Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**MIMO SHO based Macro diversity transmission for coverage improvement**
Date Submitted	**2004-06-25**
Source:	Wen Tong, Peiying Zhu, Jianglei Ma, Ming Jia, Hang Zhang and Mo-Han Fong Nortel Networks 3500 Carling Avenue Ottawa, ON. K2H 8E9 CANADA Voice: (613)-763-1315 Fax: (613)-765-7723 wentong@nortelnetworks.com
Re:	IEEE 802.16e D3 Draft
Abstract	Enhancement of handoff capability and procedures
Purpose	To incorporate the changes here proposed into the 802.16e D4 draft.
Notice	
Release	
Patent Policy and Procedures	

MIMO SHO based Macro diversity transmission for coverage improvement

.

1 Background

In this contribution, two physical layer enhancements for the handoff operation are proposed for a frequency reuse-one OFDMA multi-cell system. These enhancements are based on the MIMO/MISO capabilities for both BS and MSS to exploit the macro-diversity. The first is joint BS soft-handoff based on the space time coding structure to enhance the user data rate in the very poor geometry users. The second is to allow the minimum data rate connection during the very low geometry handoff process. It should be noted that the proposed handoff solutions are also applicable to the MBS service.

2 MIMO Soft Handoff

MIMO-OFDMA Macro diversity transmission scheme is configured with multiple BS transmissions in division in frequency domain, and the space-time coding (STTD/SM) associated with each BS antenna. The packet delivering to SHO MSS is duplicated to all the active BSs. Two examples of Macro diversity transmissions are : (assuming 3 active BSs)

1. *Joint* multiple BS transmission division in frequency domain.
    - Data packet is divided into three sub-packets, and each BS transmits one sub-packet, each BS organizes the space-time coding for two antennas and mapped onto OFDM time-frequency AMC sub-channel while 2/3 of the band is empty without signal transmission. Each transmitted AMC sub-channel is power boosted by $10\log_{10}(3)$dB to realize the full power transmission. The MSS receives the entire frequency band and performs space-time decoding to retrieve the packet data.
    - The same data packet is space-time encoded by each BS, each BS's transmission is mapped into different AMC sub-channel in frequency domain. The 2/3 of the band is empty without signal transmission. Each transmitted AMC sub-band is power boosted by $10\log_{10}(3)$ dB. The MSS receives the entire frequency band and performs diversity combining for each sub-bands and space-time decoding to retrieve the packet data.
2. *Joint* multiple BS antenna space-time coding transmission division in frequency domain.
    - Data packet is divided into three sub-packets. BS-1 antenna α and BS-2 antenna β performs the space-time encoding for the 1st sub-packet; BS-2 antenna α and BS-3 antenna α performs the space-time encoding for the 2nd sub-packet; BS-3 antenna β and BS-1 antenna β performs the space-time encoding for the 3rd sub-packet. Each antenna pair transmits one sub-packet, i.e. mapped onto one OFDM time-frequency sub-band accordingly, see Figure 1, the 2/3 of the band is empty without signal transmission. Each transmitted sub-band is power boosted by $10\log_{10}(3)$ dB. The SS receives the entire frequency band and performs space-time decoding to retrieve the packet data.
    - Data packet is encoded by 3 versions of space-time coding combinations (i) BS-1 antenna α and BS-2 antenna β (ii) BS-2-antenna α and BS-3 antenna α (iii) BS-3 antenna β and BS-1 antenna β antenna. Each combination transmits the same data packet. Each antenna pair is mapped onto one OFDM time-frequency sub-band accordingly and the 2/3 of the band is empty without signal transmission. Each transmitted sub-band is power boosted by $10\log_{10}(3)$ dB. The MSS receives

the entire frequency band and performs diversity combining for each sub-bands and space-time decoding to retrieve the packet data.

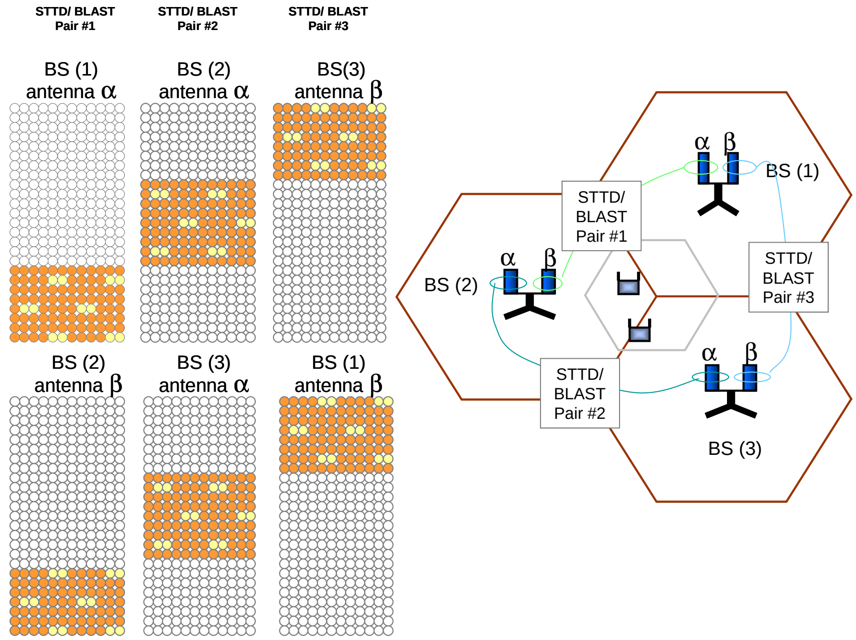

Figure 1 Example of MIMO Macro diversity transmission

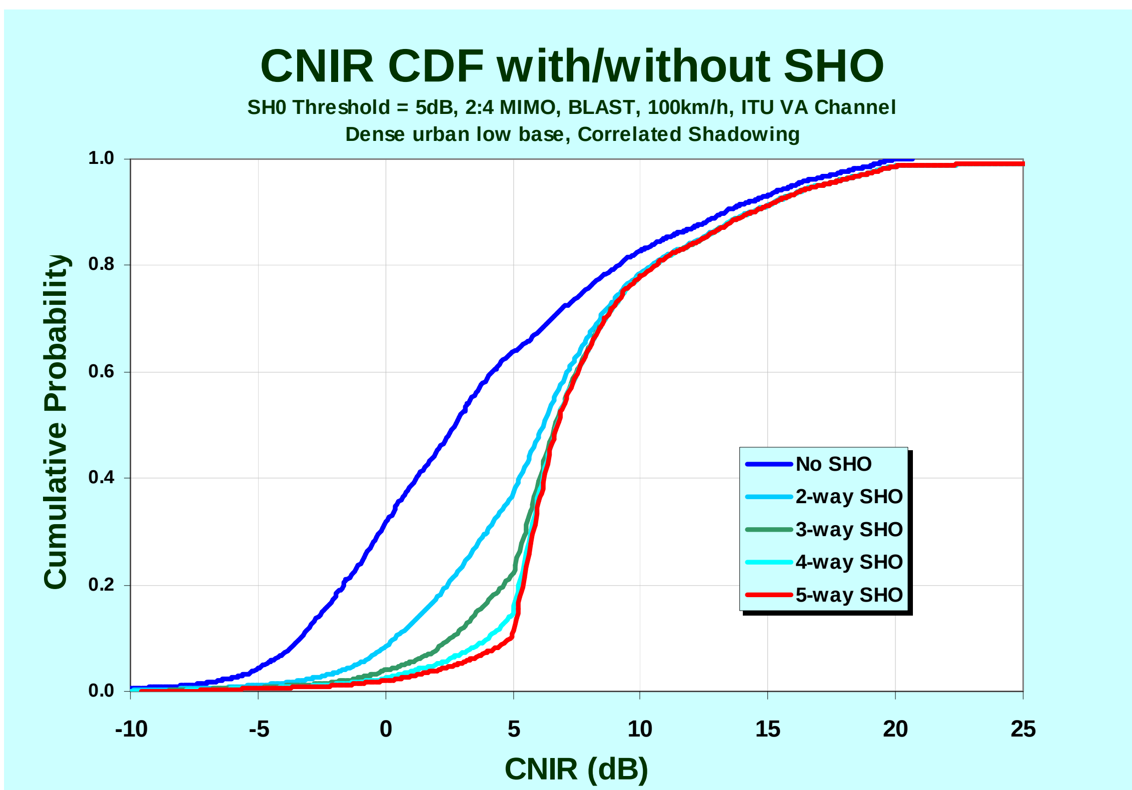

Figure 2 Impact of SHO-based Macro diversity transmission

The above schemes can be generalized to BSs with different configurations. All antennas from active BSs can be used as an anetenna pool. For each data region or subchannel, select certain number of antennas from the antenna pool to form MIMO transmission. To maximize the Macro diversity gain, it is preferred to select antennas for each transmission from different active BSs and vary antenna selection from sub-channel to subchannel. The actual scheme can be left for the implementation choice.

The procedure to establish the active BSs can reuse the SHO procedure.

Specific text changes

[Add the following text into section 8.4.8.2.4]

---------Start text proposal-------

8.4.8.2.4 MIMO Soft-hand-off based Macro-diversity Transmission

The soft hand-off (SHO) zone is defined by the OFDMA downlink TD_ZONE_IE by setting the IDcell=0, the same data regions are created among the SHO-BSs in the active set. The MSS demodulates the DL_MAP from anchor BS.

For the SHO-BSs joint transmission, for the STC capable MSS, the total *N* antennas of SHO-BSs constitute an antenna pool. The MIMO transmit format are specified in Section 8.4.8.1.4 for two-transmit-antenna case and Section 8.4.8.2.3 for four-transmit-antenna case. The MIMO pilot transmission is two-antenna transmission for PUSC and FUSC will follow the arrangement of the Figure 245 and section 8.4.8.1.2.1.2 respectively (Figure 207 for the optional FUSC and AMC permutations). The MIMO pilot transmission is four-antenna transmission for PUSC and FUSC will follow the arrangement of the Figure 251 and Section 8.4.8.2.2 respectively (Figure 208 for the optional FUSC and AMC permutations). The un-selected antennas are set to the null transmission.

---------End text proposal-------