To:
Roger Marks
Chair, IEEE 802.16 Working Group
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Date: 28 August 2008

Subject: Liaison Statement to 802.16 on clarification and corrections to the IEEE 802.16 draft standard needed to support WiMAX certification.

Dear Dr. Marks,

In the course of development and validation of product certification test cases based on IEEE Std 802.16, the WiMAX Forum has identified several critical issues with the 802.16 specification that impinge successful interoperable test certification development. The WiMAX Forum believes these issues require clarification and/or correction.

The WiMAX Forum requests that IEEE 802.16:

- review the attached Annex A problem statement and/or a WiMAX contemplated remedy for each one of the problem statements,
- develop a remedy for each one of the issues,
- and inform the WiMAX Forum of the results of IEEE 802.16's actions on this matter.

The issues identified in the supplied Annex A impact interoperability on products currently under testing and deployment, and therefore time is of the essence and the WiMAX Forum requests expeditious processing on this matter.

Should the IEEE 802.16 develop any specific remedy in response to a problem identified in Annex A, and should that remedy be incorporated into an open IEEE 802.16 Amendment or Revision project, the WiMAX Forum would appreciate further communication giving specific details of the remedy including affected IEEE Std 802.16 document sections and the language of the likely remedy.

Thank you very much for your attention to this matter of mutual importance.

Sincerely,

Wonil Roh
Vladimir Yanover
Chairs, WiMAX Technical Working Group

Enclosure:

WiMAX TWG LS to 802.16 WG, Annex A

1 HARQ ACK region allocation

The purpose of this RPD note is to clarify the number of HARQ ACK region allocation in one uplink subframe.

1.1 1.1. Introduction

In one uplink subframe, three types of control regions may be allocated: Ranging, FAST-FEEDBACK channel region and HARQ ACK region. In IEEE802.16e-2005, 8.4.4.5 Uplink transmission allocations, the maximum number of ranging region allocated in one uplink subframe is specified. In IEEE802.16e-2005, 8.4.5.4.1 UIUC allocation, the maximum number of FAST-FEEDBACK channel region allocated in one uplink subframe is specified. However, the current standard does not clearly state the maximum number of HARQ ACK region that may be allocated in one uplink subframe.

1.2 1.2. Recommended practice subject description

Specify that the maximum number of HARQ ACK region that may be allocated in one uplink subframe is one.

1.3 1.3. Contemplated Remedy

The maximum number of HARQ ACK region allocated in one uplink subframe should not be more than one.

1.4 References

[1] IEEE Std 802.16-2004, "*Part 16: Air Interface for Fixed Broadband Wireless Access Systems*"

[2] IEEEP802.16e-2005, "*Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems, Amendment 2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands and Corrigendum 1*"

[3] IEEEP802.16e-2005," Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems Corrigendum 2 (Draft 3)

2 HARQ ACK disabled burst

2.1 Introduction

This document provides clarifications on the interpretation of a HARQ ACK disabled burst and how to treat the HARQ ACK disabled burst when BS allocates downlink or uplink bursts within the limitation of the maximum burst per frame per MS based on IEEE 802.16 standards [1]-[3], WiMAX System Profile [4], and WiMAX PICS document. The document may serve as a guide to the future work on inter-operability.

2.2 Recommended practice subject description

According to the current standards (IEEE 802.16e-2004, 802.16e-2005, and 802.16e-Cor2/D3) [1]-[3], WiMAX System Profile [4], and WiMAX PICS document [5], there are some limitations in the maximum number of DL/UL bursts per frame per MS as follows.

- In IEEE 802.16e-2005, section 11.8.3.7.15 it is specified that “the number of UL non-HARQ burst is always limited to 1”.
- In WiMAX PICS Table A.27 : Max. DL HARQ bursts per frame=2(for Cat.1), 5(for Cat.2~4) and Max. UL HARQ bursts per frame=2
- In WiMAX PICS Table A.47 : Max. concurrent DL bursts=10 and Max. DL bursts per frame=16

Here, the limitation in the maximum allocation of downlink(uplink) bursts comes from the limitation in the decoding(encoding) performance of the MS in downlink(uplink). That is, the restriction on the burst allocation per frame per MS is imposed to accommodate the performance of MS in PHY level. However, it is not clearly specified how to treat the HARQ ACK disabled burst when counting the number of burst per frame per MS. Should it be counted as one normal(non-HARQ) burst or one HARQ burst?

The most prominent difference between a non-HARQ burst and a HARQ burst is in the attachment of burst CRC(or, CRC-16) and the burst allocation. A HARQ burst contains CRC-16 to be used to check an occurrence of error, while a normal(non-HARQ) burst allocated with normal DL_MAP_IE or normal UL_MAP_IE does not. Whether it is ACK disabled or not, the CRC-16 shall be attached to the bursts allocated with HARQ_DL_MAP_IE or HARQ_UL_MAP_IE as specified in the description of HARQ MAP IE as follows.

ACK Disable	1 bit	When ‘ACK Disable’ == 1, the allocated sub-burst does not require an ACK to be transmitted by the SS in the ACKCH Region (see 8.4.5.4.24). In this case, no ACK channel is allocated for the sub-burst in the ACKCH Region. For the burst, BS shall not perform HARQ retransmission and MS shall ignore ACID, AI_SN and SPID, which shall be set to ‘0’ by BS if they exist. The CRC shall be appended at the end of each sub-burst regardless of the ACK disable bit.

Moreover, for the downlink, HARQ ACK disabled/enabled burst is assigned with 1D allocation as shown in Figure 229c of the standard, which may not have a rectangular shape but may have a snake-shape, while the normal(non-HARQ) burst allocated with normal DL_MAP_IE is always allocated with rectangular shape(2D).

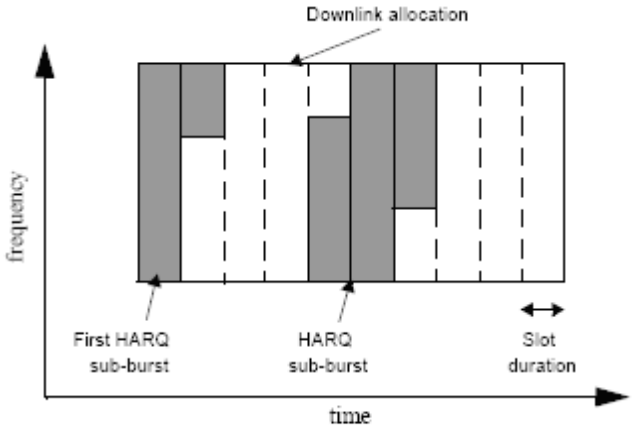

Figure 229c—HARQ downlink allocation

Thus, it means that when we talk about the maximum burst capability of HARQ ACK enabled/disabled burst in PHY level, we are talking about the capability to decode or encode bursts having CRC-16 attached with 1D allocation in downlink and to encode bursts with attaching CRC-16 in uplink. Generally, CRC-16 will be decoded and/or encoded in the hardware, while the CRC-32 attached at the PDU will be related to the software.

On the other hand, the data for the HARQ transmission shall be buffered in the memory for future retransmission or retransmission combining. However, the data in the HARQ ACK disabled burst need not be buffered since there shall be no retransmission for HARQ ACK disabled burst.

As stated in section 6.3.17 of the standard, MS shall support per-connection based HARQ and HARQ can be enabled on a per CID basis by using the DSA/DSC messages. Hence, a MAC level connection can be divided into two types according to the support for HARQ.
The traffic data for HARQ connection shall be transmitted with HARQ_DL_MAP_IE, while the traffic data for non-HARQ connection can also be transmitted via the HARQ ACK disabled burst as described in the standard as follows.

8.4.5.3.21 HARQ DL MAP IE / 8.4.5.4.24 HARQ UL MAP IE
The following modes of HARQ shall be supported by the HARQ DL MAP IE:
a) Chase combining HARQ for all FEC types (HARQ Chase). In this mode the burst profile is indicated by a DIUC.
b) Incremental redundancy HARQ with CTC (HARQ IR). In this mode the burst profile is indicated by the parameters NEP, NSCH.
c) Incremental redundancy HARQ for convolutional code (HARQ CC-IR).
The IE may also be used to indicate a non-HARQ transmission.
…(omitted)
A non-HARQ MS is required to decode DL HARQ Chase sub-burst IEs with "ACK disabled" = 1 if the MS has the capability to decode the extended HARQ IEs. (See Table 286n.)

Therefore, HARQ ACK disabled burst can be used by both HARQ transmission and non-HARQ transmission. This may cause confusion in the treatment of HARQ ACK disabled burst.
Moreover, regarding Tx power control, the power level for HARQ transmission may be adjusted compared to the non-HARQ transmission considering the retransmission gain as specified in the standard as follows.

8.4.10.3 Power control
If MS has UL HARQ connection, the normalized C/N value for HARQ bursts can be adjusted referencing to non HARQ bursts. The power offset is defined in UCD TLV of

'Relative_Power_Offset_for_UL_HARQ_burst'. If this TLV exists in the UCD, then the power offset shall be added to the C/N value in table 334 in case the transmission is HARQ.

Relative_Power_Offset_For_UL_HARQ_burst	205	1	Bit#0-3: Offset for HARQ burst relative to non-HARQ burst (signed integer in 0.5 dB unit) Bit#4-7: reserved (Shall be set to zero)

Therefore, as there is no retransmission for HARQ ACK disabled burst, the power of HARQ ACK disabled burst should be controlled similar to that of non-HARQ burst allocated with normal UL_MAP_IE (which is used only for non-HARQ transmission).

As can be seen from the observations above, there are two different aspects in the HARQ ACK disabled burst. A difference will be made according to the interpretation of the HARQ ACK disabled burst. If we treat the HARQ ACK disabled burst as a normal(non-HARQ) burst when counting the number of bursts per frame per MS, it means that an MS should be able to decode totally 16 HARQ ACK disabled bursts per frame and totally 10 HARQ ACK disabled concurrent bursts in a single frame. On the other hand, if we treat it as a HARQ burst when counting the number of bursts per frame per MS, it means that the BS can allocate only 2(Cat1) or 5(Cat2-4) HARQ ACK disabled and/or enabled burst per frame per MS. For the uplink, if we treat it as normal(non-HARQ) burst when counting the number burst per frame per MS, the BS can allocate only one HARQ ACK disabled UL burst with HARQ_UL_MAP_IE, but cannot allocate a normal burst with a normal UL_MAP_IE simultaneously in the same frame. However, if we treat it as HARQ burst when counting the number of burst per frame per MS, the BS can allocate one normal(non-HARQ) burst with normal UL_MAP_IE and 2 HARQ ACK disabled and/or enabled burst with HARQ_UL_MAP_IE in the same frame for the MS.

2.3 Contemplated Remedy

The HARQ ACK disabled burst allocated with HARQ_DL_MAP_IE with "ACK disable"=1 or HARQ_UL_MAP_IE with "ACK disable"=1 should be treated as a HARQ burst (Option 1) or a non-HARQ burst (Option 2) when counting the number of DL/UL bursts per frame per MS.

- Option 1 : Treat the HARQ ACK disabled burst as a HARQ burst (without retransmission) and count it accordingly as one HARQ burst when BS allocating bursts within the limitation of maximum bursts per frame per MS.
- Option 2 : Treat the HARQ ACK disabled burst as a normal(non-HARQ) burst and count it accordingly as one non-HARQ burst when BS allocating bursts within the limitation of maximum bursts per frame per MS.

Here, the treatment of the burst is a concept in the PHY level and the normal(non-HARQ) transmission for non-HARQ connection can also be allocated with HARQ_DL_MAP_IE or HARQ_UL_MAP_IE with "ACK disable"=1 as specified in the standard.

The group recommends Option 2 as a remedy.

References

[1] IEEE Std 802.16-2004, "Part 16: Air Interface for Fixed Broadband Wireless Access Systems"

[2] IEEEP802.16e-2005, “Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems, Amendment 2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands and Corrigendum 1”
[3] IEEEP802.16-2004/Cor2/D3, “Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems, Corrigendum 2”
[4] WiMAX ForumTM Mobile System Profile, version 1.4.0
[5] WiMAX ForumTM Mobile Protocol Implementation Conformance Statement (PICS), version 1.2.0

3 Tx Power reports

3.1 Introduction

Tx Power reports are essential for the correct operation of open loop power control. The use of Tx Power reports is described in section 8.4.10.3.2.1 in 802.16e-2005. Support of Tx Power reports is mandated by the WiMAX system profile using the BW request and Tx Power Report Header. However, the standard does not clearly specify when the MS should first start reporting them and not does it discuss if MS is ever allowed to stop sending them. .

Here is the description from the standard:

8.4.10.3.2.1 UL Tx power and Headroom transmission condition

SS may report its transmission power status using BR and UL Tx power report header (6.3.2.1.2.1.2), PHY channel report header (6.3.2.1.2.1.5) or UL Tx power report extended subheader (6.3.2.2.7.5). Further, when the following conditions are met, SS may send its transmission power status using BR and UL Tx power report header (6.3.2.1.2.1.2), PHY channel report header (6.3.2.1.2.1.5) or UL Tx power report extended subheader (6.3.2.2.7.5).

$$\left|M_{avg}(n_{last}) - M_{avg}(n)\right| \geq Tx\_Power\_Report\_Threshold \quad \text{(dB)} \qquad (149)$$

or

$$n - n_{last} \geq Tx\_Power\_Report\_Interval$$

where

$$M(n) = L + NI + Offset\_SS_{perSS} + Offset\_BS_{perSS} \quad \text{(dB)}$$

$$M_{avg}(n) = 10\log(\alpha_{p\_avg} \cdot 10^{M(n)/10} + (1 - \alpha_{p\_avg}) \cdot 10^{(M_{avg}(n-1))/10})$$

n_{last} is the time index when the last SS Tx power report is sent. The unit is frame. Tx_Power_Report_Threshold, Tx_Power_Report_Interval, and α_{p_avg} are indicated in UCD. In UCD, there are sets of those parameters sets: depending on the allocation CQICH to SS, the corresponding parameter set shall be used.

Of the three Tx Power report options described in section 8.4.10.3.2.1, only one is mandated by PICS – the BW Request and Tx Power Report header. For clarification, all mention of Tx Power reports throughout this RPD refers to the transmission of the BW Request and Tx Power Report header using equation 149.

The Tx Power Report Interval and Threshold parameters are described by UCD TLV:

Tx Power Report	196	3	Bits 0–3: Tx_Power_Report_Threshold, It is unsigned integer and shall be rend in dB scale. When "0b1111" it means infinite. Bits 4–7: It is unsigned integer whose value is d, Its value *d* shall be interpreted as Tx_Power_Report_Interval =2^d. When "0b1111" it means infinite. Bits 8–11: α_{p_avg} in multiples of 1/16 (range [1/16,16/16]) Bits 12–15: Tx_Power_Report_Threshold, It is unsigned integer and shall be read in dB scale. When "0b1111" it means infinite. It shall be used when CQICH is allocated to the SS. Bits 16–19: It is unsigned integer whose value is d. Its value *d* shall be interpreted as Tx_Power_Report_Interval =2^d frames. When "0b1111" it means infinite. It shall be used when CQICH is allocated to the SS. Bits 20–23: α_{p_avg} in multiples of 1/16 (range [1/16,16/16]), It shall be used when CQICH is allocated to the SS.

3.1.1 When Does MS need to start Sending Tx Power Reports during Network entry?

Tx Power Reports are essential for the correct operation of Open Loop Power Control (OLPC). This is why the description of Tx Power reports is included in the Open loop Power control section of the standard (in section 8.4.10.3.2). It is therefore important for the MS to start sending Tx Power reports once the MS transitions into open loop power control mode using the PMC-REQ/RSP transaction.

If the BS intends for the MS to send Tx Power Reports then it must include TLV 196 in the UCD. This is the only way that the MS can determine the Tx Power Report interval and Tx Power Report Threshold parameters since TLV 196 does not define defaults in case TLV 196 is not included in the UCD. If TLV 196 is not included in the UCD, then the MS should not send Tx Power Reports.

Tx Power Reports can also be used for Closed Loop Power Control (CLPC) mode. Since the default power control mode is closed loop, no PMC message is required for CLPC. It is not clear in the standard if the MS is required to start sending Tx Power reports for closed loop power control since the headroom condition in section 8.4.10.3.2.1 uses OLPC terms in the equation 138d.

The MS should use one or more of the following rules to start sending Tx Power reports during initial network entry:

Option 1: MS sends BW Request and Tx Power report headers prior to REG exchange if TLV 196 is present in the UCD.

Option 2: MS completes REG exchange and REG-RSP indicates support for BW Request and Tx Power Report Header (bit#0=1 in TLV 43, MAC header and extended subheader support) and TLV 196 is present in the UCD.

With any option, Tx power reports should not be sent after REG-RSP if support for BW Request and Tx Power Report Header is disabled (bit#0=0 in TLV 43, MAC header and extended subheader support).

The BS may need to reduce the size of UL allocations until the MS sends periodic Tx Power reports so the time to complete network entry may be longer for option 3 compared to options 1 and 2.

3.1.2. When does MS need to start Sending Tx Power Reports during Network Re-entry

For optimized re-entry for handover or idle mode, the MS should start sending Tx power reports immediately after the re-entry is complete if (1) TLV 196 is present in the UCD and (2) Tx power reports were enabled in the REG exchange during initial network entry.

Optimized re-entry requires the MS should confirm that it received the RNG-RSP by sending a BW Request or other UL indication. It is recommended that the MS use the BW Request and Tx Power report header for this confirmation. Otherwise the BS may delay any UL allocations until the BS receives the Tx power report. Optimized re-entry is defined here by a RNG-RSP with HO Process Optimization TLV indicating REG and SBC exchange is not required.

For full network re-entry, the rules in section **Error! Reference source not found.** apply. Full network re-entry occurs either by a RNG-RSP with status=abort or RNG-RSP with HO Process Optimization TLV indicating REG and SBC exchange is required.

3.1.3. Can the MS stop Sending Tx Power Reports?

The MS may stop sending Tx Power reports in certain cases in order to improve system performance (e.g. lower ranging channel loading) and MS battery life (e.g. by extending time of active PSC).

The MS may stop sending Tx Power reports whenever any of the following occurs

- MS enters sleep mode
- MS enters idle mode
- MS has no outstanding data to send on UL.

If the MS stops sending Tx Power reports, it should start sending them immediately if UL allocations start, in case of new active UGS or ERTPS connection, or the MS sends a BW Request Header requesting UL allocations.

If the MS stops sending Tx Power Reports but requires UL allocations, the BS may reduce the size of UL allocations until the MS sends a Tx Power report.

If the MS does not require UL allocations but receives an unsolicited 6 byte UL allocation, the MS is expected to send a BW request with BR=0. In this case, it is recommended that the MS use the BW Request and Tx Power report Header with BR=0 to provide the BS with a Tx power report.

3.1.4. Can MS support TLV Periodic Tx Power Reports while in Closed Loop Power control?

Note: This section is added to incorporate problem raised by Fujitsu RPD so a single RPD can be used to discuss all open issues with Tx Power reports.

Section 8.4.10.3.2.1 discusses two trigger conditions for sending Tx power reports:

1) Tx_Power_Report_Threshold
   Mavg(nlast)– Mavg(n) ≥ Tx_Power_Report_Threshold (dB)
2) Tx_Power_Report_Interval
   n–nlast ≥ Tx_Power_Report_Interval

where

$$M(n) = L + NI + Offset\_SSperSS + Offset\_BSperSS \text{ (dB)}$$

With closed loop power control, the MS may not be able to implement trigger 1), which is based on Tx_Power_Report_Threshold, because of the various terms that are only available in open loop power control (Offset_SSperSS, Offset_BSperSS (dB), and NI).

To resolve this issue, the following options are provided for the MS

Option A: During closed loop power control, the MS sends BW Request and Tx Power report headers only using Tx_Power_Report_Interval

Option B: During closed loop power control, the MS sends BW Request and Tx Power report headers using both the Tx_Power_Report_Interval and the Tx_Power_Report_Threshold. In this case, the MS sets Offset_SSperSS to zero and Offset_BSperSS to the cumulative value of all power corrections from the BS,

Option C: the MS does not send BW Request and Tx Power report headers during closed loop power control

3.2 Contemplated Remedy

The following clarifications are made with regard to the transmission of Tx Power Reports:

- The BS shall include TLV 196 in UCD if it expects to receive Tx Power reports from the MS.
- For initial network entry or full network re-entry, the MS shall use one or more of the following rules for sending the first BW Request and Tx Power report header during initial network entry
  - Option 1: MS sends first BW Request and Tx Power report header any time prior to PKM exchange if TLV 196 is present in the UCD.
  - Option 2: MS sends first BW Request and Tx Power report header immediately after MS completes REG exchange if TLV 196 is present in the UCD
- For open loop power control, the MS sends remaining Tx Power reports using equation 138d in 802.16-2005 using UCD TLV 196
- For closed loop power control, the MS sends remaining Tx Power reports using equation 138d in 802.16e-2005 using UCD TLV 196 with either of the options:

  Option A: the MS sends BW Request and Tx Power report headers only using Tx_Power_Report_Interval

  Option B: the MS sends BW Request and Tx Power report headers using both the Tx_Power_Report_Interval and the Tx_Power_Report_Threshold. In this case, the MS sets Offset_SSperSS to zero and Offset_BSperSS to the cumulative value of all power corrections from the BS,
- BW Request and Tx Power Report Headers should not be sent after REG-RSP if support for BW Request and Tx Power Report Header is disabled (bit#0=0 in TLV 43, MAC header and extended subheader support)
- For optimized re-entry for handover or idle mode, the MS should start sending Tx power reports immediately after the re-entry is complete if (1) TLV 196 is present in the UCD and (2) Tx power reports were enabled in the REG exchange during initial network entry. The MS can confirm that it received the RNG-RSP by sending a BW Request and Tx Power report header.
- The MS may stop sending Tx Power reports when the MS enters sleep mode, enters idle mode, or the MS has no remaining data to send on UL.
- If the MS stops sending Tx Power reports, it should start sending them immediately if UL allocations start, or the MS sends a BW Request Header requesting UL allocations.

References

[1] IEEE Std 802.16-2004, “Part 16: Air Interface for Fixed Broadband Wireless Access Systems”

[2] IEEEP802.16e-2005, “Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems, Amendment 2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands and Corrigendum 1”

[3] IEEEP802.16-2004/Cor2/D3, “Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems, Corrigendum 2”

4 Physical supported parameter TLV

Physical supported parameter TLV is referred in the IEEE 802.16-2004. This Physical supported parameter type is however not defined. Reference to this TLV Type should be removed.

4.1 Introduction

The current transmit power TLV is sent by the MS as part of the SBC-REQ. This TLV is mandatory in the WiMAX forum profiles. According to [1] this TLV should be encapsulated in the physical supported parameters compound TLV. However the physical supported parameter Type is not defined in [1].

4.2 Specific text to be included into RPD

Physical supported parameter TLV type is not defined in the IEEE 802.16-2004. Therefore the current transmit power TLV when transmitted in the SBC-REQ or the REP-RSP is recommended to be an individual TLV.

4.3 Contemplated Remedy

Remove language saying that Current Tx power TLV is encapsulated in the Physical supported parameters compound TLV