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| Re: | IEEE 802.16-REVe/D5a, BRC recirc |
| Abstract | DL channel sounding based on relaying the received downlink pilot at UL |
| Purpose | To incorporate the changes here proposed into the 802.16e/D5a draft. The update is in blue font |
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# DL channel sounding based on relaying the received downlink pilot at UL

## 1 Introduction

This contribution provides a modification to the uplink channel sounding proposed in [1]. The advantage of this approach is to allow BS to estimation the down link wide band channel response in the FDD operation. In [1] after the DL channel is estimated. And then the estimation channel is modulate on the UL sounding pilot to assist BS to further estimate DL channel to perform beam-forming. In this contribution, we propose to use the existing .16e DL and UL pilot constructs to achieve the same object in a more efficient fashion. In Figure 1, the DL sounding symbols (decimate in frequency domain) are received by MSS modem, the MSS applies the received soft sample of received pilot as UL sounding symbol (to replace the CSIT sounding symbol as a transponder pilot), in addition, the MSS also transmission the CSIT sounding pilot. Figure 1 also demonstrates an example how BS can use the transponder pilot and CSIT pilot to estimate both UL channel and L channel.

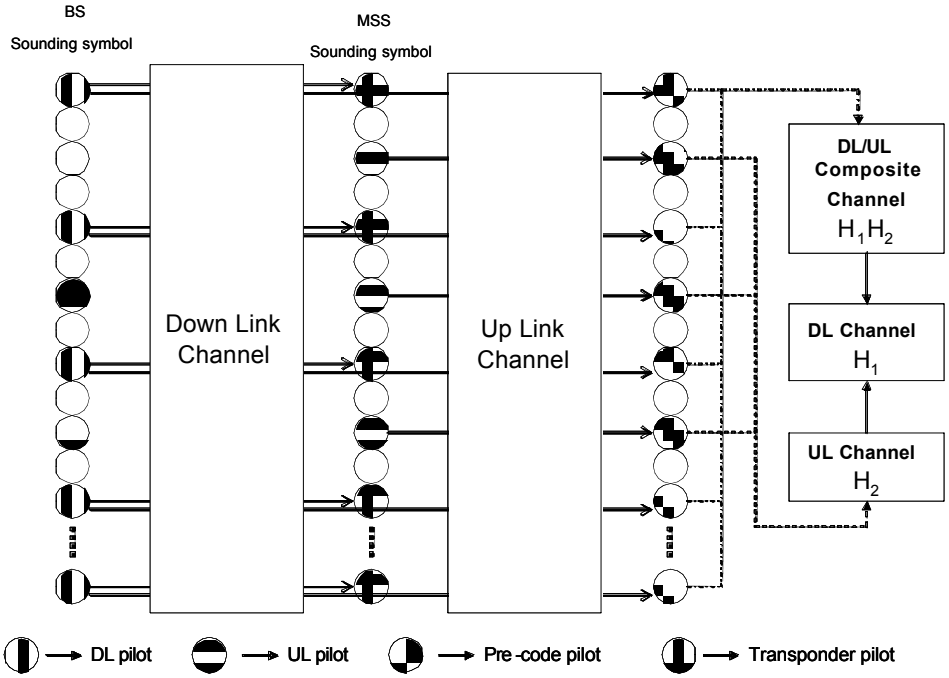


Figure 1 Joint CSIT pilot and transponder pilot channel sounding for FDD

## 2 Proposed Text Change

Add a new section 8.4.6.2.7.3 “Joint CSIT pilot and transponder pilot UL channel sounding”.

--------- *Start text* ----------

**Section 8.4.6.2.7.3 Joint CSIT pilot and received DL pilot for UL channel sounding**

For UL CSIT sounding type-B, the sub-set of the sounding sub-carriers can be replaced by the received DL pilots, which can be ~~sub-set preamble, common SYNC symbol for single BS antenna transmit or the~~ middle-amble for single and multiple antennas transmit.

For the single and multiple transmit antenna case, the uplink sound symbol is allocated with Decimation value D=3,4,5,6, with Decimation Offset value d=0, the decimation offset randomization shall be disabled , the received

MIMO mid-amble value is allocated with Decimation Offset value d=1 and at the location of $-(N_{used}/2)+n+2^{D+1}\left\lfloor\frac{N_t}{2}\right\rfloor$ where $N_t$=1,2,3,4, the $N_{used}$, and n are defined in Section 8.8.85

*--------- End text ----------*

*[In Section 8.4.6.2.7, modify Table 311 as follows:]*

*----------Start Text ----------*

Table 311: UL_Sounding_Command_IE()

| Syntax | Size | Notes |
|---|---|---|
| UL_Sounding_Command_IE(){ | | |
| **Extended UIUC** | 4 bits | 0x09 |
| Length | 4 bits | Variable |
| Sounding_Type | 1 bit | 0 = Type A<br>1 = Type B |
| Send Sounding Report Flag | 1 bit | |
| Include_additional_feedback | 2 bits | 00 = No additional feedback<br>01 = include channel coefficients (See Section 8.4.6.2.7.3)<br>10 = include received pilot coefficients<br>11 = include feedback message |
| | | |
| If (Sounding_Type == 0) { | | |
| Num_Sounding_symbols | 3 bits | Total number of sounding symbols being allocated, from 1 (“000”) to $2^3$=8 (“111”) |
| Separability Type | 1 bit | 0: occupy all subcarriers in the assigned bands;<br>1: occupy decimated subcarriers |
| if (Separability type==0) { | | (using cyclic shift separability) |
| Max Cyclic Shift Index P | 2 bits | 00:P=4;<br>01:P=8;<br>10:P=16,<br>11: P=32 |
| } Else { | | (using decimation separability) |
| Decimation Value D | 3 bits | Sound every $D^{th}$ subcarrier within the sounding allocation. Decimation value D is 2 to the power of (2 plus this value), hence 4,8,… up to maximum of 64. |
| Decimation offset randomization | 1 bit | 0= no randomization of decimation offset<br>1= decimation offset pseudo-randomly determined |
| } | | |
| For (i=0;i<Num_Sounding_symbols;i++){ | | |
| Sounding symbol index | 3 bits | Symbol index within the Sounding Zone, from 1 (bits “000”) to $2^3$=8 (bits “111”) |
| Number of CIDs | 4 bits | Number of CIDs sharing this sounding allocation |
| For (j = 0; j<Num. of CIDs; j++) { | | |
| Shorted basic CID | 12 bits | 12 LS bits of the MSS basic CID value |
| Starting Frequency Band | 7 bits | Out of 96 bands at most (FFT size dependent) |
| Number of frequency bands | 7 bits | Contiguous bands used for sounding |
| Power Assignment Method | 2 bits | 0b00 = equal power;<br>0b01 = reserved;<br>0b10 = Interference dependent. Per subcarrier power limit;<br>0b11 = Interference dependent. Total power limit |
| Power boost | 1 bit | 0 = no power boost<br>1= power boost |
| Multi-Antenna Flag | 1 bit | 0=MSS sounds first antenna only<br>1=MSS sounds all antennas |
| if (Separability type==0) { | | |
| Cyclic time shift index m | 5 bits | Cyclically shifts the time domain symbol by multiples (from 0 to P –1) of N/P where N=FFT size, and P=Max Cyclic Shift Index. |
| } Else { | | |
| Decimation Offset d | 6 bits | Relative starting offset position for the first sounding occupied subcarrier in the sounding allocation |
| } | | |
| Periodicity | 3 bits | |

| | | |
|---|---|---|
| | | 000 = single command, not periodic, or terminate periodicity. Otherwise, repeat sounding once per r frames, where r = 2^(n-1), where n is the decimal equivalent of the periodicity field |
| } | | |
| } | | |
| } else { | | |
| Permutation | 2 bits | 0b00 = PUSC perm.<br>0b01 = FUSC perm.<br>0b10 = Optional FUSC perm.<br>0b11 = Adjacent subcarrier perm. |
| IDcell | 6 bits | |
| Num_Sounding_symbols | 3 bits | |
| for (i=0;i<Num_Sounding_symbols;i++){ | | |
| Number of CIDs | 7 bits | |
| For (j=0; j<Number of CIDs; j++) { | | |
| Shortend basic CID | 12 bits | 12 LS bits of the MSS basic CID value |
| Subchannel offset | 7 bits | The lowest index subchannel used for carrying the burst, starting from subchannel 0 |
| Number of subchannels | 3 bits | The number subchannels with subsequent indexes, used to carry the burst. |
| Periodicity | 3 bits | 000 = single command, not periodic, or terminate periodicity. Otherwise, repeat sounding once per r frames, where r = 2^(n-1), where n is the decimal equivalent of the periodicity field |
| Power Assignment Method | 2 bits | 0b00 = equal power;<br>0b01 = reserved;<br>0b10 = Interference dependent. Per subcarrier power limit;<br>0b11 = Interference dependent. Total power limit |
| Power boost | 1 bit | 0 = no power boost<br>1= power boost |
| } | | |
| } | | |
| } | | |
| Padding | Variable | Pad IE to octet boundary. Bits shall be set to 0 |
| } | | |

----------End Text ----------

# 3 Reference

[1] C80216e-04/422r2:"Improvements to the Uplink Channel Sounding Signaling for OFDMA"