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| Project | **IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>** |
| Title | Traffic Channel Definition for HARQ Burst Allocation in OFDMA PHY |
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| Source(s) | Hang Zhang, Mo-Han Fong, Peiying Zhu, Wen Tong<br>Nortel Networks<br>mhfong@nortelnetworks.com<br>Tel: +1-613-765-8983 |
| Re: | IEEE P802.16e/D6-2005 |
| Abstract | This contribution proposes to apply the semi-static traffic channel (or region) definition on the DL for HARQ burst allocation, similar to the way it is currently done for non-HARQ burst allocation. The objective is to reduce the overhead in DL HARQ burst allocation. This contribution also proposes to support multiple modes of HARQ within a data region. |
| Purpose | Review and Adopt the suggested changes into P802.16e/D6 |
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# 1 Introduction

As currently defined in the p802.16e/D6 draft, semi-static DL channel definition in DCD (DL Channel Definition TLV) is used to reduce the overhead in DL burst allocation for non-HARQ traffic. As explained in details in the contribution IEEE C802.16e-04/542r2 which was adopted in session #35, the use of semi-static DL channel definition eliminate the need to explicitly specify the 28-bit OFDMA symbol offset, subchannels offset, number of OFDMA symbols and number of subchannels for each DL burst allocation. Instead, a 6-bit channel ID (CHID) is used to identify a semi-static channel (or region) defined in the DCD. The reduction in overhead is non-negligible in particular for cases where non-bulk traffic (e.g. VoIP, HTTP) is supported.

In this contribution, we propose to apply the same channel definition concept to the HARQ burst allocation schemes adopted in session #35, i.e contributions IEEE C802.16e-05/23r5 and IEEE C802.16e-05/38r1. Similar benefit can be realized for the case of HARQ burst allocation, as in the case of non-HARQ burst allocation.

In addition, we also propose to define multiple HARQ modes within a data region. This will allow greater scheduling flexibility and optimization in actual deployment scenario where MSs may have different coding capabilities.

# 2 Proposed Text Change

**Remedy 1: Add the support of semi-static channel definition (identified by CHID) to the non-MIMO HARQ burst allocation IEs.**

*[Modify Table 285m in p802.16e/D6 to include CHID. Add the MIMO support in HARQ_DL_MAP_IE as in IEEE C802.16e-05/38r1 which was adopted in session #35 but was not included in D6 text. Enhance the HARQ_DL_MAP_IE to enable the support of multiple HARQ modes within a data region]*

**Table 285m—HARQ DL MAP IE format**

| Syntax | Size | Notes |
|---|---|---|
| HARQ DL MAP IE { | | |
| **Extended DIUC 2** | 4 | Set to 0x1 |
| **Length** | 8 | Length of the IE in bytes |
| **RCID_Type** | 2 bits | 00 = Normal CID 01 = RCID11 10 = RCID7 11 = RCID3 |
| While (data remains) { | | |
| CHID use indicator | 1 bit | 0: not use CHID<br>1: use CHID |
| If (CHID use indicator == 0 ) { | | |
| **OFDMA symbol offset** | 8 bits | Offset from the start of DL sub-frame |
| **Subchannel offset** | 6 bits | |
| **Number of OFDMA symbols** | 7 bits | |
| **Number of subchannels** | 6 bits | |
| }else { | | |
| CHID | 6 bits | Index to the DL region defined in DL channel definition TLV in DCD |
| } | | |

| | | |
|---|---|---|
| Boosting | 3 bits | 000: normal (not boosted); 001: +6 dB; 010: -6 dB; 011: +9 dB; 100: +3 dB; 101: -3 dB; 110: -9 dB; 111: -12 dB |
| | | |
| N_sub_burst | 5 bits | Number of sub-bursts in the 2D region |
| For (j=0; j< N sub burst; j++) { | | |
| **Mode** | 4 bits | Indicates the mode of this IE<br>0 = Chase HARQ<br>1 = Inremental redundancy HARQ for CTC<br>2 = Inremental redundancy HARQ for convolutional code<br>3 = MIMO Chase H-ARQ<br>4 = MIMO IR H-ARQ<br>5 = MIMO IR H-ARQ for convolution code<br>6 = MIMO STC H-ARQ<br>7-15 *Reserved* |
| If (Mode == 0) { | | |
| **DL HARQ Chase sub-burst IE()** | *Variable* | |
| } else if (Mode == 1) { | | |
| **DL HARQ IR CTC sub-burst IE()** | *Variable* | |
| } else if (Mode == 2) { | | |
| **DL HARQ IR CC sub-burst IE()** | *Variable* | |
| } else if (Mode == 3) { | | |
| MIMO_DL_Chase_H-HARQ_Sub-Burst_IE() | *Variable* | |
| } else if (Mode == 4) { | | |
| MIMO_DL_IR_H-ARQ_Sub-Burst_IE () | *Variable* | |
| } else if (Mode == 5) { | | |
| MIMO_DL_IR_H-ARQ_for_CC_Sub-Burst-IE() | *Variable* | |
| } else if (Mode == 6) { | | |
| MIMO_DL_STC_H-ARQ_Sub-Burst_IE() | *Variable* | |
| } | | |
| } | | |
| } | | |
| **Padding** | *Variable* | Padding to byte; shall be set to 0 |
| } | | |

*[Modify Table 285n in p802.16e/D6 to enable the support of multiple HARQ modes within a data region Introduce sub-burst offset to allow flexibility in the placement of the sub-burst within the data region ]*

**Table 285n—DL HARQ Chase sub-burst IE format**

| Syntax | Size | Notes |
|---|---|---|
| DL HARQ Chase sub-burst IE() { | | |
| Sub-burst offset indication | 1 bit | |
| If (Sub-burst offset indication == 1) { | | |
| Sub-burst offset | 10 bits | Offset in slots with respect to the previous sub-burst defined in this data region. If this is the first sub-burst within the data region, this offset is with respect to slot 0 of the data region. |
| } | | |
| **DIUC** | 4 bits | |
| **Repetition Coding Indication** | 2 bits | 0b00 - No repetition coding 0b01 - Repetition coding of 2 used 0b10 - Repetition coding of 4 used 0b11 - Repetition coding of 6 used |
| **RCID_IE()** | *Variable* | |
| **Duration** | 10 bits | Duration in slots |
| **ACID** | 4 bits | |
| **AI_SN** | 1 bit | |
| **CQICH Control Indicator** | 1 bit | |
| If( CQICH Control Indicator == 1){ | | |
| **Allocation Index** | 6 bits | Index to the channel in a frame the CQI report should be transmitted by the SS |
| **Period (p)** | 3 bits | A CQI feedback is transmitted on the CQI channels indexed by the (CQI Channel Index) by the SS in every 2p frames. |
| **Frame offset** | 3 bits | The MSS starts reporting at the frame of which the number has the same 3 LSB as the specified frame offset. If the current frame is specified, the MSS should start reporting in 8 frames. |
| **Duration (d)** | 4 bits | A CQI feedback is transmitted on the CQI channels indexed by the (CQI Channel Index) by the SS for 2(d-1) frames. If d is 0b0000, the CQICH is de-allocated. If d is 0b1111, the MSS should report until the BS command for the MSS to stop. |
| } | | |
| **Dedicated DL Control Indicator** | 1 bit | |
| If (Dedicated DL Control Indicator ==1) { | | |
| **Dedicated DL Control IE ()** | *Variable* | |
| } | | |

| | | |
|---|---|---|
| | | |
| } | | |

*[Modify Table 285o in p802.16e/D6 to enable the support of multiple HARQ modes within a data region Introduce sub-burst offset to allow flexibility in the placement of the sub-burst within the data region ]*

**Table 285o—DL HARQ IR CTC sub-burst IE format**

| Syntax | Size | Notes |
|---|---|---|
| DL HARQ IR CTC sub-burst IE() { | | |
| Sub-burst offset indication | 1 bit | |
| If (Sub-burst offset indication == 1) { | | |
| Sub-burst offset | 10 bits | Offset in slots with respect to the previous sub-burst defined in this data region. If this is the first sub-burst within the data region, this offset is with respect to slot 0 of the data region. |
| } | | |
| **RCID_IE()** | *Variable* | |
| **Nep** | 4 bits | |
| **Nsch** | 4 bits | |
| **SPID** | 2 bits | |
| **ACID** | 4 bits | |
| **AI_SN** | 1 bit | |
| **ACK disable** | 1 bit | When this bit is "1" no ACK channel is allocated and the SS shall not reply with an ACK. |
| **CQICH Control Indicator** | 1 bit | |
| If( CQICH Control Indicator == 1){ | | |
| **Allocation index** | 6 bits | Index to the channel in a frame the CQI report should be transmitted by the SS |
| **Period(p)** | 3 bits | A CQI feedback is transmitted on the CQI channels indexed by the (CQI Channel Index) by the SS in every 2p frames. |
| **Frame offset** | 3 bits | The MSS starts reporting at the frame of which the number has the same 3 LSB as the specified frame offset. If the current frame is specified, the MSS should start reporting in 8 frames. |
| **Duration (d)** | 4 bits | A CQI feedback is transmitted on the CQI channels indexed by the (CQI Channel Index) by the SS for 2(d-1) frames. If d is 0b0000, the CQICH is de-allocated. If d is 0b1111, the MSS should report until the BS command for the MSS to stop |
| } | | |

| | | |
|---|---|---|
| **Dedicated DL Control Indicator** | 1 bit | |
| If (Dedicated DL Control Indicator ==1) { | | |
| **Dedicated DL Control IE ()** | *Variable* | |
| } | | |
| | | |
| **}** | | |

*[Modify Table 285p in p802.16e/D6 to enable the support of multiple HARQ modes within a data region Introduce sub-burst offset to allow flexibility in the placement of the sub-burst within the data region ]*

**Table 285p—DL HARQ IR CC sub-burst IE format**

| Syntax | Size | Notes |
|---|---|---|
| DL HARQ IR CTC sub-burst IE() { | | |
| Sub-burst offset indication | 1 bit | |
| If (Sub-burst offset indication == 1) { | | |
| Sub-burst offset | 10 bits | Offset in slots with respect to the previous sub-burst defined in this data region. If this is the first sub-burst within the data region, this offset is with respect to slot 0 of the data region. |
| } | | |
| **DIUC** | 4 bits | |
| **Repetition coding indication** | 2 bits | 0b00 - No repetition coding 0b01 - Repetition coding of 2 used 0b10 - Repetition coding of 4 used 0b11 - Repetition coding of 6 used |
| **RCID_IE()** | *Variable* | |
| **Duration** | 10 bits | |
| **ACID** | 4 bits | |
| **AI_SN** | 1 bit | |
| **SPID** | 2 bits | |
| **CQICH Control Indicator** | 1 bit | |
| If( CQICH Control Indicator == 1){ | | |
| **Allocation index** | 6 bits | Index to the channel in a frame the CQI report should be transmitted by the SS |
| **Period(p)** | 3 bits | A CQI feedback is transmitted on the CQI channels indexed by the (CQI Channel Index) by the SS in every 2p frames. |

| | | |
|---|---|---|
| **Frame offset** | 3 bits | The MSS starts reporting at the frame of which the number has the same 3 LSB as the specified frame offset. If the current frame is specified, the MSS should start reporting in 8 frames. |
| **Duration (d)** | 4 bits | A CQI feedback is transmitted on the CQI channels indexed by the (CQI Channel Index) by the SS for 2(d-1) frames. If d is 0b0000, the CQICH is de-allocated. If d is 0b1111, the MSS should report until the BS command for the MSS to stop |
| } | | |
| **Dedicated DL Control Indicator** | 1 bit | |
| If (Dedicated DL Control Indicator ==1) { | | |
| **Dedicated DL Control IE ()** | *Variable* | |
| } | | |
| | | |
| } | | |

**Remedy 2: Add the support of semi-static channel definition (identified by CHID) to MIMO HARQ burst allocation IEs. Note that we also show here the modification on top of the proposed text change in IEEE C802.16e-05/38r1 which was adopted in session #35 but did not get included into D6**

*[Modify Table 306i in IEEE C802.16e-05/38r1 to enable the support of multiple HARQ modes within a data region Introduce sub-burst offset to allow flexibility in the placement of the sub-burst within the data region ]*

Table 306i MIMO DL Chase H-ARQ Sub-Burst IE Format

| | | |
|---|---|---|
| MIMO DL Chase H-ARQ Sub-Burst IE { | | |
| Sub-burst offset indication | 1 bit | |
| If (Sub-burst offset indication == 1) { | | |
| Sub-burst offset | 10 bits | Offset in slots with respect to the previous sub-burst defined in this data region. If this is the first sub-burst within the data region, this offset is with respect to slot 0 of the data region. |
| \| | | |
| MU Indicator | 1 bit | Indicates whether this UL burst is intended for multiple SS |
| Dedicated MIMO DL Control Indicator | 1 bit | |
| If (MU indicator == 0) { | | |
| RCID IE() | Variable | |
| } | | |
| If (Dedicated MIMO DL Control Indicator ==1) { | | |
| Dedicated MIMO DL Control IE () | variable | |

| | | |
|---|---|---|
| } | | |
| Length | 10 bits | |
| For (i=0;i<N_layer;i++) { | | |
| if (MU indicator == 1) { | | |
| RCID IE() | Variable | |
| } | | |
| DIUC | 4 bits | |
| Repetition Coding Indication | 2 bits | 0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used |
| ACID | 4 bits | |
| AI_SN | 1 bit | |
| } | | |
| | | |
| } | | |

*[Modify Table 306j in IEEE C802.16e-05/38r1 to enable the support of multiple HARQ modes within a data region Introduce sub-burst offset to allow flexibility in the placement of the sub-burst within the data region ]*

Table 306j MIMO DL IR H-ARQ Sub-Burst IE Format

| | | |
|---|---|---|
| MIMO DL IR H-ARQ Sub-Burst IE { | | |
| Sub-burst offset indication | 1 bit | |
| If (Sub-burst offset indication == 1) { | | |
| Sub-burst offset | 10 bits | Offset in slots with respect to the previous sub-burst defined in this data region. If this is the first sub-burst within the data region, this offset is with respect to slot 0 of the data region. |
| \| | | |
| MU Indicator | 1 bit | Indicates whether this UL burst is intended for multiple SS |
| Dedicated MIMO DL Control Indicator | 1 bit | |
| ACK Disable | 1 bit | When this bit is "1" no ACK channel is allocated and the SS shall not reply with an ACK |
| If (MU indicator == 0) { | | |
| RCID IE() | Variable | |
| } | | |
| If (Dedicated MIMO DL Control Indicator ==1) { | | |
| Dedicated MIMO DL Control IE () | variable | |

| | | |
|---|---|---|
| } | | |
| Nsch | 4 bits | |
| If (ACK Disable == 0) { | | |
| SPID | 2 bits | |
| ACID | 4 bits | |
| AI_SN | 1 bit | |
| } | | |
| For (i=0;i<N_layer;i++) { | | |
| if (MU indicator == 1) { | | |
| RCID IE() | Variable | |
| } | | |
| Nep | 4 bits | |
| } | | |
| | | |
| } | | |

*[Modify Table 306k in IEEE C802.16e-05/38r1 to enable the support of multiple HARQ modes within a data region Introduce sub-burst offset to allow flexibility in the placement of the sub-burst within the data region ]*

Table 306k MIMO DL IR H-ARQ for CC Sub-Burst IE Format

| | | |
|---|---|---|
| MIMO DL IR H-ARQ for CC Sub-Burst IE { | | |
| Sub-burst offset indication | 1 bit | |
| If (Sub-burst offset indication == 1) { | | |
| Sub-burst offset | 10 bits | Offset in slots with respect to the previous sub-burst defined in this data region. If this is the first sub-burst within the data region, this offset is with respect to slot 0 of the data region. |
| \| | | |
| MU Indicator | 1 bit | Indicates whether this UL burst is intended for multiple SS |
| Dedicated MIMO DL Control Indicator | 1 bit | |
| If (MU indicator == 0) { | | |
| RCID IE() | Variable | |
| } | | |
| If (Dedicated MIMO DL Control Indicator ==1) { | | |
| Dedicated MIMO DL Control IE () | variable | |
| } | | |
| Length | 10 bits | |
| For (i=0;i<N_layer;i++) { | | |
| if (MU indicator == 1) { | | |
| RCID IE() | Variable | |

| | | |
|---|---|---|
| } | | |
| DIUC | 4 bits | |
| Repetition Coding Indication | 2 bits | 0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used |
| ACID | 4 bits | |
| AI_SN | 1 bit | |
| SPID | 2 bits | |
| } | | |
| | | |
| } | | |

*[Modify Table 306l in IEEE C802.16e-05/38r1 to enable the support of multiple HARQ modes within a data region Introduce sub-burst offset to allow flexibility in the placement of the sub-burst within the data region. Correct the definition error in Table 306l for the STC HARQ operation ]*

Table 306l MIMO DL STC H-ARQ Sub-Burst IE Format

| | | |
|---|---|---|
| MIMO DL STC H-ARQ Sub-Burst IE { | | |
| Sub-burst offset indication | 1 bit | |
| If (Sub-burst offset indication == 1) { | | |
| Sub-burst offset | 10 bits | Offset in slots with respect to the previous sub-burst defined in this data region. If this is the first sub-burst within the data region, this offset is with respect to slot 0 of the data region. |
| \| | | |
| Dedicated MIMO DL Control Indicator | 1 bit | |
| RCID_IE() | *Variable* | |
| TX count | 2 bit | 00: first transmission<br>01: second transmission<br>10: third transmission<br>11: fourth transmission |
| Length | 10 bits | |
| If (Tx count == 00) { | | |
| If (Dedicated MIMO DL Control Indicator ==1) { | | |
| Dedicated MIMO DL Control IE () | variable | |
| } | | |
| DIUC | 4 bits | |
| Repetition Coding Indication | 2 bits | 0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 |

| | | |
|---|---|---|
| | | used<br>0b11 – Repetition coding of 6 used |
| } | | |
| ACID | 4 bits | |
| | | |
| | | |
| } | | |