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Improved Data and Pilot Allocation for Cellular OFDMA Systems with Multiple Antennas

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1. Introduction

Current draft standard [1] lacks the efficient methods for data and pilot allocation for OFDMA systems with multiple antennas in the sense that space time coding (STC) operates on the mapped subchannels rather than modulated symbols. When transmit diversity schemes are employed for subchannels that are rather long in time, the channel estimation at the receiver performs poorly. Furthermore, there could be potentially a long latency to decode at the receiver. Furthermore, data and pilot mapping for multiple antennas are not defined for UL in the optional permutation zones.

In this contribution, STC enhancements with multiple antennas at BS and SS for optional zones for downlink and uplink for OFDMA PHY are proposed. Pilots and data allocation methods are described and the transmission schemes for 2 and 4 antenna BS are also suggested for the downlink and the uplink.

2. Data and Pilot Allocation

2.1. Optional FUSC and AMC for Downlink

[Replace the section 8.4.8.3 in page 96 of [1] as follows]

8.4.8.3 STC for the optional zones in the downlink

Two optional zones for the downlink, the optional FUSC and the optional AMC zones, are described in 8.4.6.1.2.3 and 8.4.6.3 [2], respectively. STC may be used to improve system performance for these zones and an example of transmit diversity (TD) with 2 tx and 1 rx is shown in Figure aaa.

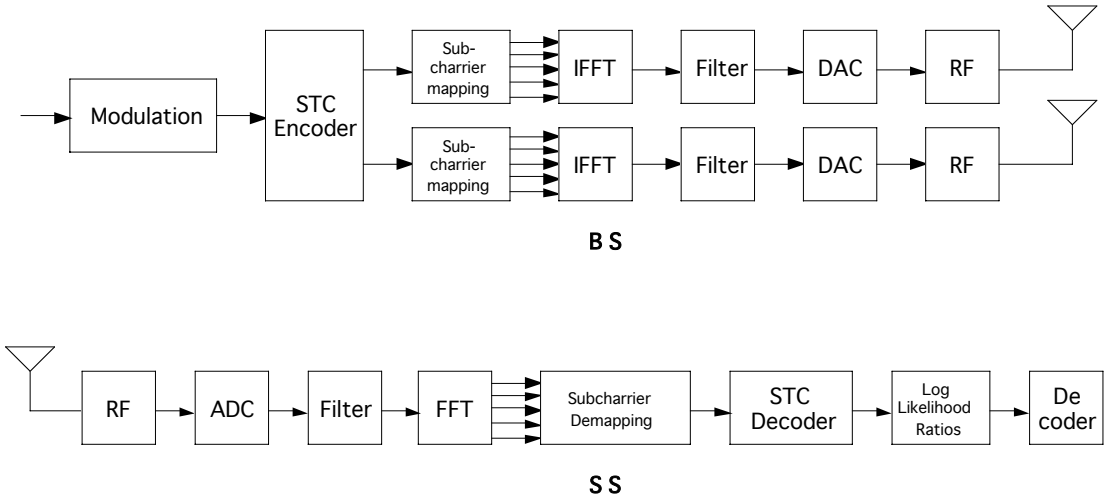

Figure aaa - Illustration of STC for optional zones in DL

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 bbb.

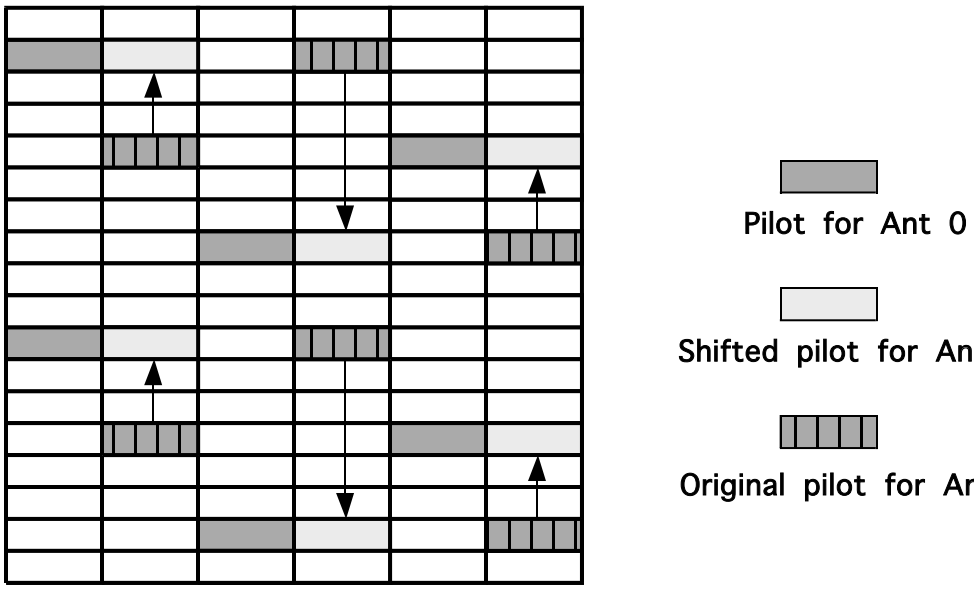

Figure bbb - Pilot allocation for 2-antenna BS for the optional FUSC and the optional AMC zones

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 ccc.

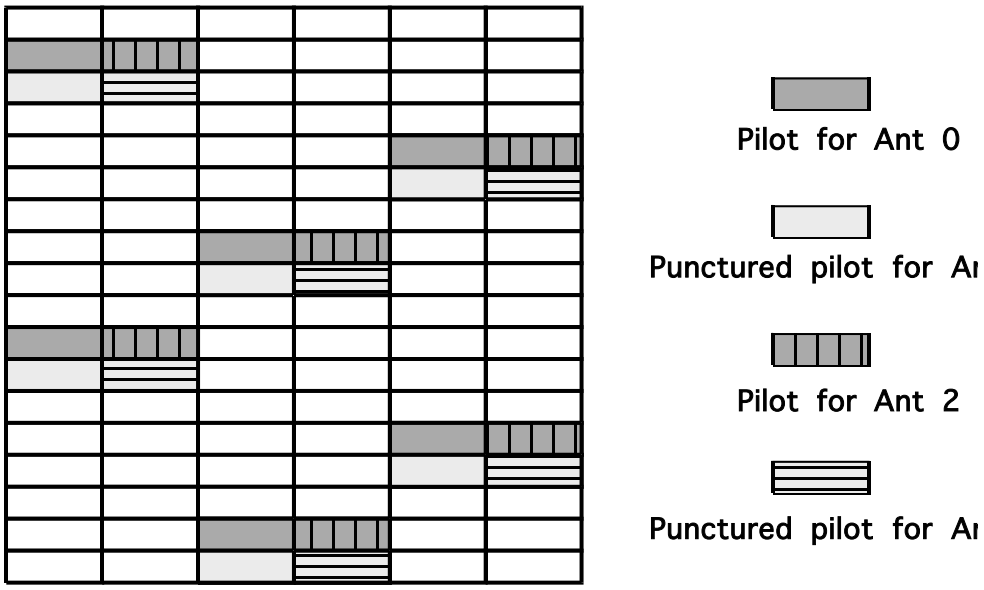

Figure ccc - Pilot allocation for 4-antenna BS for the optional FUSC and the optional AMC zones

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 either 1x6 (1 bin in 6 symbols) or 3x2 (3 bins in 2 symbols) bin combination.

2.2. Optional PUSC and AMC for Uplink

2.2.1. Specific Text Changes

[Add a new section 8.4.8.4]

8.4.8.4 STC for the optional zones in the uplink

Two optional zones in the uplink, the optional PUSC and the optional AMC zones, are described in 8.4.6.2.5 and 8.4.6.3[2], respectively. STC may be used to improve system performance for these zones. Furthermore, two single transmit antenna SS's can perform collaborative spatial multiplexing onto the same subcarrier.

8.4.8.4.1 Allocation of pilot subcarriers

For 2-antenna SS and the optional PUSC, pilots for each antenna shall be allocated as shown in Figure ddd.

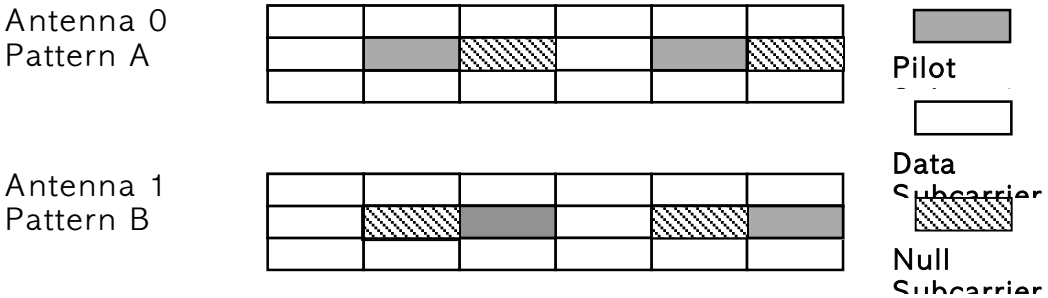

Figure ddd - Uplink pilot allocation for 2-antenna BS for the optional PUSC zones

For 2-antenna BS and the optional AMC, all pilots in the 1st ,2nd , 5th and 6th symbols shall be allocated for antenna 0, 1. This is shown in Figure eee.

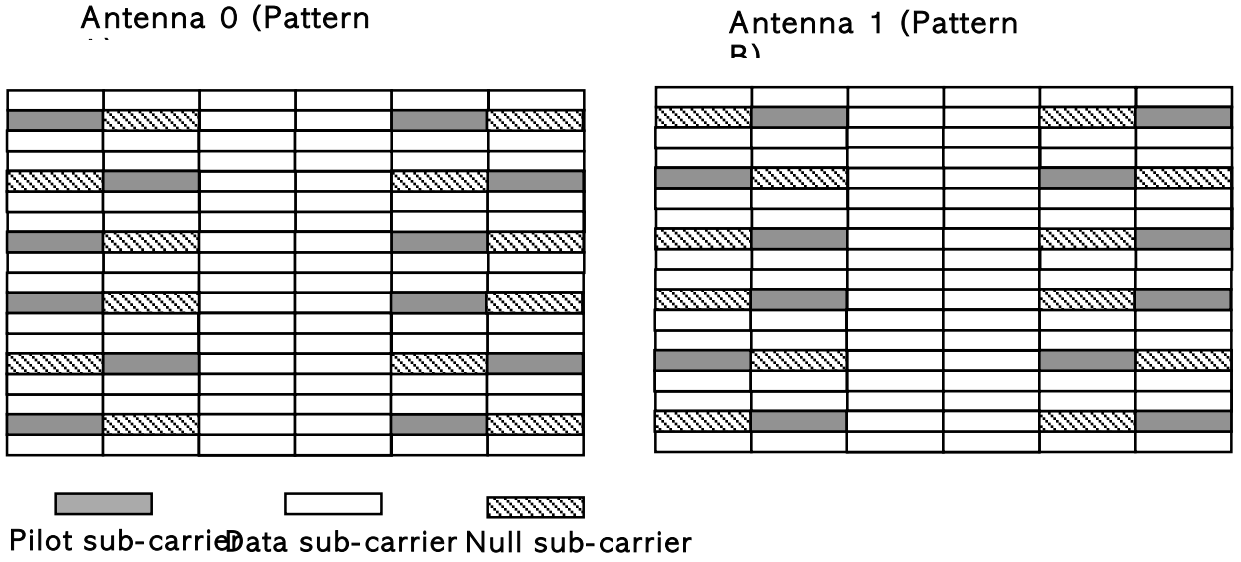

Figure eee - Uplink pilot allocation for 2-antenna BS for the optional AMC zones

Two single transmit antenna MSSs can perform collaborative spatial multiplexing onto the same subcarrier. In this case, one MSS should use uplink pilot allocation with pattern-A, and the other MSS should use the uplink pilot allocation with pattern-B.

8.4.8.4.2 Allocation of data subchannels

In the uplink optional PUSC zone with transmit diversity (TD) mode, the data subchannels shall be allocated for mini subchannel (type 01) as shown in Figure ddd. For the optional AMC zone with TD mode, the data subchannels shall be either 1x6 (1 bin in 6 symbols) or 3x2 (3 bins in 2 symbols) bin combination.

References:

[1] IEEE P802.16e/D3 Air Interface for Fixed and Mobile Broadband Wireless Access Systems – Amendment for Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands

[2] IEEE P802.16-REVd/D5-2004 Draft IEEE Standards for local and metropolitan area networks part 16: Air interface for fixed broadband wireless access systems