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Source(s)		
	Yigal Leiba	Voice:+972-3-9528440 Fax:+972-3-9528805
	Yossi Segal	yigall@runcom.co.il
	Zion Hadad	yossis@runcom.co.il
	Itzik Kitroser	zionh@runcom.co.il
	Eli Shasha	Itzikk@runcom.co.il
	Runcom Ltd.	shasha@runcom.co.il

Re:	Recirculation #14c of IEEE P802.16e/D4-2004
Abstract	Downlink channel sounding method for OFDMA PHY
Purpose	Adoption and inclusion in 802.16e specification
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DL channel sounding for OFDMA PHY

1 Abstract

Knowledge of the DL channel by the BS prior to DL transmission enables performance optimization for single antenna as well as multiple antenna system. Such knowledge can be obtained via explicit feedback reports from the MSS, or, in TDD systems, via UL channel sounding methods and reliance on the channel reciprocity. This contribution attempts to introduce such a channel sounding method.

2 Brief overview of existing feedback methods

2.1 Direct feedback methods

The 802.16e draft specification includes several messages for providing explicit feedback on the DL channel quality perceived by the MSS. Among these messages, the most relevant are:
CQI – Provides a CINR measurement of the DL channel on intervals instructed by the BS
AAS-FBCK-RSP – This message provides a measurement of the channel response in the frequency domain at the density requested by the BS. The message provides CINR and RSSI measurements as well.
REP-RSP – This message provides CINR and RSSI measurements when requested by the BS. For the AMC permutation, the message can provide a CINR per AMC band.

2.2 Indirect feedback methods

There are currently two major ways of UL channel sounding based on existing UL transmissions:
Ranging code based estimation – In all permutations except the AMC permutation the sub-carriers composing the UL ranging channel are more or less evenly distributed across the channel BW. Transmission of one or more a ranging code, which is a known sequence, by any MSS enables therefore UL channel sounding.
Embedded pilots based estimation – Any UL data transmission included pilots, which form a known sequence to the receiver. In all permutations except the AMC permutation the pilots embedded in the UL data channel are more or less evenly distributed across the channel BW, and therefore enable UL channel sounding.

2.3 Shortcomings of current methods

The existing direct feedback methods do not enable independent channels sounding per BS antenna in situations where the BS has more than one antenna. In addition, they tend to consume considerable BW if a detailed measurement report is required. The existing indirect methods can generally be used for UL channel sounding, but since they where designed for another major purpose, they are not optimized for channel sounding, increase the processing requirements in the BS, and limit flexibility.

2.4 Essentials of proposed new sounding method

The proposed sounding methods is based on the simple principles listed below:

- Support of the UL sounding method is optional for both BS and MSS
- The method makes use of the existing UL safety-zone allocation for allocating entire OFDMA symbols for sounding purpose
- The permutation used on the DL and the sub-channel/band assignment used on the DL is applied to these UL sounding symbols
- When sounding, the BS may assign allocations covering the DL sub-channel it wishes to use for future transmissions(s) to the MSS

- The DL preamble (mirrored around the DC sub-carrier the frequency domain) is used as the sounding sequence to reduce MSS storage requirements

3 Specific text changes

[Modify page 132 line 16 insert a new section and editing instructions as shown below]

[Change section 8.4.5.4.2:]

8.4.5.4.2 PAPR reduction/Safty zone allocation IE

Table 287 defines the PAPR reduction allocation and safety zone allocation IE. This IE is identified by UIUC =13.

Table 287—PAPR reduction and safety zone allocation IE format

Syntax	Size	Notes
PAPR_Reduction_and_Safty_Zone_Allocation_IE() {		
OFDMA symbol offset	8 bits	
Subchannel offset	7 bits	
No. OFDMA symbols	7 bits	
No. subchannels	7 bits	
PAPR Reduction/Safety Zone	1 bit	0 = PAPR reduction allocation 1 = Safety zone allocation
Sounding Zone	1 bit	0 = PAPR/Safety Zone 1 = Sounding Zone
reserved	~~2~~1 bit~~s~~	Shall be set to zero
}		

OFDMA Symbol offset
The offset of the OFDMA symbol in which the burst starts, the offset value is defined in units of OFDMA symbols and is relevant to the Allocation Start Time field given in the UL-MAP message.
Subchannel offset
The lowest index subchannel used for carrying the burst, starting from subchannel 0.
No. OFDMA Symbols.
The number of OFDMA symbols that are used to carry the uplink Burst.
Number of subchannels
The number subchannels with subsequent indexes, used to carry the burst.
Sounding Zone
When this bit is set to 1, all the OFDMA sub-channels shall be allocated for the sounding zone, and the PAPR reduction/Safety zone allocation IE shall be followed by sounding allocation IE(s) that describe the allocations on the sounding zone

[On page 143, line 12 insert a new section and editing instructions as shown below]

[Add a new section 8.4.5.4.21:]

8.4.5.4.2 Sounding Zone Assignment IE

Table xxx defines the Sounding zone assignment IE. In the UL-MAP, a BS may transmit UIUC=15 with the Sounding_Zone_IE() following a PAPR_Reduction_and_Safty_Zone_Allocation_IE() to assign transmission slots in the Sounding Zone. The BS shall only assign transmission slots to MSS that indicated support of the Sounding-Zone-Support feature in the SBC-REQ/RSP capabilities negotiation

Table xxx— Sounding Zone Assignment IE IE format

Syntax	Size	Notes
Sounding_Zone_IE() {		
Extended UIUC	4 bits	Sounding = ?

Length	4 bits	Length = Varibale
Permutation	2 bits	0b00 = PUSC permutation 0b01 = FUSC permutation 0b10 = Optional FUSC permutation 0b11 = Adjcent subcarrier permutation
IDcell	6 bits	
OFDMA Symbol offset	4 bits	OFDMA symbol offset within the safety zone where the allocation take place
Subchannel offset	6 bits	Sub-channel symbol offset within the safety zone where the allocation starts
Num. Allocations	4 bits	Sub-channel offset within the safety zone
For (j=0; j< Num. Allocations; j++) {		
Shortend basic CID	12 bits	The 12 LS bits of the MSS basic CID
No. Subchannels	6 bits	Number of sub-channel allocated for the transmission
}		
Padding	Variable	Pad IE to reside on Octet boundary. Padding bits shall be set to 0
}		

When allocated a transmission slot within the sounding zone, the MSS shall transmit on the sub-carriers allocated to it a sequence derived from the DL frame preamble. The transmitted sequence is derived by mirroring of the DL frame preamble in the frequency domain, and transmitting only those sub-carriers that map to data sub-carriers of the sub-channels assigned for the MSS.

[On page 192, line 49 insert a new section and editing instructions as shown below]

[Add a new section 11.8.3.7.10:]

11.8.3.7.10 Sounding Zone Support

This field indicates whether the MSS supports UL sounding on the UL safety zone for the DL permutations supported by the MSS. A bit value of 0 indicates "not supported" while 1 indicates "supported".

Type	Length	Value	Scope
TBD	1	Bit #0: Sounding Zone Support Bits #1–7: *Reserved*, shall be set to zero	SBC-REQ (see 6.3.2.3.23) SBC-RSP (see 6.3.2.3.24)