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| Title | Enhanced MAC Feedback Header | |
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| Re: | IEEE P802.16e/D5-2004 | |
| Abstract | This contribution proposes to enhance the Mode Selection Feedback header. | |
| Purpose | Review and Adopt the suggested changes into P802.16e/D5 | |
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# 1 Introduction

In general, optimized DL operations require feedback from MSS. Those types of feedbacks include DL channel quality indication (CQI) feedback, DL MIMO mode and permutation selection, physical channel report and etc. There are also other feedbacks related to UL operation, such as MSS' UL transmit power headroom etc.

In the current p802.16e/D5 text, there are two methods used by the MSS to provide feedback to the BS. One method is to assign a dedicated UL Fast Feedback channel to the MSS. The Fast Feedback channel can be used to provide CQI and Mode Selection (MIMO mode and permutation) feedback in time-division-multiplex fashion. Another method is to use the Mode Selection Feedback MAC header to provide Mode Selection feedback as defined in section 6.3.2.1.4 of p802.16e/D5.

Since the Mode Selection Feedback MAC header can carry much more feedback information than the 6-bit or less Fast Feedback channels, we propose to generalize the Mode Selection Feedback header to a generic Feedback header, to carry not just the Mode Selection Feedback information, but also other physical layer (e.g. preferred DIUC, UL tx power etc.) and MIMO feedback information, and also additional CQI information for AMC bands and antenna groups.

Since the Mode Selection Feedback header does not require a dedicated UL resource or channel, it is suitable for use on an as needed basis. There are three possible scenarios:

- Scenario 1: a MSS can autonomously send the Mode Selection Feedback header to the BS by sending bandwidth request ranging code and then send the BW request header after receiving CDMA_Allocation IE.
- Scenario 2: BS can poll a MSS to send the required feedback and then the MSS sends the required feedback on the Mode Selection Feedback header.
- Scenario 3: a MSS can autonomously send the Mode Selection Feedback header to the BS by sending the header along with UL traffic.

For scenarios 2 and 3 described above, since the header is sent using unicast UL resource assigned by the BS, the CID field in the existing Mode Selection Feedback header is redundant since the unicast UL resource uniquely identifies the MSS. Therefore, we can remove the 16-bit CID field in the header and use the bit space for sending more feedback information or multiple types of feedback information within a single header. Alternatively, the feedback header size can be reduced to 24 bits in case when there is a small amount of feedback information.

Another issue is for scenario 2, in the current p802.16d/D5, the DL FAST_FEEDBACK subheader can be used by the BS to poll a MSS to provide up to four types of feedbacks. To support various MIMO channel related feedback, and feedback to support UL operation, additional feedback types need to be defined. Also, a new polling signaling format needs to be defined to accommodate more than the existing four types of feedback.

# 2 Proposed Enhancements

In this contribution, we propose the following:

- Enhance the Mode Selection Feedback header to a generic Feedback Header
- The Feedback Header has the following features:
  - support the option of CID field omission, thus more bit space to provide feedback information;
  - support additional types of feedback;
  - support multiple feedback types and associated content concatenated into the same feedback header
- Introduce a 24-bit Mini Feedback Header. This type of feedback header is used when 24 bits are sufficient to carry the required feedback information. When sent alone without any other UL MAC PDU, the Mini Feedback Header shall be duplicated to form a 48-bit block. This enhances the reliability of the feedback.
- Introduce a new Feedback Polling IE to enable BS to request a MSS to provide various types of feedback

# 3 Proposed Text Change

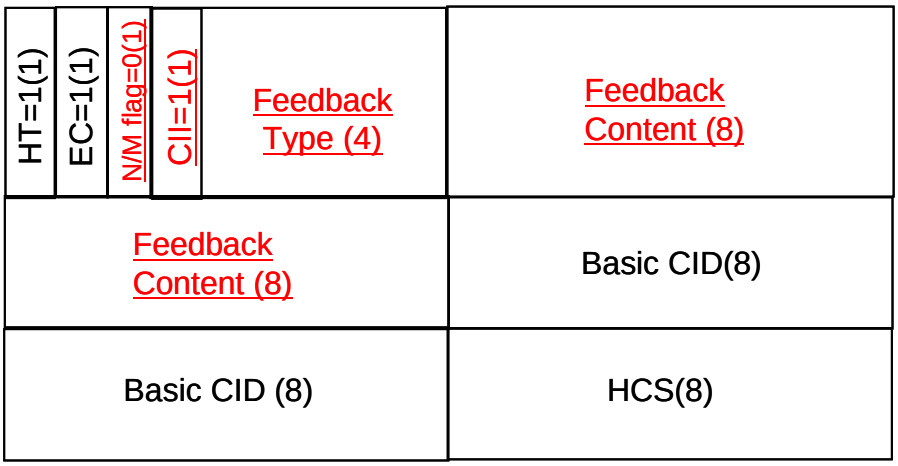
**Remedy 1:**
Replace the Mode Selection Feedback header with the Feedback Header. The CID field is optional for the Feedback Header. Additional feedback types and contents are carried by the Feedback Header.

*[Replace Section 6.3.2.1.4 by the followings]*

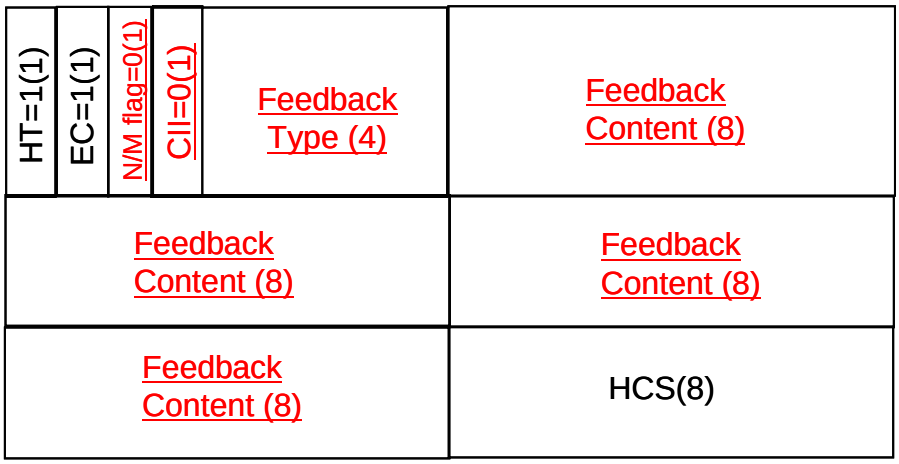
**6.3.2.1.4 Feedback header**

6.3.2.1.4.1 Feedback header

The Feedback PDU shall consist of Feedback header alone and shall not contain a payload. The Feedback header with and without CID field are illustrated in Fig. 20b.




(a) Feedback header with CID field.




(b) Feedback header without CID field.

**Figure 20b –Feedback header**

The Feedback header shall have the following properties:

a) The length of the header shall always be 6 bytes.
b) The HT field is set to 1 and the EC field is set to 1, which indicates the feedback header type.
c) The N/M field (Normal feedback header/Mini feedback header indication) shall be set to 0 to indicate that this is a normal size Feedback header
d) The Feedback Type field shall be set according to Table 7b.
e) The CII field (CID Inclusion Indication) shall be set to 1 for the header with CID field and set to 0 for the header without CID field.
f) The Feedback Content field shall be set accordingly based on the value of the feedback type field.

The Feedback header shall be used by MSS to provide its feedback(s). An MSS receiving a Feedback header on the downlink shall discard the PDU.

The feedback type is defined in Table 7b.

**Table 7b. Feedback Type and feedback content.**

| Feedback Type | Feedback contents | Decsription |
|---|---|---|
| 0b0000 | Set as described in table 296d. | MIMO mode and permutation. feedback |
| 0b0001 | DL average CQI (5bits) | 5 bits CQI feedback |
| 0b0010 | Number of index, *L* (2 bits) + *L* occurrences of Antenna index (2 bits) + MIMO coefficients (5 bits, 8.4.5.4.10.6) | MIMO coefficients feedback |
| 0b0011 | Preferred-DIUC (4 bits) | Preferred DL channel DIUC feedback |
| 0b0100 | UL-TX-Power (7 bits) (see table 7a) | UL transmission power |
| 0b0101 | Preferred DIUC(4 bits) + UL-TX-Power(7 bits) + UL-headroom (6 bits) (see Table 7a) | PHY channel feedback |
| 0b0110 | Number of groups, *M* (2 bits) + *M* occurrences of 'group index (2 bits) + CQI (5 bits)' | CQIs of antenna groups |
| 0b0111 | Number of bands, *N* (2 bits) + *N* occurrences of 'band index (6 bits) + CQI (5 bits)' | CQIs of multiple AMC bands |
| 0b1000 | Number of feedback types, *O* (2 bits) + *O* occurrences of 'feedback type (4bits) + feedback content (variable)' | Multiple types of feedback |
| 0b1001-0b1111 | Reserved for future use | |

**Remedy 2:**
Introduce the 24-bit Mini Feedback Header. A flag is used to indicate whether the feedback header is the normal Feedback header or the Mini Feedback header.

*[Insert the following at the end of Section 6.3.2.1.4]*

6.3.2.1.4.2 Mini Feedback header

The Mini Feedback PDU shall consist of Mini Feedback header alone and shall not contain a payload. The Mini Feedback header is illustrated in Fig. 20c below. When sent alone without any other UL MAC PDU, the Mini Feedback header shall be duplicate

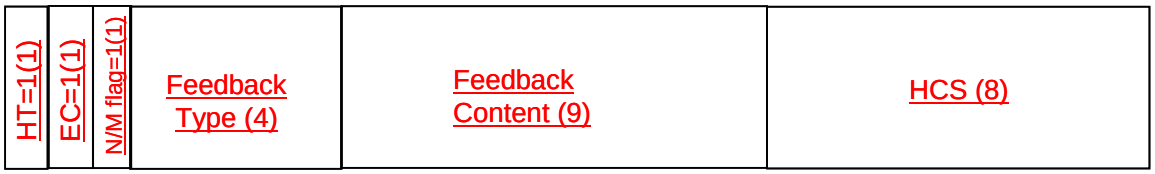



**Figure 20c – Mini Feedback header**

The Mini Feedback header shall have the following properties:

g) The length of the header shall always be 3 bytes.
h) The HT field is set to 1 and the EC field is set to 1, which indicates the feedback header type.
i) The N/M field (Normal feedback header/Mini feedback header indication) shall be set to 1 to indicate that this is a half-sized Mini Feedback header
j) The Feedback Type field shall be set according to Table 7b.
k) The Feedback Content field shall be set accordingly based on the value of the feedback type field.

The feedback type is defined in Table 7b.

**Remedy 3:**
Introduce a new Feedback Polling IE for the BS to request the MSS to provide a certain type(s) of feedback on the Feedback header or Mini Feedback header.

*[Insert the following section]*

8.4.5.3.19 Feedback Polling IE

This IE is used by BS to allocate dedicated UL resource for the purpose to obtain certain type of feedback from one or more MSS.

Table x – Feedback_polling IE format

| Syntax | Size | Notes |
|---|---|---|
| Feedback_polling IE () { | | |
| Extended UIUC | 4 bits | 0x?? |
| Length | 4 bits | Length in bytes of following fields |
| for ( i=0; i < Num_Allocations; i++) | | |
| { | | |
| Basic CID | 16 bits | |
| UIUC | | |
| Feedback_type | 6 bits | See Table 7b |
| Duration | 10 bits | In OFDMA slots (see 8.4.3.1) |
| Allocation_offset | 3 bits | The UL feedback shall be transmitted in the frame which is 0-8 frame delay relative to the current frame. |
| Period (p) | 2 bits | The UL resource region is dedicated to the MSS in every $2^p$ frame |
| Allocation Duration (d) | 3 bits | The allocation is valid for $10 \times 2^d$ frame starting from the frame defined by Allocation_offset<br>If d ==0b000, the dedicated allocation is de-allocated<br>If d == 0b111, the dedicated resource |

| | | |
|---|---|---|
| | | shall be valid until the BS commands to de-allocate the dedicated allocation |
| } | | |
| Padding bits | Variable | To align octet boundary |
| } | | |

**Feedback_type**
See Table 7b.
**Allocation_offset**
The UL feedback shall be transmitted in the frame which is 0-8 frame delay relative to the current frame.
**Duration**
In OFDMA slots (see 8.4.3.1)
**Period (p)**
The DL resource region is dedicated to a MSS in every $2^p$ frame
**Allocation Duration (d)**
The allocation is valid for 10 x $2^d$ frame starting from the frame defined by Allocation_offset
If d ==0b000, the dedicated allocation is de-allocated
If d == 0b111, the dedicated resource shall be valid until the BS commands to de-allocate the dedicated allocation