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| Project | **IEEE 802.16 Broadband Wireless Access Working Group <**<http://ieee802.org/16>**>** | |
| Title | **Modification to TWDC address and its use in IEEE 802.16.1a** | |
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| Re: | In response to Letter Ballot #38b on P802.16.1a/D3 | |
| Abstract | This contribution proposes modification to TWDC address and its use in IEEE 802.16.1a. | |
| Purpose | To discuss and adopt the proposed texts in the IEEE 802.16.1a Draft Standard. | |
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Modification to TWDC address and its use in IEEE 802.16.1a

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# Introduction

In the current draft of IEEE 802.16.1a, a pair of two-way direct communication (TWDC) addresses is used to indicate a direct communication (DC) link composed of two HR-MSs. One TWDC is for the transmitting HR-MS and another is for the receiving HR-MS, which seems to be inefficient. The TWDC address can distinguish 2048 (=211) links, and each of 64 HR-MSs in a sector/cell can make full connections with the other 63 HR-MSs in the same sector/cell in the worst case. If a single identifier is allocated to a DC link, then the address space is two times more than that of the case two TWDC addresses are allocated to a DC link. Furthermore, it can support 91 HR-MSs when each of them in a sector/cell is supposed to establish full connections with the other 90 HR-MSs in the worst case. Accordingly, we suggest use of a single Direct Communication Link ID (DCLID) for the identification of a DC link. However, it solely distinguishes a DC link without indicating its direction by which a transmitting HR-MS and a receiving HR-MS are implied, so HR-MS Indicator(HR-MS\_Ind) is used to indicate for which HR-MS is intended for its related signaling such as DC assignment. For example, let’s say that HR-MS A and HR-MS B are assigned to 0b0 and 0b1 as an HR-MS\_Ind, respectively. If HR-MS A would like to transmit an HARQ burst to HR-MS B via their DC link, then 0b0 of HR-MS\_Ind of HR-MS A is included in DC Assignment A-MAP IE to indicate the link direction.

Also, in the DC link creation, each HR-MS involving with it cannot identify which DC link needs to be created due to lack of signaling which DC link is handled. If multiple DSAs are requested from an HR-MS to different HR-MSs, then multiple requests for each DC link creation over the different links is required, but the transmitting HR-MS may not know for which DC link the creation is being requested. Thus, it is proposed to use FID to indicate which DC link is requested to be created in AAI-DC-LC-REQ.

# References

[1] IEEE P802.16.1aTM/D3, WirelessMAN-Advanced Air Interface for Broadband Access Systems - Draft Amendment: Higher Reliability Networks, June 2012.

[2] IEEE P802.16.1TM/D6, IEEE Draft for WirelessMAN-Advanced Air Interface for Broadband Wireless Access Systems, Apr. 2012.

# Proposed Texts on the IEEE 802.16.1a Amendment Draft Standard

The proposed texts are written in three different types of fonts according to each change purpose as follows.

The same texts in the current draft: black

The texts to be deleted by this contribution: ~~red strikeout~~

The texts to be added by this contribution: blue underline

[-----------------------------------------------------Start of Text Proposal------------------------------------------------------]

*[Remedy #1: Modify Table 86 in Section 6.2.3.47.1 on Page 43 in the IEEE P802.16.1a/D3 Draft Standard as follows.]*

**Table 86 – AAI-DSA-REQ message field description**

|  |  |  |  |
| --- | --- | --- | --- |
| **Field** | **Size**  **(bits)** | **Value/Description** | **Condition** |
| … | … | … | … |
| ~~TWDC address for transmitting~~DCLID | 12 | ~~TWDC assigned to this HR-MS to identify the direct communication link~~DCLID assigned to this HR-MS and its peer HR-MS to identify the direct communication link involving composed of them | Present when HR-BS controlled direct communication is supported |
| ~~TWDC address for receiving~~ | ~~12~~ | ~~TWDC assigned to peer HR-MS to identify the direct communication link~~ | ~~Present when HR-BS controlled direct communication is supported~~ |
| … | … | … | … |

*[Remedy #2: Modify the current texts in Section 6.2.3.65.15 on Page 68 in the IEEE P802.16.1a/D3 Draft Standard as follows.]*

**6.2.3.65.15 AAI-DC-LC-REQ**

When HR-BS creates direct communication link between two HR-MSs. It shall send link creation message to both source and destination HR-MSs. Direct communication link creation can only be initiated by the HR-BS.

**Table 106o – AAI-DC-LC-REQ message field description**

|  |  |  |  |
| --- | --- | --- | --- |
| **Field** | **Size**  **(bits)** | **Value/Description** | **Condition** |
| FID | 4 | Indicates which direct communication link needs to be created, which is corresponding to this flow |  |
| ~~TWDC address for transmitting~~DCLID | 12 | ~~Address assigned to DC link~~DCLID assigned to this HR-MS and its peer HR-MS to identify the direct communication link composed of them |  |
| ~~TWDC address for receiving~~ | ~~12~~ | ~~Address assigned for DC link~~ |  |
| HR-MS\_Ind | 1 | Each of two different HR-MS\_Inds is assigned to each HR-MSs involving with the direct communication link to indicate for which HR-MS is intended for its related signaling by this value. |  |

~~TWDC address for transmitting~~

* ~~The TWDC address is used by the HR-MS for transmitting. The peer HR-MS of the DC-link shall receive on the resource scheduled with this TWDC address.~~

~~TWDC address for receiving~~

* ~~The HR-MS shall receive on the resource assigned to this TWDC address since it is assigned to the peer HR-MS on the DC-Link for transmission.~~

*[Remedy #3: Modify the current texts in Section 6.2.3.65.16 on Page 68 in the IEEE P802.16.1a/D3 Draft Standard as follows.]*

**6.2.3.65.16 AAI-DC-LC-RSP**

The HR-MSs shall send back a response once they receive the direct communication link creation request.

**Table 106p – AAI-DC-LC-RSP message field description**

|  |  |  |  |
| --- | --- | --- | --- |
| **Field** | **Size**  **(bits)** | **Value/Description** | **Condition** |
| ~~TWDC address for transmitting~~DCLID | 12 |  | ~~mandatory~~ |
| Confirmation Code | 1 | 0b0: accept  0b1: reject | ~~mandatory~~ |

Once the HR-BS receives responses from both HR-MSs, it can continue on other steps of direct communication setup.

*[Remedy #4: Modify the current texts in Section 6.2.3.65.17 on Page 69 in the IEEE P802.16.1a/D3 Draft Standard as follows.]*

**6.2.3.65.17 AAI-DC-LD-REQ**

When HR-BS wants to remove a direct communication link, it shall send deletion request to both HR-MS and wait for responses from the HR-MSs.

**Table 106q – AAI-DC-LD-REQ message field description**

|  |  |  |  |
| --- | --- | --- | --- |
| **Field** | **Size**  **(bits)** | **Value/Description** | **Condition** |
| ~~TWDC address for transmitting~~DCLID | 12 | ~~TWDC address~~DCLID assigned to the direct communication link |  |

*[Remedy #5: Modify the current texts in Section 6.2.3.65.18 on Page 69 in the IEEE P802.16.1a/D3 Draft Standard as follows.]*

**6.2.3.65.18 AAI-DC-LD-RSP**

The HR-MS shall reply with reasons to HR-BS when it receives the link deletion request from HR-BS.

**Table 106p – AAI-DC-LD-RSP message field description**

|  |  |  |  |
| --- | --- | --- | --- |
| **Field** | **Size**  **(bits)** | **Value/Description** | **Condition** |
| ~~TWDC address for transmitting~~DCLID | 12 | ~~TWDC address~~DCLID assigned to the direct communication link |  |

*[Remedy #6: Modify the current texts in Section 6.2.3.65.19 on Page 69 in the IEEE P802.16.1a/D3 Draft Standard as follows.]*

**6.2.3.65.19 AAI-DC-LR-REQ**

HR-BS may require the HR-MS to report the status of the direct communication link by sending a request to the peer HR-MS.

**Table 106s – AAI-DC-LR-REQ message field description**

|  |  |  |  |
| --- | --- | --- | --- |
| **Field** | **Size**  **(bits)** | **Value/Description** | **Condition** |
| ~~TWDC address for transmitting~~DCLID | 12 | DCLID assigned to the direct communication link |  |

*[Remedy #7: Modify the current texts in Section 6.2.3.65.20 on Page 70 in the IEEE P802.16.1a/D3 Draft Standard as follows.]*

**6.2.3.65.16 AAI-DC-LC-RSP**

HR-MS shall send back report regarding the direct communication link when it receives a link report request from HR-BS.

**Table 106t – AAI-DC-LC-RSP message field description**

|  |  |  |  |
| --- | --- | --- | --- |
| **Field** | **Size**  **(bits)** | **Value/Description** | **Condition** |
| ~~TWDC address~~DCLID | 12 | ~~TWDC address for transmitting~~DCLID assigned to the direct communication link |  |
| Link state | 1 | 0b0: active  0b1: no link found |  |

*[Remedy #8: Modify Table 192 in Section 6.3.5.5.2.1 on Page 106 in the IEEE P802.16.1a/D3 Draft Standard as follows.]*

**Table 192 – Description of CRC Mask**

|  |  |  |
| --- | --- | --- |
| **Masking Prefix (1 bit MSB)** | **Remaining 15 bit LSBs** | |
| 0b0 | *Type Indicator* | *Masking Code* |
|  | 0b000 | 12 bit STID or TSTID |
|  | 0b001 | Refer to Table 193 |
|  | 0b010 | Refer to Table 194 |
|  | 0b011 | 12 bit ~~TWDC address~~DCLID for direct communications |
| 0b1 | 15 bit RA-ID: The RA-ID is derived from the AMS' random  access attributes  (i.e., superframe number (LSB 5bits), frame\_index (2 bits),  preamble code index  for ranging or BR (6 bits) and opportunity index for ranging or  BR (2 bits)) as  defined below:  RA-ID = (LSB 5bits of superframe number | frame\_index |  preamble\_code\_index | opportunity\_index) | |

*[Remedy #9: Modify the current texts in Section 6.12.2.2.1.2 on Page 120 in the IEEE P802.16.1a/D3 Draft Standard as follows.]*

**6.12.2.2.1.2 Connection establishment and management for associated HR-MS**

HR-BS/HR-RS shall check AAI-DSA-REQ messages received from HR-MS and determine whether HR-MS direct communication can be adopted for a flow. The HR-BS/HR-RS may help the source and destination HR-MSs setting up a direct communication link through DSA signaling.

HR-BS knows the possibility of setting up a direct communication between two HR-MSs by checking the HR-MS neighbor tables. If the two nodes are neighbor, HR-MS may schedule the two HR-MSs to do channel measurement and determine whether a direct communication link should be setup.

To support direct communication between a pair of HR-MSs, a direct communication link shall be setup. When the DC link is first setup, ~~two 12-bit Two-way Direct Communication (TWDC) addresses are~~Direct Communication Link ID (DCLID) and HR-MS indicator (HR-MS\_Ind) are assigned to each DC~~-~~ link to facilitate the two way communication with including FID, which is corresponding to the flow between the HR-MSs, via AAI-DC-LC-REQ. ~~Each HR-MS is~~Both the HR-MSs involving with a direct communication are assigned ~~one TWDC address~~an identical DCLID to identify their DC link, and each of them is assigned a different HR-MS\_Ind to indicate which HR-MS between them is intended for its related signaling such as DC assignment using DC Assignment A-MAP IE~~for identifying it as the transmitter over the DC-link~~. The DC Assignment A-MAP IE for direct communication link is CRC masked as specified in Table 192.

The ~~TWDC address~~DCLID is referred in the link management messages such as link deletion and status report and resource assignment.

A security association may be setup between the two HR-MS linked by the direct communication. The procedure for setup security association over a direct communication link is defined in section 6.12.10.2. The security association may be shared by different flows over the direct communication link.

After a direct communication link is setup, flows 1 can be setup over the direct communication link with the DSA transactions as specified in section 6.12.2.2.1.2.2. When a flow is assigned over a direct communication link, the sender and receiver shall monitor direct communication related ~~TWDC address~~DCLID within the MAP and transmit/receive over the allocated resources.

HR-BS may take a few steps to setup a direct communication link between two HR-MS.

Firstly, the HR-BS shall schedule the two HR-MSs do a channel measurement with the method specified in section 6.12.2.2.1.1. The HR-MSs reports the channel measurement results to the HR-BS after the measurement.

If HR-BS decides to setup a direct communication link, it shall assign ~~TWDC address~~DCLID to the direct communication link and send ~~TWDC address~~DCLID to the two HR-MSs using AAI-DC-LC-REQ messages. The HR-MSs shall sends back AAI-DC-LC-RSP for confirmation.

After receiving AAI-DC-LC-RSP from both HR-MSs, the HR-BS may help the two HR-MSs establish a security association over the direct communication link if security is required. The setup of security association over direct communication link is specified in section 6.12.10.2.

Once a security association is setup, then the communication link is considered being established between the two HR-MSs. The HR-MSs shall find the existing flows between the two HR-MSs and move the existing flows by setting up new flows over the direct communication link with AAI-DSA method specified in section 6.12.2.2.1.2.2.

Figure 232 shows the procedure to setup a direct communication link between HR-MSs.

When HR-MS wants to delete the direct communication link, it shall send AAI-DC-LD-REQ to the two HR-MSs involved.

*[Remedy #10: Modify the current texts in Section 6.12.2.2.1.2.1.2 on Page 123 in the IEEE P802.16.1a/D3 Draft Standard as follows.]*

**6.12.2.2.1.2.1.2 Direct Communication Link Deletion**

To remove a direct communication link between two HR-MSs, the HR-BS shall request deletion of the direct communication link to the HR-MSs by sending an AAI-DC-LD-REQ to the HR-BSs. If one of the HR-MSs is not associated with the HR-BS and the HR-MS has a control connection to the HR-BS which is forwarded by its peer HR-MS by the forwarding to network in 6.12.3.2, then its peer HR-MS should forward the received AAI-DC-LD-REQ to it. In response to the received AAI-DC-LD-REQ from the serving HR-BS or the peer HR-MS, the HR-MSs shall send an AAI-DC-LD-RSP to the HR-BS or the peer HR-MS associated with the HR-BS. The AAI-DC-LD-RSP from the HR-MS not associated with the HR-BS should be forwarded to the HR-BS by the peer HR-MS. Once the HR-BS receives the responses from both the HR-MSs, it may release the ~~TWDCs~~DCLID and HR-MS\_Inds assigned to the HR-MSs, and then the DCLID and HR-MS\_Inds released can be re-assigned to a different direct communication link later.

*[Remedy #11: Modify the current texts in Section 6.12.2.2.1.4 on Line 11, Page 126 in the IEEE P802.16.1a/D3 Draft Standard as follows.]*

* HR-BS/RS initiates the process by transmitting a DC Assignment A-MAP IE, with the field “Direct Link A-MAP IE Type” set to “0b0000”. The ~~Direct Link~~DC Assignment A-MAP IE is CRC masked using the ~~TWDC address~~DCLID of the transmitting HR-MS. Both transmitting and receiving HR-MS will be able to recognize this allocation and prepare to transmit/receive accordingly.

*[Remedy #12: Modify the current texts in Section 6.12.2.2.1.5 on Line 1, Page 128 in the IEEE P802.16.1a/D3 Draft Standard as follows.]*

* For each broadcasted Assignment A-MAP IE, the base station employs the CRC mask corresponding to Type Indicator = 0b011, as specified in Table 192. The 12 bit TWDM of the transmitting station is used in the place of ~~TWDC~~DCLID.

*[Remedy #13: Modify the current texts in Section 6.12.2.2.2.2.1 on Page 128 in the IEEE P802.16.1a/D3 Draft Standard as follows.]*

**6.12.2.2.2.2.1 Direct Communication Assignment A-MAP IE**

Table 194 describes the fields in a Direct Communication Assignment A-MAP IE used for resource assignment to the direct link between two HR-MSs involving in BS-controlled HR-MS direct communications.

DC Assignment A-MAP IE is CRC masked according to Table 192, with the Type Indicator set to 0b011. This value of Type Indicator distinguishes DC Assignment A-MAP IE from DL/UL assignments.

In DC Assignment A-MAP IE, HR-MS\_Ind of the transmitting HR-MS is used to indicate that the HR-MS assigned this value as an HR-MS\_Ind is corresponding to a transmitting HR-MS for this DC assignment and the other HR-MS is corresponding to a receiving HR-MS.

**Table 194 – Direct Communication Assignment A-MAP IE format a**

|  |  |  |
| --- | --- | --- |
| **Syntax** | **Size (bits)** | **Notes** |
| Direct Communication Assignment A-MAP\_IE{ | 12 |  |
| Direct Link A-MAP IE Type | 4 | Set to 0b0000 |
| HR-MS\_Ind of the transmitting HR-MS | 1 | Indicates the HR-MS assigned this value as an HR-MS\_Ind is corresponding to a transmitting HR-MS for this DC assignment |
| *ISizeOffset* | 5 | Offset use to compute burst size index |
| MEF | 1 | MIMO encoder format  0b0: SFBC  0b1: Vertical Encoding with only 1 stream |
| Resource Index | 11 | 512 FFT size: 0 in first 2 MSB bits + 9 bits for resource index  1024 FFT size: 11 bits for resource index  2048 FFT size: 11 bits for resource index  Resource index includes location and allocation size |
| HFA DL | 3 | HARQ Feedback Allocation in the DL |
| HFA UL | 3 | HARQ Feedback Allocation in the UL |
| ACID | 4 | HARQ channel identifier |
| AI\_SN | 1 | HARQ identifier sequence number |
| Number of valid frames | 5 | Number of frames that this allocation applies to; when equal 0b0000, indicate the de-allocation of the defined resource. |
| Reserved | ~~3~~2 | To make the size equal 40 bits |
| } |  |  |

a A 16-bit CRC is generated based on the randomized contents of the 1 Direct Communication Assignment A-MAP IE. The CRC is masked by the 16-bit CRC mask generated according to Table 192, i.e., with Type Indicator set to “0b011”.

[------------------------------------------------------End of Text Proposal------------------------------------------------------]