Project	**IEEE 802.16 Broadband Wireless Access Working Group** <http://ieee802.org/16>	
Title	**Signaling for Base Station Cooperation**	
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Re:	Response to the Call for Contributions IEEE 802.16m-08/016 ─ Downlink MIMO schemes	
Abstract	This contribution proposes the signaling mechanism to enable base station cooperation for 802.16m system description document (SDD).	
Purpose	To adopt the signaling mechanism proposed herein for base station cooperation into IEEE 802.16m system description document (SDD).	
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Signaling for Base Station Cooperation

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1 Overview

It has been shown in previous contributions and the references contained therein that base station cooperation (BSC) [1] (a.k.a. collaborative MIMO [2][3], or closed loop MIMO macro diversity [3]) can not only mitigate inter-cell interference (ICI) effectively, but also deliver substantial spectral efficiency improvement.

New as it is, BSC can be considered as a natural combination of two existing IEEE 802.16 [4] technologies, namely macro diversity handover (MDHO) and spatial division multiple access (SDMA) [1][2][3]. As a result, introduction of BSC into IEEE 802.16m would *NOT* require significant standard change.

This contribution intends to describe a minimum set of changes to the current IEEE 802.16 standard [4] that can enable BSC at the air interface R1 [5]. Operations on other interfaces will be briefly discussed without being further specified, as they are not in the scope of IEEE 802.16m. Since BSC can be realized as a combination of MDHO and SMDA, we assume in the following discourse that all the base stations that are able to perform BSC support both MDHO and SDMA.

2 Base Station Cooperation: Protocol and Signaling Aspect

The protocol and signaling to enable BSC encompasses *basic capability negotiation*, diversity set, etc, all of which will be described below. As we can see, diminutive protocol and signaling modifications to the air interface R1 would be needed to enable base station cooperation.

- **Basic capability negotiation**

During network entry/re-entry process, an MS and the BS can negotiate the support for BSC by exchanging REG-REQ and REG-RSP message. The *handover supported field TLV* originally defined in the current IEEE 802.16 standard [4] can be extended to indicate the capability of performing BSC. The detailed format of the new *handover supported field TLV* is shown in section 3.

- **Diversity set establishment, maintenance and distribution**

For MDHO, both the MS and BS shall establish and maintain a diversity set, which identifies a set of BSs that are involved in macro diversity transmission/reception. For instance, each MS in Figure 1 (i.e., MS 1, MS2, MS3, MS4 and MS5) is aware of its own diversity set, which is

$$MS1_{\text{diversity set}} = \{BS1, BS3\}$$
$$MS2_{\text{diversity set}} = \{BS1, BS2, BS3\}$$
$$MS3_{\text{diversity set}} = \{BS1, BS2, BS3\}$$
$$MS4_{\text{diversity set}} = \{BS1, BS2\}$$

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$$MS5_{\text{diversity set}} = \{BS2, BS3\}$$

Via MOB_MSHO-REQ/MOB_MSHO-RSP handshake, each BS in Figure 1 (i.e., BS1, BS2 and BS3) would also know the diversity set of each MS in its cell. Moreover, all the BSs can further exchange via the backbone the diversity set information as well as other necessary information such as channel state of related MSs. Each BS then can use the collected information (i.e., diversity set, channel state, etc.) as the basis for determining which MSs/BSs would be involved in the BSC. As an alternative, all the BSs can report all such information to a network entity, which will then make decision for all the BSs/MSs with regard to how base station cooperation should be conducted.

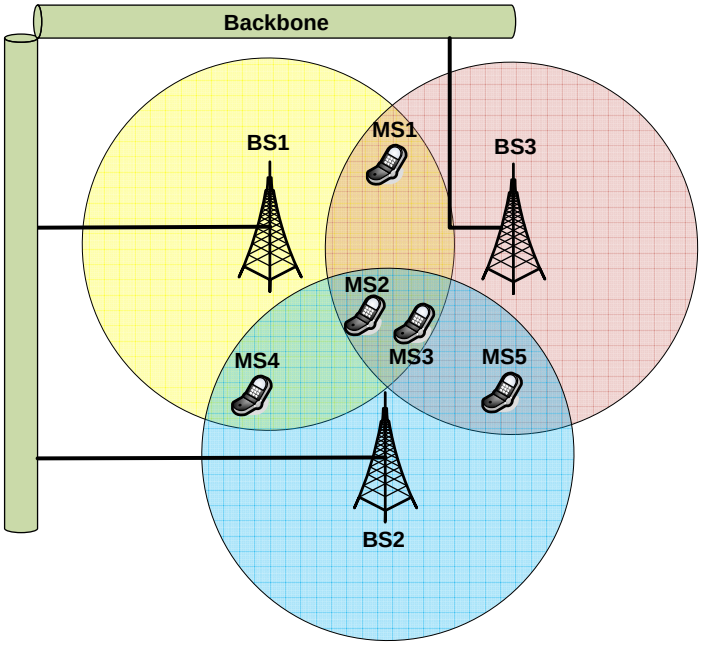

Figure 1: Diversity set and base station cooperation

For example, BS1 and BS2 in Figure 1 can perform base station cooperation with MS1, MS2 and MS3. As another example, all the BSs (i.e., BS1, BS2 and BS3) can form a virtual antenna array and communicate with MS2 and MS3 using base station cooperation.

Anyhow, how the needed information (e.g., diversity set, channel state, etc.) is exchanged via the backbone is beyond the scope of IEEE 802.16m standard, while how BSs decide which MSs would be engaged in communication using base station cooperation is completely implementation dependent. Meanwhile, the establishment and maintenance/update of diversity set for BSC would follow the same protocol defined for MDHO, and thus no additional protocol changes would be needed herein.

- **MAP**

Once the decision of BSC has been made, each BS needs to convey this decision to the MSs that are currently served by the BS and would be involved in the base station cooperation. Related IEs defined in existing IEEE 802.16 [4] can be used to fulfill this function.

3 Proposed Text Change

11. TLV encodings

11.7.13.5 Handover Supported Field

[Revise the table as follows]

Type	Length	Value	Scope
27	1	Bit #0: MDHO/FBSS HO supported when it is set to 1. When this bit is set to 0, the BS shall ignore all other bits. Bit #1: MDHO DL RF Combining supported with monitoring MAPs from active BSs when this bit is set to 1 Bit #2: MDHO DL soft Combining supported with monitoring single MAP from anchor BS when this bit is set to 1. Bit #3: MDHO DL soft combining supported with monitoring MAPs from active BSs when this bit is set to 1 Bit #4: MDHO UL Multiple transmission *Bit #5: Base station cooperation supported when this bit is set to 1* Bit#*6-7*: *Reserved*, shall be set to zero	REG-REQ REG-RSP

4 Reference

[1] A. Molisch, et al., “Base Station Cooperation and Channel Sounding”, IEEE C802.16m-08/183, March 2008, Orlando, FL

[2] Y. Song, et al., “Collaborative MIMO”, IEEE C802.16m-07/244r1, November 2007, Atlanta, GA

[3] H. Yang, et al., “Closed-loop MIMO Macro Diversity”, IEEE C802.16m-07/243, November 2007, Atlanta, GA

[4] “DRAFT Standard for Local and metropolitan area networks Part 16: Air Interface for Broadband Wireless Access Systems”, P802.16Rev2/D4, April 2008, LAN/MAN Standards Committee of the IEEE Computer Society and IEEE Microwave Theory and Techniques Society

[5] S. Hamiti, et al., “The Draft IEEE 802.16m System Description Document”, IEEE C802.16m-08/003r1, April 2008