Project	**IEEE 802.16 Broadband Wireless Access Working Group** <http://ieee802.org/16>
Title	**Optional Use of the TTG Interval for UL Sounding**
Date Submitted	**2008-03-10**
Source(s)	Fred Vook, Mike Kloos, Mark Spiotta Motorola E-mail: fred.vook@motorola.com
Re:	LB26b – IEEE802.16 REV2/D3.
Abstract	This contribution proposes an efficiency improvement to the UL sounding signaling that enables the establishment of an UL sounding zone in the TTG portion of the frame when appropriate.
Purpose	Review and adopt.
Notice	*This document does not represent the agreed views of the IEEE 802.16 Working Group or any of its subgroups*. It represents only the views of the participants listed in the "Source(s)" field above. It is offered as a basis for discussion. It is not binding on the contributor(s), who reserve(s) the right to add, amend or withdraw material contained herein.
Release	The contributor grants a free, irrevocable license to the IEEE to incorporate material contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE's name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE's sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.16.
Patent Policy	The contributor is familiar with the IEEE-SA Patent Policy and Procedures: <http://standards.ieee.org/guides/bylaws/sect6-7.html#6> and <http://standards.ieee.org/guides/opman/sect6.html#6.3>. Further information is located at <http://standards.ieee.org/board/pat/pat-material.html> and <http://standards.ieee.org/board/pat>.

Optional Use of the TTG Interval for UL Sounding

Fred Vook, Mike Kloos, Mark Spiotta
Motorola

Introduction

This contribution proposes an optional feature for improving the efficiency of the UL Channel Sounding signaling methodology used to support beamforming and MIMO+BF. The proposed feature involves the capability to set up an additional sounding zone located inside the BS transmit/receive transition gap (TTG) interval wherein a BS can command an MS to transmit a sounding waveform. Only MSs that indicate explicit support for that feature can be scheduled to sound inside the TTG interval (where the support for the feature is indicated in the CSIT capability TLV). BSs will only be allowed to use this feature under the following conditions:

- The time needed for the BS to effectively transition from transmit to receive must be less than the TTG interval by at least an amount equal to an OFDM symbol so that the UL sounding symbol occurring in the TTG interval is completed prior to the beginning of the UL.

- Any MSs scheduled to sound in the TTG interval must have indicated their ability to sound in the TTG interval in the CSIT capability TLV.

- Any MS scheduled to sound in the TTG interval must not have any data scheduled for it in the last slot of the downlink unless the MS has adequate time to transition from receive to transmit in time to transmit the UL sounding in the TTG interval.

- The sounding command will inform the TTG-sounding-capable MS that it is being scheduled to sound in the TTG interval, in which case the MS will know to perform its transition from receive to transmit earlier than usual (early enough so that the transition to transmit is completed by the time it must sound). Note that in REV2-D3, the sounding methodology includes a means for establishing and referring to multiple sounding zones (and a fix to that process for certain cases is proposed in).

The advantage of this methodology is that the BS can support more users for UL sounding than would otherwise have been supported.

Overview of proposed modifications

The proposed modification is straightforward and does not break backward compatibility with any mobile stations that are constructed to support UL Sounding as specified in [1] and profiled in [2]. There are two parts to the proposed modification:

- The reserved bit in the PAPR Reduction/Safety Zone/Sounding Zone Allocation IE() is modified to indicate that the sounding zone exists inside the TTG interval.

- A reserved bit in the CSIT capability TLV indicates whether the MS supports sounding in the TTG zone.

Proposed Text Changes

[Section 8.4.5.4.2 – Table 362 – PAPR Reduction/Safety Zone/Sounding Zone Allocation IE:]

[Additions in underlined blue. Deletions in ~~strikethrough red~~.]

Syntax	Size (Bit)	Notes
PAPR_Reduction_Safety_Sounding_Zone_Allocation _IE(){	--	--
OFDMA Symbol Offset	8	-
Subchannel Offset	7	Not used for Sounding
No. OFDMA Symbols	7	-
No. Subchannels / SZ Shift Value	7	No. Subchannels for PAPR Reduction / Safety Zone. Shift value (u) for Sounding Zone
PAPR Reduction / Safety Zone	1	0=PAPR reduction allocation 1=Safety Zone Allocation
Sounding Zone	1	0 = Sounding relevance is the same for all CIDs 1 = Sounding relevance is specified for each CID
~~*Reserved*~~ Sounding Zone in TTG interval	1	~~Shall be set to zero.~~ 1 = the Sounding Zone exists in the TTG interval and starts one OFDMA symbol prior to the first OFDMA symbol of the UL (the OFDMA symbol offset field is ignored). 0 = the Sounding Zone exists as specified by the OFDMA Symbol Offset value
}	-	-

[Add the following paragraph at the end of Section 8.4.5.4.2]

Sounding Zone in TTG Interval:

If this bit is one, then the sounding zone is located in the TTG interval of the frame exactly one OFDMA symbol prior to the start of the uplink subframe in which this PAPR Reduction Safety Sounding Zone Allocation IE is referring. The value of the OFDMA symbol offset field is ignored when this bit is one. BSs are not allowed to schedule an MS inside a sounding zone located in the TTG interval unless the MS has indicated its support for sounding in a TTG interval: OFDMA MS CSIT capability (Section 11.8.3.7.14). Furthermore, BSs are not allowed to schedule an MS to sound in the TTG interval unless the MS has adequate time to transition from receive to transmit prior to transmitting its sounding in the

TTG interval. In addition, any DL allocations intended for the MS must terminate in time for the MS to complete its transition to transmitting its sounding symbol in the TTG.

[Section 11.8.3.7.14 – OFDMA MS CSIT capability:]

[Additions in underlined blue. Deletions in ~~strikethrough red~~.]

Type	Length	Value	Scope
174	2	Bit 0: CSIT compatibility type A. Bit 1: CSIT compatibility type B. Bit 2: Power assignment capability (indicates sup-port for nonequal power assignment) Bits 3–5: Sounding response time capability Bits 6–9: Maximum number of simultaneous sounding instructions (0 = unlimited) Bit 10: SS does not support P values of 9 and 18 when supporting CSIT type A Bit 11: SS supports sounding in a TTG zone ~~Bits 11–15: *Reserved*~~ Bits 12–15: *Reserved*	--

References

[1] IEEE P802.16-2004/Cor2/D4 – Draft Corrigendum to IEEE Std 802.16-2004, May 22, 2007

[2] WiMAX Forum™ Mobile System Profile – Release 1.0 Approved Specification (Revision 1.4.0: 2007-05-02).

[3] F. W. Vook, Corrections for Supporting Multiple Sounding Zones, IEEE C802.16maint-08/060, January 14, 2008. (Revised as IEEE C802.16maint-08/060r1, March 10, 2008).