IEEE P802.11
Wireless LANs

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| CC28 CR HEz Protocol Clean Up |
| Date: 2018-09-10 |
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**Abstract**

This submission proposes resolutions of comments received from TGaz CC28.

(The proposed change is based on TGaz Draft 0.5.2)

* CIDs: 491, 387, 43, 122, 397, 392, 396, 45, 132, 393, 394, 400, 401, 402, 403, 404 (16 CIDs)

| **CID** | **Page** | **Clause** | **Comment** | **Proposed Change** | **Resolution** |
| --- | --- | --- | --- | --- | --- |
| 491 | 52.00 | 11.22.6.4.3.4 | Definition of t3' and t2' is not clear. What is the difference between t3 and t3'? |  | Revised No specific solution outlined in comment but made changes to clarify definitions. |
| 387 | 57 | 11.22.6.4.3.4 | "and if negotiate from ISTA to RSTA" -- what does this mean? | Clarify | Revised No specific solution outlined, but reworded text to clarify |
| 43 | 57 | 11.22.6.4.3.4 | Typo on the word "negotiated" |  | Accepted |
| 122 | 57 | 11.22.6.4.3.4 | Missing 'd' in 'negotiate'. |  | Accepted |
| 397 | 57 | 11.22.6.4.3.4 | Should also illustrate the case with no ISTA-to-RSTA | Add a figure, or say it is the same as the figure except no TF and no UL | RevisedNo specific solution outlined, but tried to clarify |
| 392 | 57 | 11.22.6.4.3.4 | "For the details of HEz Polling Part and HEz Range Measurement Sounding Part, please refer to 21the descriptions in 11.22.6.4.2.2 (HEz Polling Part) and 11.22.6.4.2.3 (HEz Range Measurement 22Sounding)." -- not needed (not used in other subclauses) | Delete | RevisedNo specific solution outlined, but reworded that text |
| 396 | 57 | 11.22.6.4.3.4 | "the ISTA shall response with the ISTA-to- 26RSTA LMR using the HE TB PPUD format" -- this is normal TF behaviour so need not be stated | Delete | RevisedMade it clear that the specified behaviour is not to repond to the TF with \*any\* frame, but with the specific LMR frame |
| 45 | 57 | 11.22.6.4.3.4 | Typo on word "PPDU" | As per comment | Accepted |
| 132 | 57 | 11.22.6.4.3.4 | Correct typo | change TB PPUD to TB PPDU | Accepted |
| 393 | 57 | 11.22.6.4.3.4 | "PPUD" | "PPDU" | Accepted |
| 394 | 57 | 11.22.6.4.3.4 | New term? " HE Location Measurement Report Part" |  | Revised-No specific solution outlined, but tried to align all the terms used |
| 400 | 57 | 11.22.6.4.3.4 | What if not all the reports from the ISTAs are received by the RSTA? | Clarify how this is handled | Revised-No specific solution outlined, but tried to clarify in text. |
| 401 | 57 | 11.22.6.4.3.4 | What if not all the reports to the ISTAs are received by the ISTAs? | Clarify how this is handled | Revised-No specific solution outlined,but tried to clarify in text. |
| 404 | 58 | 11.22.6.4.3.4 | This should not just be a NOTE | Delete "Note:" | AcceptedRemoved “Note:” |
| 403 | 58 | 11.22.6.4.3.4 | ", for example, receiving the PHY-RXEND.indication(Integrity Check Error) " -- this should not just be an example | Change to "In the secured mode of HEz, if the RSTA receives a PHY-RXEND.indication(IntegrityCheckError) instead of an UL NDP from an ISTA". Ditto below | Revised-Agree in principle, revised language. |
| 402 | 58 | 11.22.6.4.3.4 | "Integrity Check Error" should be one word and italics | As it says in the comment (5x in total) | Revised-Agree in principle, revised terminology |
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***TGaz Editor: replace Section 11.22.6.4.3 with the following revised text, changes relative to draft 0.5.2***

#### 11.22.6.4.3 Measurement Exchange in HEz Mode

11.22.6.4.3.1 General

HEz mode is the dynamic trigger-based sequence of the FTM procedure. The HEz sequence shall appear in scheduled availability time windows assigned to ISTAs during the negotiation phase. Within each availability window the RSTA and ISTAs shall perform ranging activities related to polling, range measurement sounding and measurement results reporting, as well as group related scheduling indications. Each availability window consists by default of a single TXOP and can be extended to multiple TXOPs by announcement, if a single TXOP is insufficient to accommodate all ISTAs responding to the polling phase (see 11.22.6.4.3.2 and 11.22.6.4.3.3). Each instance of the HEz measurement exchange divides into one or more of three ordered parts: polling, range measurement sounding and measurement results reporting. Figure 11-35b shows a nominal case of an availability window composed of a single polling, range measurement sounding and measurement reporting parts. An RSTA and ISTA participating in an HEz mode ranging shall perform HEz ranging measurement and measurement results activities only within the availability window.



Figure 11-35b – HEz Availability Windows

Availability windows nominally consist of a single poll, which should poll all ISTAs assigned to the availability window. If the available bandwidth is insufficient to allow for the polling of all ISTAs within the group, the RSTA shall indicate within the TF Location Poll that one or more extra TF Location Polls can be expected within the availability window, see example in Figure 11-35b1. Any extra instances of polling/sounding/reporting can either be transmitted in the same TXOP or a new TXOP (see Figure 11-35b2) depending on the maximum allowed TXOP duration and the predicted length of the extra instances of polling/sounding/reporting. All instances of polling/sounding/reporting must be completed before the end of the availability window.

During the availability window, measurement resources and results are made available to each ISTA whose poll response was correctly received at the RSTA. This may also lead to extra polling/sounding/reporting instances, even if all ISTA were polled in the first polling instance, but the RSTA is not able to accommodate all ISTA that responded in a single range measurement sounding instance (see Section 11.22.6.4.3.3).

Within the availability windows, the RSTA shall use an AID or Ranging ID (RID) to identify an associated or unassociated ISTA respectively. The AID and RID shall be non-conflicting, shall have the same size and valid address space, and shall follow the same rules. The RID is assigned during the FTM negotiation phase (refer to section TBD).

Note: It is recommended that a device discards ranging measurements when it detects that its ranging peer’s clock drift considering its local clock, exceeds the allowed tolerance from the values specified in section 21.3.17.3



Figure 11-35b1 –HEz Measurement Exchange with two instances of polling/sounding/reporting within a single TXOP.



Figure 11-35b2 – HEz Measurement Exchange with two instances of polling/sounding/reporting in separate TXOPs.

11.22.6.4.3.2 HEz Polling Part

The polling part is the first part of each position measurement phase and precedes the range measurement sounding part. At the beginning of each availability window the RSTA shall transmit a TF with type Location and sub-type Polling. An ISTA shall request a measurement instance by responding with a CTS-to-self in its designated frequency allocation as identified in the TF Location Polling, SIFS time after the TF Location Polling frame, see Figure 11-35c.

If the available bandwidth does not allow for the polling of all ISTAs served by this availability window, the RSTA shall schedule one or more extra polling opportunities within the availability window (see Figure 11-35b1 and Figure 11-35b2) and shall indicate that in the TF Location Poll frame and the associated subsequent measurement and polling parts.



Figure 11-35c HEz Measurement Exchange with two ISTAs

11.22.6.4.3.3 HEz Range Measurement Sounding Part

The range measurement sounding part commences SIFS time after the location polling part and is the second part of the HEz measurement exchange, see Figure 11-35c. The range measurement sounding part is composed of one or more TF of type Location, subtype Sounding allocating uplink resources to one or more ISTAs (compare Figure 11-35c1). Each TF Location Sounding shall allocate uplink resources for one or more ISTA’s UL NDP multiplexed in the spatial stream domain. The frame format of the UL NDP is a Ranging TB NDP PPDU, see Section 28.3.17. SIFS time after the last UL NDP, the RSTA shall transmit an NDP-A frame followed by a DL NDP sounding frame; the NDP-A is a Ranging NDP Announcement frame, see Section 9.3.1.19, and the DL NDP is a Ranging NDP PPDU, see Section 28.3.16. Figure 11-35c shows a range measurement between an RSTA and two ISTAs (ISTA 1 and ISTA 4) responding to the poll. The TF of type Location, sub-type Sounding allocates a separate spatial stream to each ISTA. The DL NDP is used by all ISTA taking part in the exchange.

The RSTA will select one bandwidth value for the range measurement sounding part based on the Format and Bandwidth subfield of the Ranging Parameters field(s) (see 9.4.2.246) provided by each of the ISTAs during negotiation. This bandwidth can different from the bandwidth used in the polling part but needs to adhere to the rules of multiple frame transmission in an EDCA TXOP (see Section 10.22.2.7).

* The RSTA shall set the TXVECTOR parameter CH\_BANDWIDTH of the TF type Location, subtype Sounding to that same bandwidth, and use the same value for the BW subfield of the Common Info field of said TF.
* When transmitting the Ranging NDP-A and DL NDP frames, the RSTA shall set the TXVECTOR parameter CH\_BANDWIDTH to that same bandwidth.
* Any ISTA that transmits an UL NDP as a response to the TF type Location, subtype Sounding, shall set the TXVECTOR parameter CH\_BANDWIDTH to the value defined in the BW subfield of the Common Info field of the soliciting TF.



Figure 11-35c2 - HEz Measurement Exchange with multiple TF Sounding

The RSTA can schedule some ISTAs that replied during the polling part to the first range measurement sounding instance and other ISTAs to the one or more extra Range Measurement Sounding instances, see Figure 11-35b1. This is necessary if different ISTA have indicated varying, incompatible Format and Bandwidth parameters in their Ranging Parameters fields or if the RSTA wants to limit the time duration of each Range Measurement Sounding instance.

Both RSTA and ISTA peform TOF measurements by capturing the timestamps of the NDP frames. The ISTA records the time at which the UL NDP is transmitted (t1). The RSTA then captures the time at which the UL NDP arrives (t2) and records the time at which the DL NDP is transmitted (t3). The ISTA finally captures the time at which the DL NDP arrives (t4). See Figure 11-35d. The timestamp values t2 and t3 shall be measured according to the RSTA’s clock (i.e., without applying any frequency offset correction to the time basis).



Figure 11-35d Timing diagram for a HEz Range Measurement Sounding phase

The Round-Trip Time (RTT) is defined by:

RTT = [(t4-t1) – (t3’-t2’)]

Where t3’ and t2’ are the time at which the DL NDP was transmitted and the time at which the UL NDP was received, respectively, as converted by the ISTA from the RSTA’s time basis to its own time basis. The mechanism by which the ISTA derives t3’ and t2’ from the TOD and TOA fields of the relevant LMR are implementation dependent.

The TOA field’s value contains a timestamp that represents the time, with respect to a time base, at which the start of the first HE-LTF of the associated NDP frame arrived at the receive antenna connector. The TOD field’s value contains a timestamp that represents the time, with respect to a time base, at which the start of the preamble of the associated NDP frame appeared at the transmit antenna connector, refer to Section 11.22.6.4.3.4 (HEz Measurement Reporting Part).

If the range measurement sounding instance includes more than a single TF Location Sounding, e.g., in Figure 11-35c1, the ISTA and RSTA shall refer the t1 and t2 to the UL NDP frame instance transmitted by that ISTA, refer to Figure 11-35e.



Figure 11-35e HEz Measurement Sounding Sequence with UL TDMA Multiplexing

The UL power control, timing and frequency synchronization requirements in the HEz mode of associated and unassociated STAs shall follow the same rules as those of any other HE STA in associated mode.

11.22.6.4.3.4 HEz Measurement Reporting Part

The last part of each HEz Measurement exchange is the HEz Measurement Reporting, which appears SIFS time after the HEz Measurement Sounding part, see Figure 11-35c. The Measurement results shall be carried in Location Measurement Results (LMR) frames (see Section 9.6.7.37). LMR frames shall carry measurement results from the RSTA to the ISTA, and if negotiated, also from the ISTA to the RSTA, see Figure 11-35f. Measurement results carried in a measurement reporting part shall be either from the current availability window or the previous availability window used by the ISTA. Each LMR is a unicast frame. All the RSTA to ISTA LMR, of ISTAs that were served in the preceding range measurement sounding instance, are carried in one HE MU PPDU. If ISTA to RSTA LMR was negotiated, the RSTA shall assign UL resources to the ISTAs using a TF with type Location and sub-type LMR.

LMR feedback is carried in Action No Ack frames (see 9.6.7.37) and are therefore neither acknowledged nor retransmitted.

An HEz exchange sequence including the optional of ISTA-to-RSTA LMR is illustrated in Figure 11-35f. If the optional RSTA-to-ISTA LMR was negotiated by one or more ISTAs, then SIFS time after sending out the RSTA-to-ISTA LMR, the RSTA may transmit a TF type location, sub-type LMR to solicit the ISTA-to-RSTA LMR frame(s). This TF shall allocate uplink resources to ISTAs that negotiated IST-to-RSTA LMR and were served in the preceding range measurement sounding instance. In response to the TF, the addressed ISTAs shall respond by transmitting the ISTA-to-RSTA LMR frame. The feedback type of the ISTA-to-RSTA LMR could be either immediate (including measurements for this availability window) or delayed (including measurement for previous availability window frequented by the ISTA). The ISTAs indicate their ISTA-to-RSTA LMR type to the RSTA during negotiation. When an ISTA indicates delayed ISTA-to-RSTA LMR reporting, and if the ISTA-to-RSTA LMR for the previous availability window is not ready, then the ISTA shall not responsd to the poll in the HEz polling part of the current availability window.



Figure 11-35f - HEz Measurement Exchange Sequence with Bidirectional LMR Feedback for n ISTA

In the secured mode of HEz, if an RSTA receives the PHY-RXEND.indication(*IntegrityCheckError*) primitive, the RSTA shall set the Invalid Measurement field in the RSTA-to-ISTA LMR frame carrying the TOA measured from the UL NDP to 1. Equally, if ISTA-to-RSTA LMR was negotiated between the ISTA and RSTA and the ISTA receives a PHY-RXEND.indication(*IntegrityCheckError*) primitive, the ISTA shall set the Invalid Measurement field in the ISTA-to-RSTA LMR carrying the TOA measured from the DL NDP to 1.

If the Invalid Measurement field in an RSTA-to-ISTA LMR or ISTA-to-RSTA LMR is set to 1, the RSTA or ISTA receiving the LMR should discard the TOA carried in the LMR.