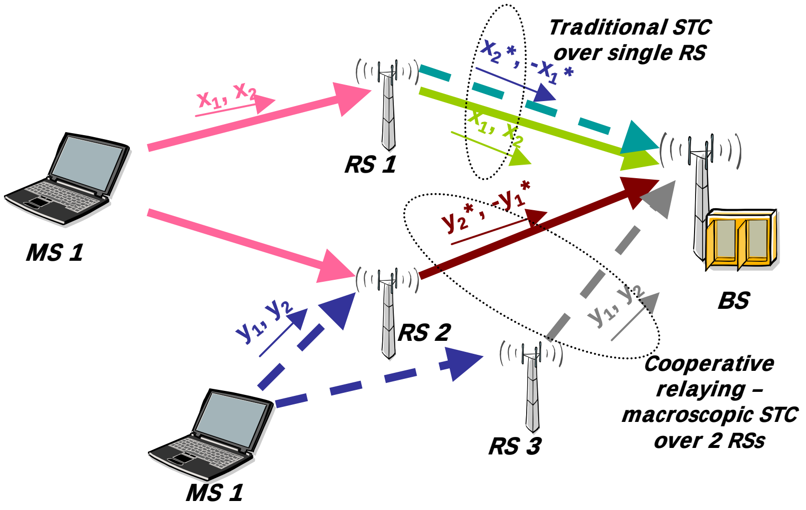


Features of interleaving-based macroscopic MIMO

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

Method 2: Macroscopic STC/SFC MIMO

- Macroscopic STC/SFC for potential spatial diversity
  - Macroscopic STC/SFC over different RSs or traditional STC over single RS are alternative according to the scattering environments
  - The setup of macro-STC 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
- MS and BS are interchangeable in the above figure



Features of Macroscopic STC/SFC MIMO

- Low complexity and high compatibility
  - Similar to the traditional STC, e.g. Alamouti 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 STC/SFC
- Simple RS design

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