Project	**IEEE 802.16 Broadband Wireless Access Working Group** <http://ieee802.org/16>
Title	**Downlink Collaborative MIMO for Cell-edge User in Multi Cell Environment**
Date Submitted	**2008-05-05**
Source(s)	Sunam Kim Jaewan Kim Dongguk Lim Bin-Chul Ihm HanGyu Cho LG Electronics LG R&D Complex, 533 Hogye-1 dong Dongan-gu, Anyang, 431-749, Korea Voice: +82-31-450-7903 E-mail: snkim816@lge.com lgjohnkim@lge.com dongguk@lge.com bcihm@lge.com hgcho@lge.com
Re:	IEEE 802.16m-08/016r1 Call for Contributions on Project 802.16m System Description Document (SDD). Specific topic : Downlink MIMO schemes
Abstract	Propose collaborative MIMO on IEEE 802.16m MIMO section
Purpose	For IEEE 802.16m discussion and adoption
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Downlink Collaborative MIMO for a Cell-edge user in Multi-Cell Environment

Sunam Kim, Jaewan Kim, Dongguk Lim, Bin-Chul Ihm and HanGyu Cho
LG Electronics

Introduction

In 802.16m system requirements, target performance of cell edge user must be improved relative to reference system[1].

Generally, FFR scheme is useful for the enhancement of the cell edge user performance but might not be good in terms of bandwidth efficiency. MIMO macro diversity(MD), specified in IEEE 802.16e standard, can be a good solution for inter-cell interference management, but, is not applicable to various MIMO schemes [2].

We propose, therefore, downlink collaborative MIMO(Co-MIMO) scheme to obtain spatial diversity gain and macro diversity gain, and also show a high-level working scenario in accordance with FFR scheme.

Collaborative MIMO and FFR

There are some consideration points for Co-MIMO operation because the same signal is transmitted through multi BSs at the same time.

- Extensibility : How many the collaborative BSs can be used
- Resource allocation : Use the same resources
- Scheduling : Edge users will be scheduled in the restricted resource region (i.e. Co-MIMO zone)
  - There is a possibility to limit scheduling gain
- Co-MIMO scheme : How to obtain the spatial diversity gain
- Channel estimation: Must be easy to estimate the channel of Co-MIMO BSs

As mentioned previously, FFR scheme avoids inter-cell interference by allocating interfering signals on different frequency bands. On the contrary, Co-MIMO obtains diversity gain by replacing potential interference with the signal.

Figure 1 shows edge users located in the multi-cell environment. Figure 2 (a) shows the conventional FFR scheme and Fig. 2(b) shows the coexistence of Co-MIMO and FFR scheme corresponding to the Fig. 1. As shown in Fig. 2 (b), some users can operate in FFR while others do Co-MIMO.

The collaborative BS determines the resource block for Co-MIMO based on the messages such as CQI, MIMO type and service time from the serving BS. The resource allocation for Co-MIMO can be established by ‘request’ from the serving BS and ‘grant’ from each collaborative BS. This enables scheduling for Co-MIMO without the additional controller

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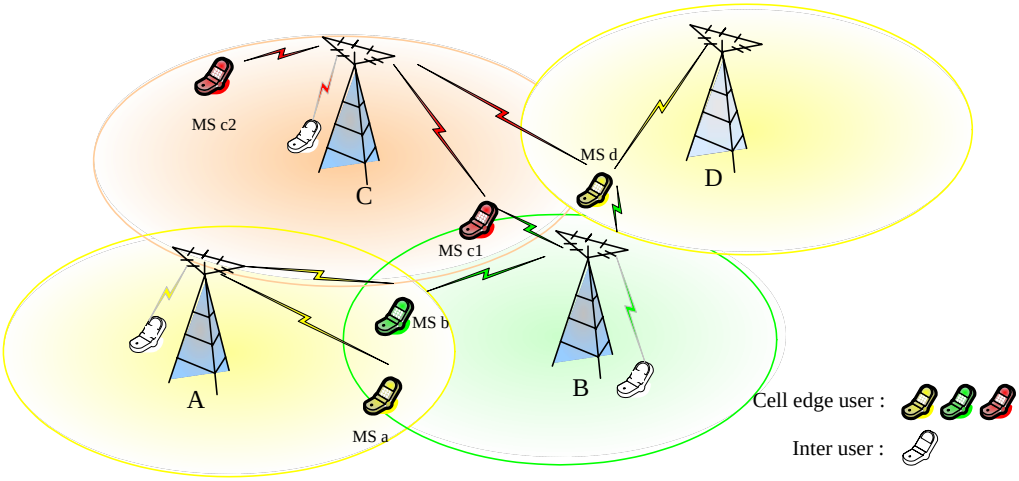
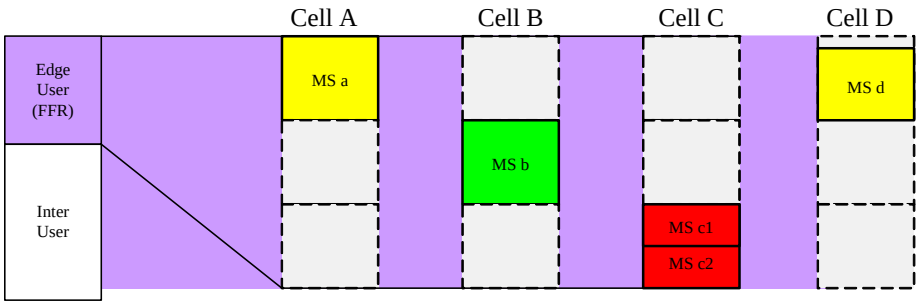
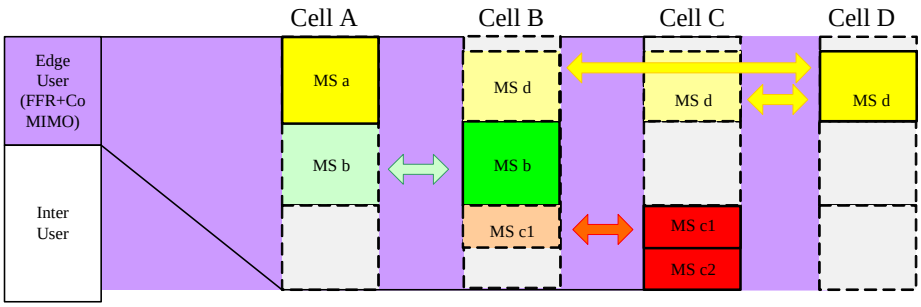


Fig 1. Edge user in the multi cell(BS) environment



(a) conventional FFR scheme



(b) Co-MIMO under the FFR

Fig 2. Resource allocation

Co-MIMO Scheme

Open loop Co-MIMO scheme is suitable for the case when uplink feedback is not available. After the resource allocation for Co-MIMO is completed, the packet data is encoded by the same manner at each BS according to the pre-determined MIMO type. Conventional OL MIMO schemes can also be used for OL Co-MIMO at each BS.

Closed-loop Co-MIMO can further improve cell-edge user throughput. To minimize uplink feedback, we propose codebook based precoding for closed-loop Co-MIMO mode. A MS searches the best PMI (Pre-coding Matrix Index) from codebook table and feedback it to the collaborative BSs.

There are three feedback methods which can be considered:

- BS to BS backbone network communication between the serving BS and the collaborative BSs
- Direct feedback to the collaborative BSs from the MS side.
- Feedback via relay station located at the cell-edge area of the collaborative BSs.

Backbone network delay and the impact on the conventional uplink signal structure shall be considered when we decide a feedback mechanism.

Proposed Texts

---------- Text Start ----------

11.x.y.z Collaborative MIMO

Collaborative MIMO (Co-MIMO) can obtain spatial and macro diversity gain. Co-MIMO operation can be established by ‘request’ from the serving BS and ‘grant’ from collaborative BSs. Co-MIMO can efficiently coexists with conventional FFR scheme. Co-MIMO can be operated with/without uplink feedback. Open loop(OL) Co-MIMO is suitable for the case when uplink feedback signaling is not available. Conventional OL MIMO schemes can be used for OL Co-MIMO at each BS. Closed-loop(CL) Co-MIMO is suitable for the case when the beamforming gain can be obtained. For that, codebook based pre-coding Co-MIMO should be used for CL Co-MIMO and its feedback signaling method for PMI will be FFS.

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Reference

[1] IEEE 802.16m-07_002r4, IEEE 802.16m system requirements, 2007-10-09

[2] IEEE, IEEE Standard for Local and metropolitan area networks Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems, 2007-06-27