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Abstract		
Purpose		
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# Time Frequency Mapping of Downlink MIMO in OFDMA PHY

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## **1 Problem Statement**

The mapping of downlink MIMO in 802.16REVd/D5, deserves additional clarifications:

1. Time Frequency map filling order was changed to frequency first and then time. The effect of this on DL STC mapping is not clearly stated.
2. The ordering of modulated bursts into different STC layers is not stated.
3. In 8.4.8.2.3. page 589 line 54, it is stated that sub-channel symbol time is measured in “(two symbols per entry)”. While this is correct only for PUSC.

## Detailed Text Changes

### 1. Section 8.4.8.2.3:

[Modify text in 802.16-2004 from page 589 line 53 to line 56 as follows]

The following matrices defines the transmission format with the row index indicating the antenna number and column index indicating the subchannel symbol time (1 symbol per entry), the entrees defines the transmission from a subchannel used for this transmission configuration (the same operation is repeated for all subchannels used in this format).

[Add text at the end of Section 8.4.8.2.3]

The multi antenna transmission is described in terms of slots, where the burst modulators fill (frequency first) a vector of per sub-channel fifos. The input of each fifo is slot based and the output of each fifo is OFDMA-symbol based. Each such fifo is connected to an independent STC machine, which reads the slots, processes them, and finally outputs STC encoded data symbols per antenna for the corresponding subchannel.

The multi antenna transmission is defined differently for horizontal (Num-Layers>1) and vertical coding (Num-Layers=1). Vertical coding indicates transmitting the coded stream of a single burst over multiple antennas, while horizontal coding indicates transmitting a separate burst per antenna. More specifically the schemes depicted in figure XXX are elaborated below. The sequence  $\{S_k\}$  in the figure depicts the data QAM symbols allotted to the same subcarrier over consecutive in a subchannel over one OFDMA symbol duration time.

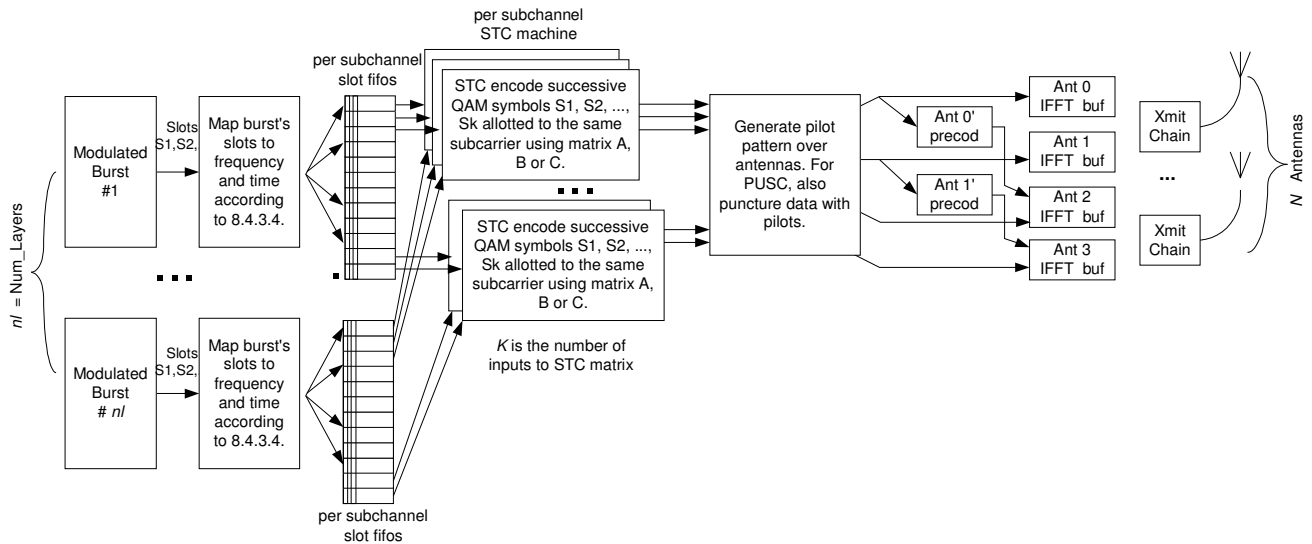


Figure XXX – N-antenna STC transmission

#### A. Horizontal Coding cases (Num\_layers >1):

A.1. The signal originates from Num\_layers>1 burst modulators, which either modulate successive bursts for a single user (mapped to layers with increasing index), or for Num\_layers different users (according to 8.4.5.3.8-9).

A.2. Each burst modulator feeds (frequency first) a set of sub-channel slot fifos according to burst width.

A.3. Sub-channel slot fifos are read by a set of independent STC machines, there are exactly Num\_layers sub-channels connected to each STC machine (one from each layer). The STC machine merely directs layer n of its input to antenna n. Therefore the STC machines output encoded data symbols per antenna per OFDMA symbol time.

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A.4. Finally the encoded data symbols are mapped to time and frequency (for the different antennas) and pilots are generated. For PUSC additional pilots puncture data when needed (8.4.8.2.1.).

B. Vertical Coding and Alamouti (Num layers =1):

B.1. The signal originates from a single burst modulator, modulating a single burst for a single user.

B.2. The burst modulator feeds (frequency first) a set of sub-channel slot fifos according to burst width. For each subchannel and slot time,  $R$  slots should be fed, where  $R$  is the space time coding rate. For  $R > 1$ , there are  $R$  feeding rounds per slot time. The first round slots are fed in sub-channel order, then the second round slots are fed in sub-channel order, and so on.

B.3. Sub-channel slot fifos are read by a set of independent STC machines, there is exactly one sub-channel connected to each STC machine. Each STC machine applies its respective matrix (i.e. A, B or C) to successive outputs of its respective sub-channel, where the matrix rows correspond to antennas, and matrix columns to OFDMA symbol times. Therefore the STC machines output encoded data symbols per antenna per OFDMA symbol time.

B.4. Finally the encoded data symbols are mapped to time and frequency (for each antenna separately) and pilots are generated. For PUSC, additional pilots puncture data when needed (8.4.8.2.1.).

Directivity of the two antenna transmission schemes may be enhanced using 8.4.8.1.6. as depicted in figure XXX.