Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**STC Enhancements for optional FUSC and AMC zones for OFDMA PHY Layer**
Date Submitted	**2004-05-19**
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Re:	In response to Comment #232 as a reply comment
Abstract	STC enhancements for the optional AMC and FUSC for the downlink
Purpose	Adoption of proposed changes into P802.16e
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STC Enhancements for Optional FUSC and AMC Zones for OFDMA PHY Layer

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1 Introduction

This document describes the PHY enhancements to enable the space-time coding (STC) functionalities in the optional FUSC and the optional adjacent subcarrier permutation (or AMC) zones for OFDMA [1]. The following features are proposed:

- Pilot and data allocation for 2 and 4-antenna BS in the optional FUSC and the optional AMC modes for the downlink (DL)
- Transmission schemes for open- and closed-loop STC with 2 and 4-antenna BS for DL

2 Specific Text Changes

2.1. Pilots and Data Allocation for STC

[Add a new section 8.4.8.3 in page 590 of [1]]

8.4.8.3 STC in the optional FUSC and the optional adjacent-subcarrier permutation zones for DL

Two optional zones, the optional FUSC and the optional AMC zones, are described in 8.4.6.1.2.3 and 8.4.6.3, respectively. In both zones, pilot subcarriers are allocated first according to Table 310 in 8.4.6.1.2.3. The remaining subcarriers are used for data transmission.

8.4.8.3.1 Allocation of pilot subcarriers

For 2-antenna BS, all pilots in the even symbols shall be allocated for antenna 0 whereas all pilots in the odd symbols shall be allocated for antenna 1. The positions of pilots in the odd symbols are further switched with those of data subcarriers whose locations coincide with pilots in the previous symbol. This is shown in Figure yyy-1.

For 4-antenna BS, pilot pattern shall first be changed as in the 2-antenna BS case, and then the neighboring two subcarriers shall be further punctured for antenna 2 and 3 as is shown in Figure yyy-2.

8.4.8.3.2 Allocation of data subchannels

In the optional FUSC zone with transmit diversity (TD) mode, the data subchannels shall be allocated for two consecutive OFDMA symbols. For the optional AMC zone and TD mode, the data subchannels shall be 3x2 (3 bins in 2 symbols) bin combination.

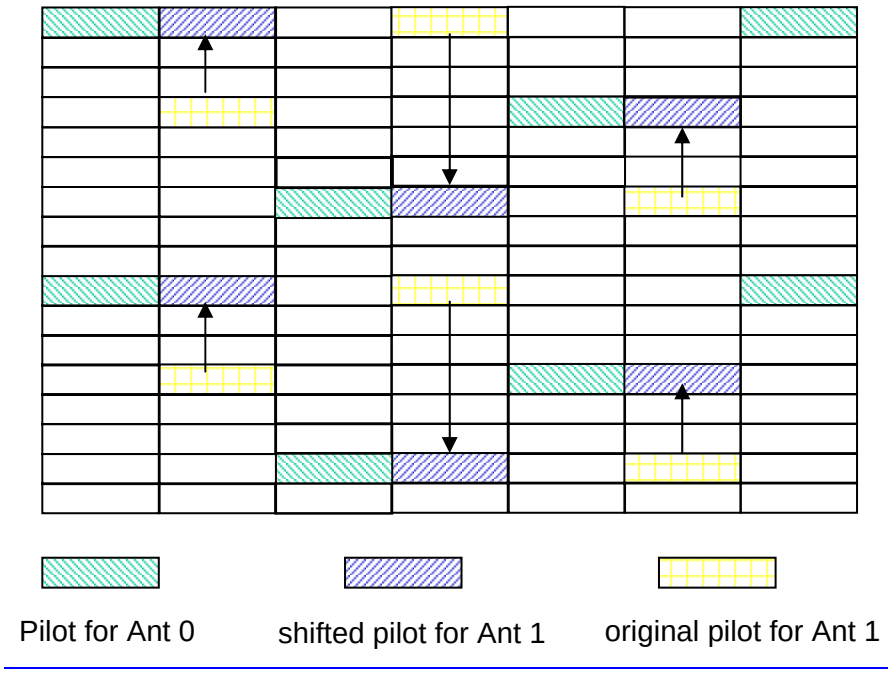

Figure yyy-1 Pilot allocation for 2-antenna BS for the optional FUSC and the optional AMC zones

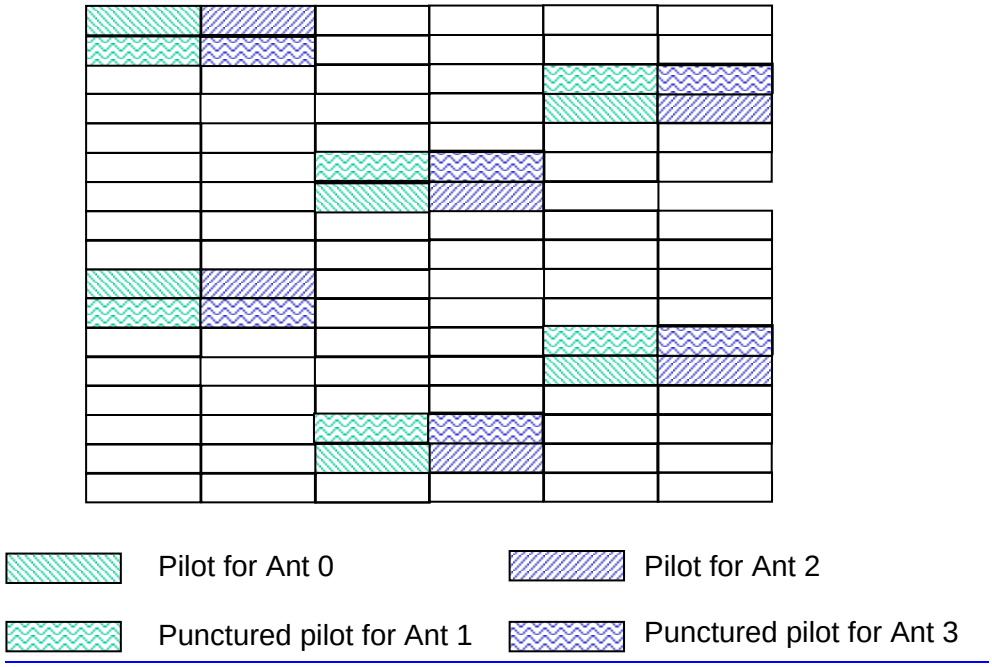

Figure yyy-2 Pilot allocation for 4-antenna BS for the optional FUSC and the optional AMC zones

2.2. STC Transmission Schemes for 2-antenna BS

[Add a new section 8.4.8.3.3]

8.4.8.3.3 Transmission schemes for 2-antenna BS

For both permutation zones with 2-antenna BS, one of the following two transmission matrices shall be used:

$A = \begin{bmatrix} s_1 & -s_2^* \\ s_2 & s_1^* \end{bmatrix}$;

$B = \begin{bmatrix} s_1 \\ s_2 \end{bmatrix}$, where s1 and s2 may be encoded in different rates.

When the AMC permutation zone is chosen, BS may further enhance the system performance by multiplying complex weights to antennas, thereby transmitting in one of the following two formats:

$A = \begin{bmatrix} s_1 w_0 & -s_2^* w_0 \\ s_2 w_1 & s_1^* w_1 \end{bmatrix}$;

$B = \begin{bmatrix} s_1 w_0 \\ s_2 w_1 \end{bmatrix}$. w_i are the fed-back antenna weights from SS through the fast feedback channels such as CQI channel and its mapping shall be done as shown in Figure 231. With $w_0 = 1$, BS may implement a simplified beamforming transmission. Furthermore, antenna selection diversity is achieved when one of $w_i = 0$. In order to facilitate fast and accurate adaptation, BS may issue multiple CQI channels to a certain SS (See 8.4.5.4.12.xx).

2.3. STC Transmission Schemes for 4-antenna BS

[Add a new section 8.4.8.3.4]

8.4.8.3.4 Transmission schemes for 4-antenna BS

For both permutation zones with 4-antenna BS, one of the following three transmission matrices shall be used:

$A = \begin{bmatrix} s_1 & -s_2^* & 0 & 0 \\ s_2 & s_1^* & 0 & 0 \\ 0 & 0 & s_3 & -s_4^* \\ 0 & 0 & s_4 & s_3^* \end{bmatrix}$, where the rates of s1 and s2 are the same but may be different from that of s3 and s4;

$B = \begin{bmatrix} s_1 & -s_2^* & s_5 & -s_7^* \\ s_2 & s_1^* & s_6 & -s_8^* \\ s_3 & -s_4^* & s_7 & s_5^* \\ s_4 & s_3^* & s_8 & s_6^* \end{bmatrix}$;

$C = \begin{bmatrix} s_1 \\ s_2 \\ s_3 \\ s_4 \end{bmatrix}$, where s_i may have different rates.

When the AMC permutation zone is chosen, BS may further enhance the system performance by multiplying complex weights to antennas as follows:

$$A = \begin{bmatrix} s_1 w_0 & -s_2^* w_0 & 0 & 0 \\ s_2 w_1 & s_1^* w_1 & 0 & 0 \\ 0 & 0 & s_3 w_2 & -s_4^* w_2 \\ 0 & 0 & s_4 w_3 & s_3^* w_3 \end{bmatrix};$$

$$B = \begin{bmatrix} s_1 w_0 & -s_2^* w_0 & s_5 w_0 & -s_7^* w_0 \\ s_2 w_1 & s_1^* w_1 & s_6 w_1 & -s_8^* w_1 \\ s_3 w_2 & -s_4^* w_2 & s_7 w_2 & s_5^* w_2 \\ s_4 w_3 & s_3^* w_3 & s_8 w_3 & s_6^* w_3 \end{bmatrix};$$

$$C = \begin{bmatrix} s_1 w_0 \\ s_2 w_1 \\ s_3 w_2 \\ s_4 w_3 \end{bmatrix}.$$

References:

[1] IEEE P802.16-REVd/D5-2004 Air Interface For Fixed Broadband Wireless Access Systems