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| Project | **IEEE 802.16 Broadband Wireless Access Working Group <**<http://ieee802.org/16>**>** | |
| Title | **Clarification on HR-MS neighbor discovery** | |
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| Re: | “IEEE 802.16-12-400-00-Gdoc,” in response to Letter Ballot Recirc #38b on P802.16.1a/D3 | |
| Abstract |  | |
| Purpose | To discuss and adopt the proposed text in the draft amendment document on GRIDMAN | |
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**Clarification on HR-MS neighbor discovery**

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# Introduction

We propose some modifications to the specification of HR-MS neighbor discovery to make the description clearer.

# References

[1] IEEE P802.16n/D3, Air Interface for Broadband Wireless Access Systems - Draft Amendment: Higher Reliability Networks, June 2012.

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

# Proposed Text for the 802.16.1a AWD

Note:

The text in **BLACK** color: the existing text in the IEEE P802.16.1a/D3

The text in **~~RED~~** color: the removal of existing IEEE P802.16.1a/D3

The text in **BLUE** color: the new text added to the IEEE P802.16.1a/D3

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

***[Remedy1: Modify Section 6.2.3.65.12 in IEEE P802.16.1a/D3 as indicated]***

* + - * 1. AAI-HR-RNG-CMD message

HR-BS/RS sends AAI-HR-RNG-CMD message to instruct ~~one or group of~~ its associated HR-MS to carry out neighbor discovery. The field “Action” in AAI-HR-RNG-CMD message tells the receiving HR-MS whether ~~it (them) should~~ to transmit or receive the specified ranging signal~~s~~. Using the field “Reversed action offset”, ~~T~~the serving HR-BS/HR-RS can schedule transmissions of ranging signal in both directions between a pair of HR-MSs. ~~allocate ranging resources to both involved HR-MSs in a single assignment. This allows the receiving HR-MS to transmit back a ranging sequence right after successfully processing the ranging sequence transmitted by the other HR-MS.~~

Table 106 – AAI-HR-RNG-CMD message field description

| **~~Field~~** | **~~Size (bits)~~** | **~~Value/Description~~** | **~~Condition~~** |
| --- | --- | --- | --- |
| ~~Frame Identifier~~ | ~~4~~ | ~~Frame which contains the ranging channel. The frame identifier is the 4 least significant bits of the frame number.~~ |  |
| ~~Subframe Index~~ | ~~3~~ | ~~Indicates the subframe index of the allocated ranging opportunity.~~ |  |
| ~~Dedicated ranging code index~~ | ~~5~~ | ~~Indicates the index of dedicated ranging code.~~ |  |
| ~~Action~~ | ~~2~~ | ~~0b00: ranging for neighbor discovery and receiving node to carry out transmission~~  ~~0b01: ranging for neighbor discovery and receiving node to carry out receiving~~  ~~0b10: DC/FTN periodic ranging transmission~~  ~~0b11: Reserved~~ |  |
| ~~Reversed action offset~~ | ~~4~~ | ~~0b0001-0b1111: Indicates number of frames that this HR-MS should switch to receive the same ranging code in the same ranging slot~~  ~~0b0000: no such reversed action.~~ |  |
| ~~if (Action == 0b00||0b10) || (Reversed action offset > 0x0){~~ |  |  |  |
| ~~Transmit power level~~ | ~~5~~ | ~~Unsigned integer from 0 to 31 in units of 1 dBm, where 0b00000 = 0dBm and 0b11111 = 31dBm~~ |  |
| ~~}~~ |  |  |  |
| ~~If (Action == 0b10){~~ |  |  |  |
| ~~Periodicity~~ | ~~2~~ | ~~Indicates the periodicity of periodic ranging:~~  ~~0b00: transmit ranging signal every 2 frames~~  ~~0b01: transmit ranging signal every 4 frames~~  ~~0b10: transmit ranging signal every 16 frames~~  ~~0b11: transmit ranging signal every 32 frames~~ |  |
| ~~Tx/Rx Offset~~ | ~~1~~ | ~~Offset between transmitting and receiving ranging from the other HR-MS:~~  ~~0b0: Offset = 1 frame~~  ~~0b1: Offset = 3 frames~~ |  |
| ~~}~~ |  |  |  |
| ~~Reporting mode~~ | ~~1~~ | ~~Indicates if the report mode is exclusive or triggered by threshold.~~  ~~0b0: exclusive reporting~~  ~~0b1: triggered-based reporting~~ |  |
| ~~if(Reporting mode == 0b1){~~ |  |  |  |
| ~~SINR threshold~~ | ~~4~~ | ~~Indicates the SINR threshold for the ranging signal above which report should be made by receiving station. The 4 bit value from 0b0000 to 0b1111 represent values among {–9, –8.5, –8, –7.5, –7, –6.5,–6, –5.5, –5, –4.5, –4, –3.5, –3, –2.5,–2, –1.5} dB~~ |  |
| ~~}~~ |  |  |  |

| **Field** | **Size (bits)** | **Value/Description** | **Condition** |
| --- | --- | --- | --- |
| Frame Identifier | 4 | Frame which contains the ranging channel. The frame identifier is the 4 least significant bits of the frame number. |  |
| Subframe Index | 3 | Indicates the subframe index of the allocated ranging opportunity. |  |
| Action | 2 | 0b00: ranging for neighbor discovery and receiving node to carry out transmission  0b01: ranging for neighbor discovery and receiving node to carry out receiving  0b10: DC/FTN periodic ranging transmission  0b11: Reserved |  |
| if (Action == 0b00){ |  |  |  |
| Transmit power level | 5 | Unsigned integer from 0 to 31 in units of 1 dBm, where 0b00000 = 0dBm and 0b11111 = 31dBm |  |
| Reversed action offset | 4 | 0b0000-0b1111: Indicates the number of frames between the frame that this HR-MS transmits the dedicated ranging code until the frame that this HR-MS should try to receive the same ranging code. | Present if HR-BS assigns ranging resources in both directions. |
| Reporting mode | 1 | Indicates if the report mode is exclusive or triggered by threshold.  0b0: exclusive reporting  0b1: triggered-based reporting | Present if the field “Reserved action offset” is present |
| if(Reporting mode == 0b1){ |  |  |  |
| SINR threshold | 4 | Indicates the SINR threshold for the ranging signal above which report should be made by receiving station. The 4 bit value from 0b0000 to 0b1111 represent values among {–9, –8.5, –8, –7.5, –7, –6.5,–6, –5.5, –5, –4.5, –4, –3.5, –3, –2.5,–2, –1.5} dB | Present if the field “Reserved action offset” is present |
| } |  |  |  |
| }elseif (Action == 0b01){ |  |  |  |
| Reporting mode | 1 | Indicates if the report mode is exclusive or triggered by threshold.  0b0: exclusive reporting  0b1: triggered-based reporting |  |
| if(Reporting mode == 0b1){ |  |  |  |
| SINR threshold | 4 | Indicates the SINR threshold for the ranging signal above which report should be made by receiving station. The 4 bit value from 0b0000 to 0b1111 represent values among {–9, –8.5, –8, –7.5, –7, –6.5,–6, –5.5, –5, –4.5, –4, –3.5, –3, –2.5,–2, –1.5} dB |  |
| } |  |  |  |
| Reversed action offset | 4 | 0b0000-0b1111: Indicates the number of frames between the frame that this HR-MS receives the dedicated ranging code until the frame that this HR-MS should switch to transmit the same ranging code. | Present if HR-BS assigns ranging resources in both directions. |
| Transmit power level | 5 | Unsigned integer from 0 to 31 in units of 1 dBm, where 0b00000 = 0dBm and 0b11111 = 31dBm | Present if the field “Reserved action offset” is present |
| }elseif (Action == 0b10){ |  |  |  |
| Transmit power level | 5 | Unsigned integer from 0 to 31 in units of 1 dBm, where 0b00000 = 0dBm and 0b11111 = 31dBm |  |
| Periodicity | 2 | Indicates the periodicity of periodic ranging:  0b00: transmit ranging signal every 2 frames  0b01: transmit ranging signal every 4 frames  0b10: transmit ranging signal every 16 frames  0b11: transmit ranging signal every 32 frames |  |
| Tx/Rx Offset | 1 | Offset between transmitting and receiving ranging from the other HR-MS:  0b0: Offset = 1 frame  0b1: Offset = 3 frames |  |
| } |  |  |  |
| Dedicated ranging code index | 5 | Indicates the index of dedicated ranging code. | Optional when (“Action == 0b01” and “Reversed action offset is not present”)  Mandatory for other cases |

When an AAI-HR-RNG-CMD message is used to scheduled ranging for neighbor discovery, it may be unicast, multicast or broadcast to the receiving HR-MSs. When the AAI-HR-RNG-CMD message is multicast or broadcast, the field “Reserved action offset” shall not be present in the message.

When AAI-HR-RNG-CMD message is used to schedule periodic ranging between two HR-MSs involved in BS-controlled direct communication, it is transmitted in the DL resource assignment identified by the TWDC allocated to one of the two sides of the direct communication link. The HR-MS that has its TWDC used shall transmit the ranging signal as defined by the field “Frame Index”, “Subframe Index” and “Periodicity”. The other HR-MS, i.e., at the other side of the direct communication link, shall transmit the same ranging code, at the same location within a frame, and at an offset as defined by Tx/Rx Offset.

When AAI-HR-RNG-CMD message is used to schedule periodic ranging between two HR-MSs involved in BS-controlled FTN, it is transmitted in the DL resource assignment of the forwarded HR-MS. The forwarding HR-MS shall transmit the ranging signal as defined by the fields “Frame Index”, “Subframe Index” and “Periodicity”. The forwarded HR-MS shall transmit the same ranging code, at the same location within a frame, and at an offset as defined by Tx/Rx Offset.

***[Remedy2: Modify Table 106m in IEEE P802.16n/D3 as indicated]***

| **Field** | **Size (bits)** | **Value/Description** | **Condition** |
| --- | --- | --- | --- |
| For (*i* = 0; *i* < Number of ranging codes to be reported; *i*++){ |  |  |  |
| Frame Identifier | 4 | Frame which contains the ranging channel. The frame identifier is the 4 least significant bits of the frame number. |  |
| Subframe Index | 3 | Indicates the subframe index of the allocated ranging opportunity. |  |
| Detected ranging code index | 5 | Index of the ranging code detected. |  |
| Received SINR | 4 | Indicates the received SINR of the ranging code. The 4 bit value from 0b0000 to 0b1111 represent values among {–9, –8.5, –8, –7.5, –7, –6.5,–6, –5.5, –5, –4.5, –4, –3.5, –3, –2.5,–2, –1.5} dB |  |
| Timing offset | 15 | Time offset, in units of 1/*Fs*, of the received ranging signal, with respect to the frame timing of the HR-MS.  MSB 1 bit represents the sign of the value. That is, the value is negative(–) if the MSB=0b1, and the value is positive(+) if the MSB=0b0. LSB 14 bits represent timing offset correction value of [1…16384] that corresponds to 0x0000 ~ 0x3FFF, respectively. | Optional |
| Frequency offset | 9 | Frequency offset, in units of  2% of the subcarrier spacing (ƒ), of the received ranging signal, with respect to the frequency of the HR-MS.  MSB 1bit represents the sign of the value. That is, the value is negative(–) if the MSB=0b1, and the value is positive(+) if the MSB=0b0. LSB 8 bits represent frequency offset correction value of [1..256] that corresponds to 0x00 ~ 0xFF, respectively | Optional |
| } |  |  |  |

***[Remedy3: Modify Section 6.12.2.2.1.1 in IEEE P802.16.1a/D3 as indicated]***

HR-MS Neighbor Discovery

For associated HR-MSs to discover each other, the serving HR-BS/HR-RS shall request ~~schedule~~ some HR-MSs to broadcast ranging signals ~~so that~~ while other HR-MSs ~~can try~~ to attempt to receive and verify their neighbor relationship. The process ~~can be~~ is described as follows:

* The serving HR-BS/HR-RS sends AAI-HR-RNG-CMD message described in 6.2.3.65.12 to schedule one or multiple registered HR-MSs to broadcast ranging sequences in assigned channels. Multiple HR-MSs may share the same ranging sequence or the same assigned channel.
* Using AAI-HR-RNG-CMD message, the serving HR-BS/HR-RS also schedules some other ~~HR-MSs~~ HR-MS(s) to listen on ranging channel for the ranging signal ~~those channels scheduled for ranging signals~~.
* ~~Each HR-MS that is scheduled to receive ranging sequences shall determine what sequences it can properly decode, together with related information such as estimations of time/frequency offsets and signal strength.~~
* The HR-MS receiving a ranging sequence that has met the reporting criteria defined by the “Reporting mode” and possibly “SINR threshold” as specified in AAI-HR-RNG-CMD message shall report their measurements to the serving HR-BS/HR-RS using AAI-HR-RNG-REP message described in 6.2.3.65.13.

~~The format of AAI-HR-RNG-CMD message is described in . The HR-BS unicasts AAI-HR-RNG-CMD message to a single HR-MS or multicasts the message to a group of HR-MSs that are supposed to broadcast the ranging signal. The HR-BS unicasts AAI-HR-RNG-CMD message to a single HR-MS or multicasts the message to a group of HR-MSs that are supposed to attempt to receive the ranging signal. The HR-BS can also broadcast the AAI-HR-RNG-CMD message to all of its subordinates HR-MS. In such a case, all HR-MS that are not involved in UL transmission during the ranging opportunity index shall attempt to receive the ranging signal.~~

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