IEEE P802.11
Wireless LANs

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| Location Related Clarifications to REVmc Draft 4.2 |
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Abstract

This contribution addresses some clarifications needed regarding Locationing.

It uses Draft 4.2 as a baseline.

***Revision history:***

***v0 :*** Initial submission.

***v1 :*** Added Naveen as a co-author.

***NOTE TO EDITOR* : *Please make the changes shown in Tracked Changes.***

* Receiving a neighbor report

If dot11RMNeighborReportActivated is true, an AP receiving a neighbor report request shall respond with a Neighbor Report Response frame containing zero or more Neighbor Report elements. If an SSID element is specified in the corresponding Neighbor Report Request frame, the Neighbor Report element(s) shall contain information only concerning neighbor APs that are members of the current ESS identified by the SSID element contained within the neighbor report request. If the SSID element is omitted, the Neighbor Report element(s) shall contain information concerning neighbor APs that belong to the same ESS as the requesting STA. If the wildcard SSID element is specified in the corresponding Neighbor Request frame, the Neighbor Report element(s) shall contain information concerning all neighbor APs. If there are no neighbor APs available, the AP shall send a Neighbor Report Response frame with no Neighbor Report elements.

If dot11RMNeighborReportActivated is false in an AP receiving a neighbor report request, it shall ignore the request and return a Neighbor Report frame with the Incapable bit in the Measurement Report Mode field set to 1.(#2185)

A serving AP shall include a TSF (#136)subelement in the Neighbor Report element if it is able to guarantee an accumulated error of 1.5 TU or better on the TSF Offset subfield. Otherwise, the AP shall not include a TSF (#136)subelement in the Neighbor Report element.

When either of the following is true:(M55)(#3759)

* An(#3759) AP that has both dot11FineTimingMsmtRespActivated and dot11RMLCIConfigured(#M130) equal to true receives a Measurement Request element with Measurement Type field(#5647) equal to LCI(M91).(#3759)
* An(#3759) AP that has both dot11FineTimingMsmtRespActivated and dot11RMCivicConfigured(M130) equal to true receives a Measurement Request element with Measurement Type field(#5647) equal to Location Civic(M91).(#3759)

within a Neighbor Report Request frame then the AP shall include a Neighbor Report element for the AP's own BSSID.

When either of the following is true:(#2403)(#3759)

* An(#3759) AP that has both dot11FineTimingMsmtRespActivated(#3112) and dot11RMLCIConfigured(M130) equal to true receives a Measurement Request element with Measurement Type field(#5648) equal to LCI(M91) within a Neighbor Report Request frame.(#3759)
* An(#3759) AP that has dot11LciCivicInNeighborReport and dot11RMLCIConfigured(M130) equal to true receives a Neighbor Report Request frame.(#3759)

then the AP shall include a Measurement Report subelement with Measurement Type field(#5648) equal to LCI(M91) in each Neighbor Report element in the Neighbor Report Response frame. If the maximum horizontal or vertical location error of a neighboring AP relative to a reference AP is known to the AP and this relative error is smaller than the absolute error indicated in the LCI subelement, then the AP may include a Relative Location Error subfield in the Measurement Report field. If the Measurement Report subelement is included but the LCI information of the neighbor is unknown, the AP shall indicate an unknown LCI for the neighbor following the format defined in 8.4.2.20.10 (LCI (#136)request (Location configuration information request)(#5329)).(#2403)

When both of the following are true:(Ed)(#2403)(#3759)

* An(#3759) AP that has at least one of dot11FineTimingMsmtRespActivated(#3112) and dot11RMLCIConfigured(M130) equal to false receives a Measurement Request element with Measurement Type field(#5648) equal to LCI(M91) within a Neighbor Report Request frame.(#3759)
* An(#3759) AP that has at least one of dot11LciCivicInNeighborReport and dot11RMLCIConfigured(M130) equal to false receives a Neighbor Report Request frame.(#3759)

then the AP shall include a Measurement Report subelement with the Incapable field set to 1 in each Neighbor Report element in the Neighbor Report Response frame. (#2403)

When either of the following is true:(#2403)(#3759)

* An(#3759) AP that has dot11FineTimingMsmtRespActivated(#3112) and dot11RMCivicConfigured(M130) equal to true receives a Measurement Request element with Measurement Type field(#5648) equal to Location Civic(M91) within a Neighbor Report Request frame.(#3759)
* An(#3759) AP that has dot11LciCivicInNeighborReport and dot11RMCivicConfigured(M130) equal to true receives a Neighbor Report Request frame.(#3759)

then the AP shall include a Measurement Report subelement with Measurement Type field(#5648) equal to Location Civic(M91) in each Neighbor Report element in the Neighbor Report Response frame. If the Measurement Report subelement is included but the location civic information(#3621) of the neighbor is unknown, the AP shall indicate an unknown Civic address following the format defined in 8.4.2.21.13 (Location Civic (#1294)report).(#2403)

When both of the following are true:(#2403)(#3759)

* An(#3759) AP that has at least one of dot11FineTimingMsmtRespActivated(#3112) and dot11RMCivicConfigured(M130) equal to false receives a Measurement Request element with Measurement Type field(#5648) equal to Location Civic(M91) within a Neighbor Report Request frame.(#3759)
* An(#3759) AP that has at least(#3112) one of dot11LciCivicInNeighborReport and dot11RMCivicConfigured(M130) equal to false receives a Neighbor Report Request frame.(#3759)

then the AP shall include a Measurement Report subelement with the Incapable field set to 1 in each Neighbor Report element in the Neighbor Report Response frame.(#2403)

Each Measurement Report subelement returned shall have the same Measurement Token value as in the Measurement Token field of the corresponding(#3761) Measurement Request element, or(#6253) if there is no corresponding Measurement Request then the Measurement Token value(#3761) shall be set to 0.(#2403)

If an AP determines that the LCI and/or civic(#3616) location of a neighboring AP changes, the AP may send an unsolicited Neighbor Report Response frame containing complete neighbor information including the updated neighboring AP location information. The Dialog Token field is set to 0 as defined in 8.6.7.7 (Neighbor Report Response frame format).(#2403)

A STA that receives an LCI report that contains a Usage Rules/Policy(#3203) subelement shall process the LCI information in compliance with the retransmission and retention permissions in the Usage-rules subelement.(#2403)

* Passive voice considered dangerous. Who are the actors? Included in what?

The Wide Bandwidth Channel subelement shall not be included in the Neighbor Report element when either the HT Operation subelement or the VHT Operation subelement is included in the Neighbor Report element.

* Passive voice considered dangerous. Who are the actors? Included in what? Style: “when” is not germain. I think it means to say something like “A VHT AP in which dot11FineTimingMsmtRespActivated is true that transmits a Neighbor Report frame containing a Neighbor Report element that contains an HT Operation Element shall include a VHT Operation subelement in that Neighbor Report element.”

When an AP in a VHT BSS that has dot11FineTimingMsmtRespActivated equal to true transmits a Neighbor Report element that contains an HT Operation subelement, then the APshall also include a VHT Operation subelement in the Neighbor Report element.

* Ditto Editorial comment about what is included where.

When an AP in a non-DMG BSS that has dot11FineTimingMsmtRespActivated equal to true transmits a Neighbor Report element that does not contain an HT Operation or VHT Operation subelement, then the AP shall include a Wide Bandwidth Channel subelement in the Neighbor Report element.

* Fine timing measurement procedure negotiation(#2164)(#3110)

In order to initiate a fine timing measurement procedure, a STA that supports the fine timing measurement procedure as an initiator (referred to as an initiating STA)(M91) shall transmit a Fine Timing Measurement Request frame.(#3033) This frame is called the initial Fine Timing Measurement Request frame.(M91) After transmission of this frame, the initiating STA shall be ready to receive a Fine Timing Measurement frame.(#5172)

A STA that supports the fine timing measurement procedure as a responder(M56) (referred to as a responding STA)(M91) shall not transmit Fine Timing Measurement frames addressed to a peer STA unless (#5172)the responding STA has received an initial Fine Timing Measurement Request frame from the peer STA.(M91)(M56)

The initial Fine Timing Measurement Request frame shall have:(M91)

* the Trigger field set to 1,
* a set of scheduling parameters in a Fine Timing Measurement Parameters element that describe the initiating STA’s availability for measurement exchange.

The first Fine Timing Measurement frame in the FTM session is called the initial Fine Timing Measurement frame. The responding STA should transmit an initial Fine Timing Measurement frame within 10 ms in response to the initial Fine Timing Measurement Request frame. This initial Fine Timing Measurement frame shall include the Fine Timing Measurement Parameters(#3465) element. The value of the Status Indication field indicates if(Ed) the request was successful, incapable or failed(#3033).

NOTE—In an initial Fine Timing Measurement frame, the responding STA might indicate that the(#5181) request for an FTM session is successful, even if the initial Fine Timing Measurement frame includes at least one of (#3208)

* a Measurement Report element that indicates an unknown LCI or
* a Measurement Report element that indicates an unknown civic(#3616) location.

(#6354)The responding STA's selection of the format and bandwidth in the FTM Format and Bandwidth field should be the same as that requested by the initiating STA. The responding STA shall not choose a bandwidth wider than requested. The responding STA shall not choose a VHT format if HT-mixed or non-HT format was requested. The responding STA shall not choose an HT format if non-HT format was requested.

(#6354)In the case of requests for contiguous 160 MHz bandwidth, the initiating STA can indicate whether it uses a single or two separate RF LOs. In the cases when the responding STA advertises transmission of Fine Timing Measurement frames with contiguous 160 MHz transmissions, the responding STA chooses the appropriate entry in the FTM Format and Bandwidth field depending on the number of RF LOs used by the responding STA.

If the request was successful(#3033)

* If the responding STA is ASAP capable, the(#3110) responding STA’s selection of ASAP should be the same as that requested by the initiating STA.(M56)
* The responding STA’s selection of the Min Delta FTM value shall be greater than or equal to the corresponding value requested by the initiating STA.
* The responding STA's selection of the Number of Bursts Exponent value shall be 0 when the initiating STA requests it to be 0.(M56)

NOTE—Apart from the Status Indication, Value, ASAP, Number of Bursts Exponent, and Min Delta FTM fields, the other fields in the Fine Timing Measurement Parameters(#3465) element in the initial Fine Timing Measurement frame have no constraints.(#3034)

When the responding STA cannot support(Ed) the initiator’s Min Delta FTM or Number of Bursts Exponent constraints(#3110), the responding STA shall (#6212)(#5858)(#3110)set the Status Indication field to (#3110)Request incapable and the FTM session ends(#3110). When the responding STA (#3110)is unable to fulfill the (#3110)request by the initiating STA, the responding STA shall set the Status Indication field to Request(#3110) failed and the FTM session ends(#3110). (M56)

* Measurement exchange(#2164)

Fine Timing Measurement(#6418) frames are sent during (Ed)time windows called burst instances. The timing of the burst instances (Ed)is defined by the following parameters:

* Partial TSF Timer – The partial TSF timer, as defined in 8.4.2.166 (Fine Timing Measurement Parameters(#3465) element(#2164)), at the beginning of the first burst instance
* Burst Duration(#3463) – The (Ed)duration of each burst instance starting at the boundary of a burst period(Ed)
* Burst Period – The interval from the beginning of one burst instance to the beginning of the following burst instance.

An FTM trigger frame is a Fine Timing Measurement Request frame that has the Trigger field set to 1 and does not include any of the following elements: (M91)

* a Measurement Request element
* a Fine Timing Measurement Parameters element.

The initiating STA shall transmit an FTM trigger frame(M91) as soon as it is available on channel at the beginning of the burst(#3205).(M91) This indicates to the responding STA its availability for the remainder of the burst instance. Following this FTM(M91) trigger frame the responding STA shall transmit an Ack frame and should transmit FTMs per Burst Fine Timing Measurement frames (M91)before the Burst Duration(#3463) elapses. In addition, the initiating STA shall be ready to receive a Fine Timing Measurement frame.(#5172) These(M56) Fine Timing Measurement frames shall not include a Fine Timing Measurement Parameters(#3465) element (for additional constraints on the Fine Timing Measurement frame see 10.24.6.7 (LCI and Location Civic retrieval using fine timing measurement procedure(#2403))).(M91) Within (Ed)a burst instance, consecutive Fine Timing Measurement frames (#3112) shall be spaced at least Min Delta FTM apart. Within (Ed)a burst instance the initiating STA shall perform fine timing measurement on each Fine Timing Measurement frame addressed to it, except the last Fine Timing Measurement frame in a burst. The initiating STA may perform fine timing measurement on the last Fine Timing Measurement frame in a burst.(#3206)

NOTE—If the initiating STA successfully transmits a non-initial Fine Timing Measurement Request frame (i.e. FTM trigger frame) late in a burst instance, fewer than FTMs per Burst might be successfully transmitted by the responding STA in the burst instance.(#5172) If a Fine Timing Measurement frame, except for the initial Fine Timing Measurement frame in the ASAP=0 case, is sent outside a burst instance, it might not be acknowledged.(#6417)

The first burst instance shall start at the value indicated by the value of(#5172) the Partial TSF Timer field(#6212)(#5671)(#5859)(#3206)(M56) in the initial Fine Timing Measurement frame, regardless of the ASAP field’s value. When ASAP is set to 1 by the responding STA, the Partial TSF Timer field value shall be set to a value less than 10 ms from the reception of the most recent initial Fine Timing Request frame.(#3206)

The scheduling(#3206) parameters of an FTM session are(#3112) illustrated in Figure 10-34 (Example negotiation and measurement exchange sequence, ASAP=0, and FTMs per Burst = 2(Ed)(#2164)(#3206)(#5174)(#6778)).

The initiating STA can request the responding STA to start the burst instances “as soon as possible” by setting the ASAP field to 1.(#3112) The scheduling(M56) in this case is illustrated in Figure 10-35 (Example negotiation and measurement exchange sequence, ASAP=1, and FTMs per Burst = 2 (Ed)(#2164)(#5174)(#6778)).  . 

The initiating STA may also request a single burst(#3206)(#6212)(#5172) of fine timing measurements to be taken as soon as possible(#3206), in which case it set(MDR)s the Number of Bursts Exponent field to 0 and (#3206)the ASAP field to 1. This is illustrated in Figure 10-36 (Example negotiation and measurement exchange sequence for a single burst instance, ASAP=1, and FTMs per Burst = 3(Ed)(#2164)(#5174)(#6778)).      .

For non-DMG STAs, both(#3206) the Fine Timing Measurement frame and the corresponding Ack frame(#6330) shall be transmitted using a single transmit chain.(#5049)

The responding STA shall not transmit Fine Timing Measurement frames using Clause 16 (DSSS PHY specification for the 2.4 GHz band designated for ISM -applications) or Clause 17 (High rate direct sequence spread spectrum (HR/DSSS) PHY -specification) formats, MCS 32 format,(#6244) or HT-greenfield format(#3206).(M56)

(#6354)The responding STA should transmit Fine Timing Measurement frames with the format and bandwidth it indicated(#6354).(M56)

(#6354)For the Fine Timing Measurement frames transmitted during the FTM session,

* The responding STA shall not use a bandwidth wider than that indicated by the STA in the initial Fine Timing Measurement frame.
* The responding STA shall not use a VHT format if the STA indicated HT-mixed or non-HT format in the initial Fine Timing Measurement frame.
* The responding STA shall not use an HT format if the STA indicated non-HT format in the initial Fine Timing Measurement frame.

The ASAP Capable field shall be set to 1 in the initial Fine Timing Measurement frame if a responding STA is ASAP-capable; otherwise it shall be set to 0.(#3206)(#3267)

* Submission 11-15/897r1 misses quoting parts of the following paragraphs. It has been assumed that deletion of the material was not intended.

A responding STA transmits Fine Timing Measurement frames in overlapping pairs of consecutive frames(#3206). For example, in Figure 10-35 (Example negotiation and measurement exchange sequence, ASAP=1, and FTMs per Burst = 2 (Ed)(#2164)(#5174)(#6778)), FTM\_1 and FTM\_2, FTM\_2 and FTM\_3, and FTM\_3 and FTM\_4 are overlapping pairs of consecutive frames.(#3206) The first Fine Timing Measurement frame of a pair of consecutive Fine Timing Measurement frames(#3206) contains a nonzero value in the(M56) Dialog Token field. The follow up Fine Timing Measurement frame contains a Follow Up Dialog Token field(M56) set to the value of the Dialog Token field(M56) in the first frame of the consecutive(#3206) pair. Dialog Tokens field values(M56) of consecutive Fine Timing Measurement frames shall(#3206) be consecutive, except when the value wraps around to 1 or in the last Fine Timing Measurement frame in an FTM session.(#5185)(#3206) With the first Fine Timing Measurement frame, both STAs capture timestamps. The responding STA captures the time at which the Fine Timing Measurement frame is transmitted (*t1*). The initiating STA captures the time at which the Fine Timing Measurement frame arrives (*t2*) and the time at which the Ack response is transmitted (*t3*). The responding STA captures the time at which the Ack frame arrives (*t4*). See Figure 6-17 (Fine timing measurement primitives and timestamps capture(#3338)).(Ed) In the follow up Fine Timing Measurement frame, in the same or the subsequent burst(#3206), the responding STA transfers the timestamp values it captured (*t1* and *t4*) to the initiating STA. In this follow up Fine Timing Measurement frame, the timestamp values (*t1* and *t4*) shall be the measurement according to the responding STA’s clock (i.e., without applying any frequency offset correction to the time bases(#6316)).(#3112)

NOTE—A Fine Timing Measurement frame can contain nonzero values in both the Dialog Token and Follow Up Dialog Token fields, meaning that the Action frame contains follow up information from a previous measurement, and new Timestamp values are captured to be sent in a future follow up Fine Timing Measurement frame.(#5185)

When the ASAP field is set to 0 by a responding STA, the Follow Up Dialog Token,(#5185) TOD, TOA, TOD Error, and TOA Error fields in the Fine Timing Measurement frame following the initial Fine Timing Measurement frame shall be reserved.

***NOTE TO EDITOR*** :***Please split paragraph as shown here.***

When the ASAP field is set to 1 by a responding STA, the timestamps for the initial Fine Timing Measurement frame shall be captured and sent in the following Fine Timing Measurement frame. In the Fine Timing Measurement frame following the initial Fine Timing Measurement frame, the TOD and TOA fields shall be set to the timestamps associated with the initial Fine Timing Measurement frame.(#3206)

The round trip time (RTT) is defined by Equation (10-5).

* *RTT* = [(*t4*’ – *t1’*) – (*t3* – *t2*)](#3206)

where *t1’* and *t4’* are the time at which the Fine Timing Measurement frame was transmitted and the time at which the Ack was received, respectively, as determined by the initialing STA.(#3206)

NOTE—The mechanism by which *t1’* and *t4’* are derived from the TOD and TOA fields, and the mechanism by which *t2* and *t3* are determined, are implementation dependent.(#3206)

The Fine Timing Measurement protocol can also be used to synchronize a local clock between STAs. One higher-layer protocol for synchronizing a local clock time between STAs is specified in IEEE Std 802.1AS. The SME at the initiating STA may estimate the offset of the local clock relative to that at the responding STA using clock offset as defined by Equation (10-6).(#5172)

* clock offset = [(t2 - t1') - (t4' - t3)]/2

If the (#190)(#1198)Ack frame for a transmitted Fine Timing Measurement frame is not received, the responding(#2164) STA shall not retry the frame. In order to send the frame again, the responding STA shall(#5172) send a Fine Timing Measurement frame with the same Action frame body as(#5172) the Fine Timing Measurement frame(#6545) for which the Ack was not received(#3206), except for an updated Dialog Token. The Sequence Number in the MAC header is also updated. This is called an FTM retransmission.(#5172)

(#5172)A responding STA that transmits a Fine Timing Measurement frame with the ASAP field set to 0 shall set the Partial TSF Timer field to an offset value *DTSF* from the partial value of the responding STA's TSF timer at the time of the transmission of the Ack to the last Fine Timing Measurement Request frame from the initiating STA, subject to:

*DTSF* >= *K\_1* x *TMDFTM* + *TFTM\_1* + aSIFSTime + *TAck*+ *TACCESS\_FTM1*

where

*K\_1* is the maximum number of initial Fine Timing Measurement frame (FTM\_1) retransmissions the responding STA might attempt.

*TMDFTM* is the value of the Min Delta FTM field of the Fine Timing Measurement Parameters field of FTM\_1.

*TFTM\_1* is the duration of the FTM\_1*.*

*TAck* is the duration of the Ack frame expected as a response.

*TACCESS\_FTM1*is the estimated medium access time for FTM\_1.

NOTE—This value of the Partial TSF Timer field ought to result in the FTM trigger frame not being transmitted before a successful transmission of FTM\_1.

(#5182)When neither an Ack to the initial Fine Timing Measurement frame nor an FTM trigger frame has been received by the responding STA, the responding STA shall not terminate the FTM session before the time indicated by the Partial TSF timer plus the Burst Duration.

* Use of passive voice in the following paras.

The responding STA shall set the Follow Up Dialog Token field to 0 in the initial Fine Timing Measurement frame and its FTM retransmissions.

 (#5185)

The responding STA shall set the Dialog Token field to 0 in the last Fine Timing Measurement frame and its FTM retransmissions.