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Re:	Call for comments, maintenance task group
Abstract	
Purpose	
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Corrections to definitions of Uplink MIMO in OFDMA PHY

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1 Problem Statement

Several inconsistencies and ambiguities exist in the definitions of uplink MIMO in 802.16REVd/D5, specifically:

1. The data-subcarrier mapping scheme for UL STTD is not defined (8.4.8.1.5). Note that encoding subcarrier pairs across multiple tiles is not possible due to the existence of the subchannel rotation scheme.

2. MIMO_UL_Basic_IE (8.4.5.4.11):

    a. This IE describes UL allocations, which should be similar in concept to the regular UL-MAP_IE. The first paragraph in the section is therefore not correct as it refers to a subsequent allocation and mentions ongoing relevance until the end of the frame.

    b. *Duration* is specified for each burst in the IE. It is unclear how an SS should sum over semi-overlapping durations when computing slot offset (for instance when multiple allocations are specified in the IE, each with a different duration), and how it should calculate the slot offset for a regular UL-MAP_IE (or an additional MIMO IE) that follows a MIMO IE.

    c. The *MIMO_Control* field is defined differently for a 'dual transmission capable' SS and for a 'Collaborative SM capable SS'. It is not clear what an SS that supports both schemes should use.

    d. *CID* is specified to be the SS's Basic CID. The CID should specify any unicast CID, as in the regular UL-MAP_IE.

    e. Clarification is needed as to the requirements from a non-MIMO-enabled SS: Such an SS should still be able to decode the MIMO_UL_Basic_IE in order to add the appropriate duration to the overall slot offset count.

    f. *Num_Assign* is defined as having 4 bits, supporting up to 16 layers. This requires an SS to maintain the state (needed for accumulating duration of slot offset) of 16 layers concurrently. For comparison, on the downlink only 4 layers are supported (!).

g. STTD can currently only be defined as part of the MIMO_UL_Basic_IE(). However it should be supported by regular UL-MAP_IEs, as is the case for downlink STC. A separate switch IE in the map should exist for toggling STTD mode.

3. Pilot boosting level for UL PUSC in SM and collaborative SM modes: a boost of 3dB per pilot is warranted since each power amplifier (antenna) transmits only half of the pilots in each symbol.

4. Definition of uplink MIMO capability negotiation is missing.

2 Detailed Text Changes

1. Correct section 8.4.8.1.5: provide missing definition of STTD mode, define data subcarrier mapping in STTD mode.

[Modify section 8.4.8.1.5 as follows]

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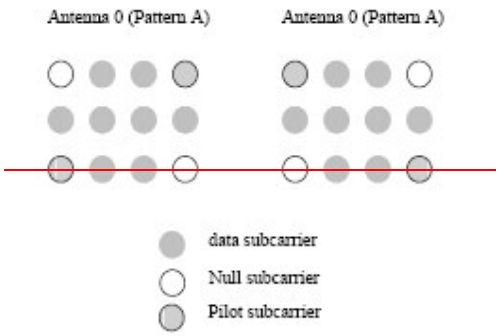
8.4.8.1.5 Uplink using STC

A user supporting transmission using STC configuration in the uplink, shall use a modified uplink tile~~.~~, 2-transmit diversity ('STTD mode') data or 2-transmit spatial multiplexing ('SM mode') data can be mapped onto each subcarrier~~.~~. The mandatory tile shall be modified to ~~accumudate~~ accommodate those configurations. ~~Figure 249 depicts the UL tile for STC transmission.~~



~~Figure 249 – UL STC tile~~

In STTD mode, the tiles shall be allocated to subchannels and the data subcarriers enumerated as defined in 8.4.6.2. The pilots in each tile shall be split between the two antennas and the data subcarriers shall be encoded in pairs after constellation mapping, as depicted in figure 249. The data subcarriers transmitted from Antenna #0 follow the original mapping defined in 8.4.6.2.

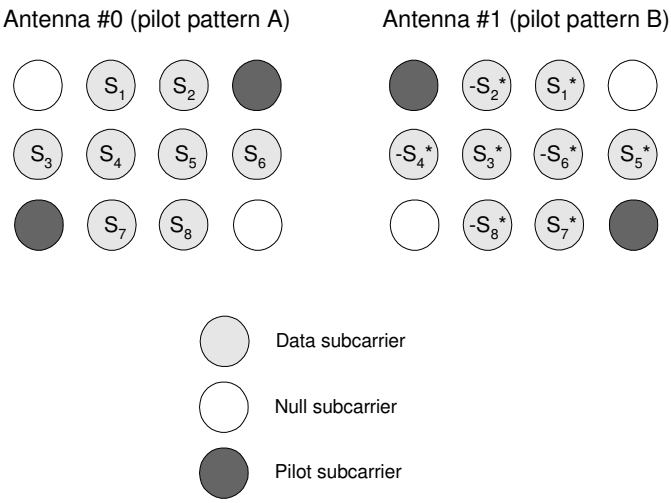


Figure 249 – Mapping of data subcarriers in STTD mode.

Two single transmit antenna SS's can perform collaborative spatial multiplexing onto the same subcarrier. In this case, ~~the~~ one SS shall ~~should~~ use the uplink tile with pilot-pattern A, and the other SS shall ~~should~~ use the uplink tile with pilot-pattern B. The pilot patterns are depicted in figure 249.

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2. Section 8.4.5.4.11: Clarify text, define duration accumulation, and define 'layer index' for accumulating duration needed for tracking slot offset.

[Modify section 8.4.5.4.11 as follows]

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8.4.5.4.11 MIMO UL Basic IE format

In the UL-MAP, a MIMO-enabled BS may transmit UIUC=15 with the MIMO_UL_Basic_IE() to ~~indicate the MIMO mode of the subsequent uplink allocation to a specific MIMO-enabled SS CID~~ describe uplink allocations assigned to MIMO-enabled SSs. The MIMO mode indicated in the MIMO_UL_Basic_IE() shall only apply to the ~~subsequent uplink~~ allocations described in the IE ~~until the end of frame~~.

A MIMO-enabled SS shall track the slot offset within the UL zone by accumulating duration for each MIMO layer independently. For the purpose of tracking the slot offset, a MIMO-enabled SS shall regard non-MIMO allocations described by an UL-MAP_IE as assigned to the first MIMO layer. An SS that is not MIMO-enabled shall accumulate the duration assigned to the first MIMO layer when tracking the slot offset within the zone.

Table 297—MIMO UL basic IE format

Syntax	Size	Notes
MIMO_UL_Basic_IE() {		
Extended UIUC	4 bits	MIMO = 0x02
Length	4 bits	~~Length of the message in bytes~~ (variable)
Num_Layers~~Assign~~	2 ~~4~~ bits	~~Number of burst assignment~~
reserved	2 bits	Shall be set to zero
For (j=0; j<Num_Layers~~assign~~; j++) {		
Layer_Index	2 bits	
CID	16 bits	~~SS basic CID~~

UIUC	4 bits	
MIMO_Control	2 ~~1~~ bits	~~For dual transmission capable SS~~ ~~0: STTD~~ ~~1: SM~~ ~~For Collaborative SM capable SS~~ ~~0: pilot pattern A~~ ~~1: pilot pattern B~~ 0b00: STTD 0b01: SM 0b10: Collaborative SM, pilot pattern A 0b11: Collaborative SM, pilot pattern B
Duration	10 bits	In OFDMA slots (see 8.4.3.1)
reserved	2 bits	Shall be set to zero
}		
If (! byte boundary) {		
Padding nibble	4 bits	Padding to reach byte boundary
}		
}		

Num_Layers ~~**Num_assign**~~
~~This field specifies the number of assignments in this IE.~~
This value plus one indicates the number of MIMO layers for which allocations are described in this IE.

Layer_Index
Index of the MIMO layer to be used for transmitting this IE.

CID
Unicast CID to which the allocation is assigned.

MIMO_Control
MIMO_Control field specifies the MIMO mode of UL burst. ~~For a dual transmission capable SS, the value of 0 indicates STTD mode, the value of 1 indicates SM mode; For a collaborative SM capable SS, the value of 0 indicates pilot pattern A, the value of 1 indicates pilot pattern B.~~

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3. Add section 8.4.5.4.14: define UL STTD switch.

[Add new section 8.4.5.4.15]

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8.4.5.4.15 Uplink STTD switch IE format
In the UL-MAP, a BS supporting uplink STTD may transmit UIUC=15 with the UL_STTD_IE () to toggle the use of STTD in subsequent allocations. The STTD_IE () can appear anywhere in the UL-MAP and it shall remain in effect until another STTD_IE() is encountered or until the end of the UL-MAP. The UL-MAP message shall begin in non-STTD mode. The BS, while in STTD mode, may only assign allocations to SSs that support uplink STTD.

Syntax	**Size**	**Notes**
UL_STTD_IE() {		
Extended UIUC	4 bits	STTD = 0x06
Length	4 bits	Length = 0x0
}		

-------- END --------

4. Add 3dB boosting for SM and collaborative SM modes.

[Modify section 8.4.9.4.3, page 621 lines 1-3]

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In the downlink, and for the optional uplink tile structure each pilot shall be transmitted with a boosting of 2.5 dB over the average power of each data tone. For the mandatory uplink tile structure in SM and collaborative SM modes, each pilot shall be transmitted with a boosting of 3dB over the average power of each data tone. The Pilot subcarriers shall be modulated according to the following formula:

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5. Add section 11.8.3.7.7: define uplink MIMO capability negotiation.

[Add new section 11.8.3.7.7]

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11.8.3.7.7 OFDMA SS MIMO uplink support

This field indicates the different MIMO options supported by a WirelessMAN-OFDMA PHY SS in the uplink. This field is not used for other PHY specifications. A bit value of 0 indicates "not supported" while 1 indicates "supported."

Type	Length	Value	Scope
155	1	Bit #0: 2-antenna STTD Bit #1: 2-antenna SM Bit #2: single-antenna cooperative SM Bit #3-#7: *reserved*	SBC-REQ (see 6.3.2.3.23) SBC-RSP (see 6.3.2.3.24)

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