Project	IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>
Title	Modified Pilot Allocation for downlink STC PUSC
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Re:	IEEE 802.16e D5 Draft
Abstract	We propose a modification of the pilot allocation scheme in the PUSC mode for the two and four antenna case in the down link. This pilot allocation enhances the channel estimation performance for highly frequency selective channels, without incurring any extra overhead and without affecting the existing subcarrier permutations.
Purpose	To propose enhancements to the pilot allocation for downlink STC PUSC in 802.16e/D5.
Notice	
Release	
Patent Policy and Procedures	

Modified Pilot Allocation for Downlink STC PUSC

Beceem Communications, Inc.

1. Introduction

The 802.16e standard plans to support high data rates over large cells, which would invariably result in frequency selective fading. This makes the channel estimation problem quite challenging. This becomes especially so in the multiple antenna case and so the pilot allocation schemes should be very carefully designed. We propose a modified pilot placement across the time and frequency domains for the PUSC to improve the channel frequency response estimation. This is done without affecting the temporal channel tracking property of the pilots. Specifically, the scheme relies on the fact that channel is assumed to remain constant during the duration of the space time code (which in the PUSC mode extends over 2 slots and hence 4 OFDM symbols).

2. Proposed Pilot Allocation Schemes

2.1 Modified Pilot Allocation for the PUSC (the 2 antenna case)

The current pilot allocation scheme in the PUSC mode for the 2 antenna case is as described in the cluster structure of Figure 245 (p. 584) and reproduced in Figure 1(a). It is easy to see that the overhead of pilots and null carriers is 2 carriers/OFDM symbol/antenna and that it allows us to estimate (on average) 1 frequency bin/OFDM/antenna. We propose instead to replace it with the pilot configuration shown in Figure 1(b). This pilot configuration doubles the number of frequency bins that can be estimated for the same overhead of 2 carriers/OFDM symbol/antenna. Morever, this new configuration captures more of the frequency diversity as the pilot locations rotate from one symbol to the next. The only assumption made here is that the channel remains constant over 4 OFDM symbols (but this is a necessary condition anyway for ST coding to work).

2.2 Modified Pilot Allocation for the PUSC (the 4 antenna case)

The current pilot allocation scheme in the PUSC mode for the 4 antenna case is as described in the cluster structure of Figure 251 (p. 589). This configuration has an overhead of 4 carriers/ofdm-symbol/antenna and it allows us to effectively estimate 1 frequency-bin/per 2 OFDM symbol/per antenna. Moreover, we are forced to perform data puncturing to create enough space for pilots. We propose instead the pilot configuration in Figure 2 which allows to estimate the same effective number of frequency bins, namely 1 frequency-bin/per 2 OFDM symbol/per antenna, for half the overhead. This allows us to reduce the overhead (and hence avoid the need for data pucturing). The scheme assumes that the channel remains fixed over the ST block which is a prerequisite for ST coding to work.

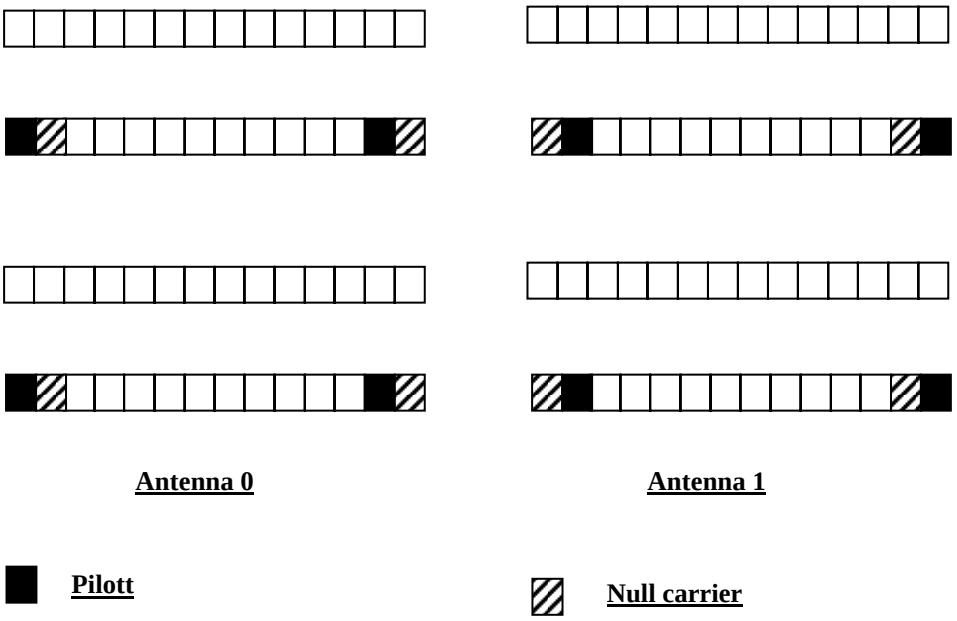

Figure 1(a) Current pilot allocation for PUSC (two antenna case)

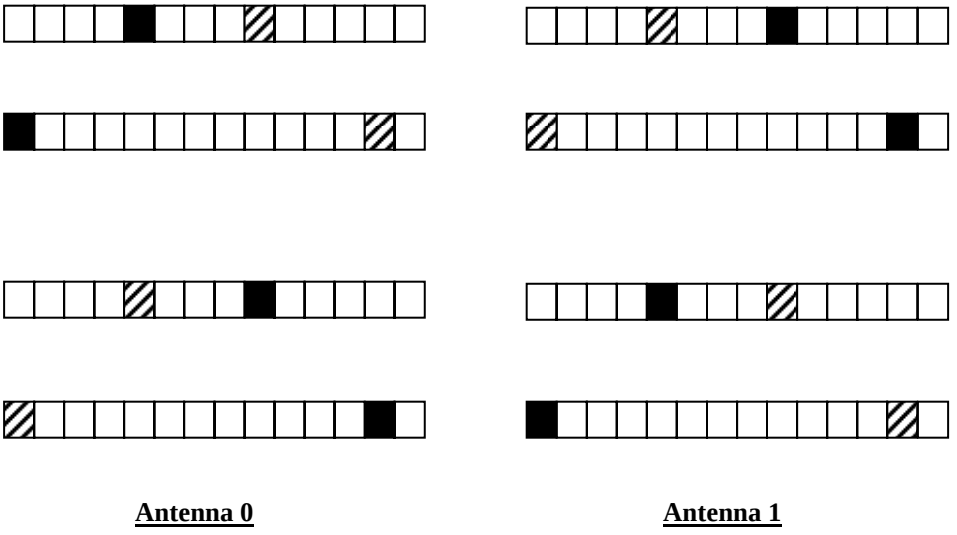

Figure 1(b) Modified pilot allocation for PUSC (two antennas case)

3. Specific text changes to 802.16e/D5

In section 8.4.8.1.2.1.1 STC using 2 Antennas in PUSC, replace the first two lines

In PUSC the data allocation to cluster is changed (Figure 245) to accommodate two antenna transmission with the same estimation capabilities, each cluster shall be transmitted twice from each antenna

with the following text

In PUSC the data allocation to cluster is changed according to the pilot allocation in Figure 1(b).

In section 8.4.8.2.1 STC for 4 antennas using PUSC, replace the whole text with the following text

For this configuration, two consecutive clusters are constructed according to Figure 2 to accommodate transmission from 4 antennas

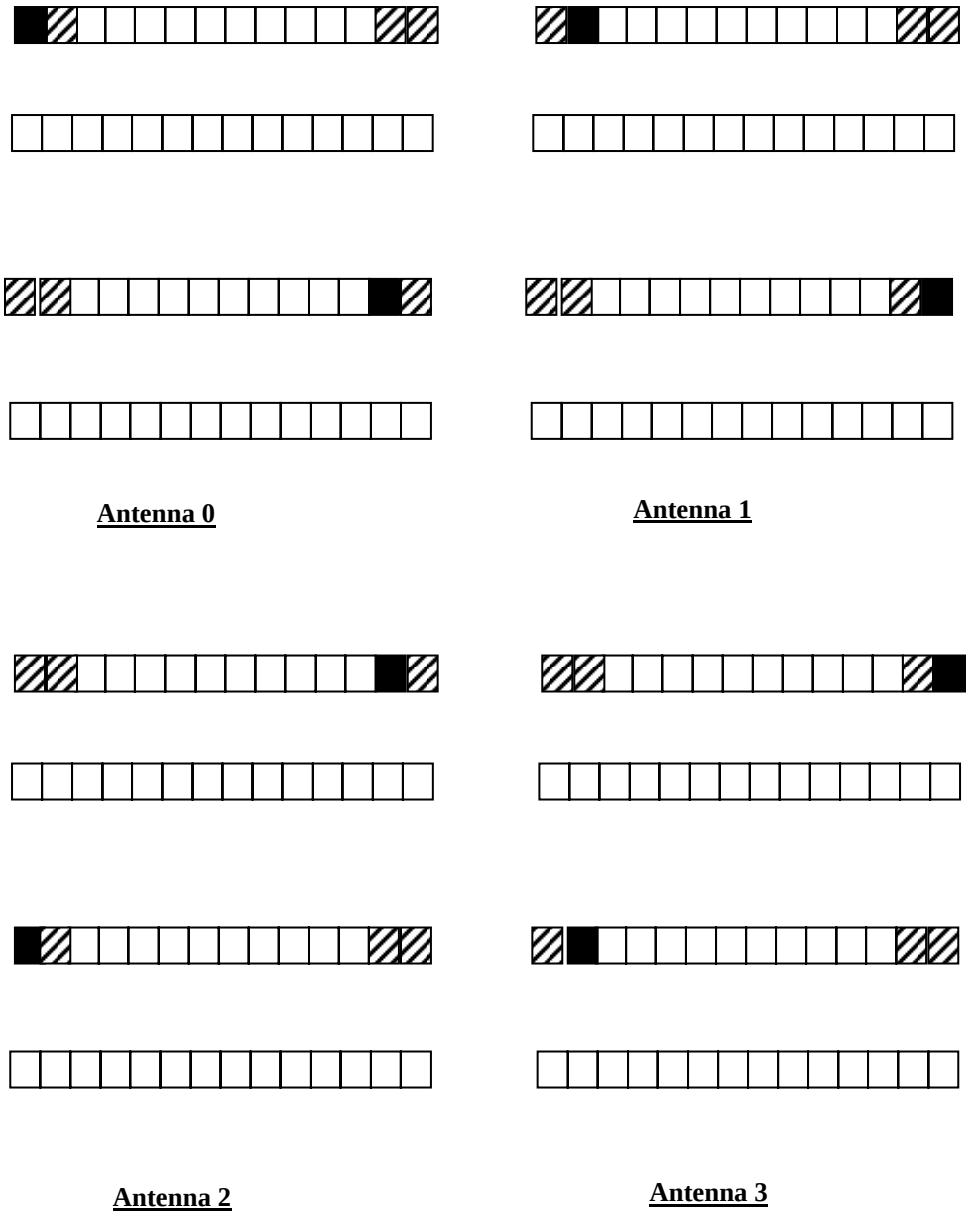

Figure 2 Modified pilot allocation for PUSC (four antenna case)