IEEE P802.11
Wireless LANs

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| Initial Sponsor Ballot Timing Measurement Comment Resolutions Normative Text |
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Abstract

This document contains normative text changes to resolve initial sponsor ballot comment IDs: 116, 117, 279, 286, 287, 288, 293, 294, 295, 297, 300, 301 and 302..

The submission is referenced to draft D7.04 and augments to all editor instructions as well as the actual base draft modifications.

All new text relative to the draft D7.04 is identified in blue color and underlined and all deleted text is identified by ~~strikethrough~~.

7.4.13 Unprotected WNM Action details

7.4.13.3 Timing Measurement frame format

The Timing Measurement frame is used to support the timing measurement procedure described in 11.22.5. The format of the Timing Measurement frame is shown in Figure 7-101ay.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
|  | Category | Action | Dialog Token | Follow Up Dialog Token | TOD |
| Octets: | 1 | 1 | 1 | 1 | 4 |
|  |  |  |  |  |  |
|  | TOA | Max TOD Error | Max TOA Error |  |  |
| Octets: | 4 | 1 | 1 |  |  |
| Figure 7-101ay—Timing Measurement frame format |

The Category field is set to the value indicating the Unprotected WNM category, as specified in Table 7-24 in 7.3.1.11.

The Action field is set to the value indicating Timing Measurement as specified in Table 7-43ai in 7.4.13.1.

The Dialog Token field is set to a non-zero value chosen by the sending STA to identify the Timing Measurement frame as the first of a pair, with the second or follow up Timing Measurement frame to be sent later. The Dialog Token is set to zero to indicate that the Timing Measurement frame will not be followed by a subsequent follow up Timing Measurement frame.

The Follow Up Dialog Token is set to the non-zero value of the Dialog Token field of the previously transmitted Timing Measurement frame to indicate that it is the follow up Timing Measurement frame and that the TOD, TOA, Max TOD Error and Max TOA Error fields contain the values of the timestamps captured with the first Timing Measurement frame of the pair. The Follow Up Dialog Token is set to zero to indicate that the Timing Measurement frame is not a follow up to a previously transmitted Timing Measurement frame. A zero value in this field also indicates that the TOD, TOA, Max TOD Error and Max TOA Error fields are reserved. See 11.22.5.

The TOD, TOA, Max TOD Error, and Max TOA Error fields are expressed in units of 10 nanoseconds.

The TOD field contains a timestamp that represents the time at which the start of the preamble of the previously transmitted Timing Measurement frame appeared at the transmit antenna port.

The TOA field contains a timestamp that represents the time at which the start of the preamble of the ACK to the previously transmitted Timing Measurement frame arrived at the receive antenna port.

NOTE — The values specified in the TOD and TOA fields are described in 10.3.59.

The Max TOD Error field contains an upper bound for the error in the value specified in the TOD field. For instance, a value of 2 in the Max TOD Error field indicates that the value in the TOD field has a maximum error of +/- 20 nanoseconds.

The Max TOA Error field contains an upper bound for the error in the value specified in the TOA field. For instance, a value of 2 in the Max TOA Error field indicates that the value in the TOA field has a maximum error of +/- 20 nanoseconds.

A value of zero for the Max TOD Error or the Max TOA Error field indicates that the upper bound on the error in the corresponding TOD or TOA value is unknown. A value of 255 indicates that the upper bound on the error is greater than or equal to 2.55 microseconds.

10.3.59 Timing Measurement

The following set of primitives supports exchange of timing measurement information from one SME to another. The informative diagram in Figure 10-6k depicts various points in time that are of interest to the timing measurement procedure.



Figure 10-6k—Timing Measurement Primitives and Timestamps Capture

NOTE 1 — In Figure 10-6k, t1 and t3 correspond to the point in time at which the start of the preamble for the transmitted frame appears at the transmit antenna port. An implementation may capture a timestamp during the transmit processing earlier or later than the point at which it actually occurs and offset the value to compensate for the time difference.

NOTE 2— In Figure 10-6k, t2 and t4 correspond to the point in time at which the start of the preamble for the incoming frame arrives at the receive antenna port. Because time is needed to detect the frame and synchronize with its logical structure, an implementation will necessarily determine when the start of the preamble for the incoming frame arrived at the receive antenna port by capturing a timestamp some time after it occurred and compensating for the delay by subtracting an offset from the captured value.

10.3.59.1 MLME-TIMINGMSMT.request

10.3.59.1.1 Function

This primitive requests the transmission of Timing Measurement frame to a peer entity.

10.3.59.1.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-TIMINGMSMT.request (
Peer MAC Address,
Dialog Token,
Follow Up Dialog Token,
t1,
t4,
Max t1 Error,
Max t4 Error,
VendorSpecific)

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Valid range | Description |
| Peer MAC Address | MACAddress | Any valid individual addressed MAC Address | The address of the peer MAC entity to which the Timing Measurement frame shall be sent. |
| Dialog Token | Integer | 1-255 | The dialog token to identify the Timing Measurement transaction. |
| Follow Up Dialog Token | Integer | 0-255 | The dialog token of a Timing Measurement frame which the current frame follows. See 11.22.5. |
| t1 | Integer |  | Set to the value of t1 (see Figure 10-6k) expressed in 10 nanosecond units. |
| Max t1 Error | Integer | 0-255 | Maximum error in the t1 value expressed in 10 nanosecond units, See 7.4.13.3. |
| t4 | Integer |  | Set to the value of t4 (see Figure 10-6k) expressed in 10 nanosecond units. |
| Max t4 Error | Integer | 0-255 | Maximum error in t4 value expressed in 10 nanosecond units. |
| VendorSpecific  | A set of informationelements | As defined in 7.3.2.26 | Zero or more information elements. |

10.3.59.1.3 When generated

This primitive is generated by the SME to request that a Timing Measurement frame be sent to a peer entity.

10.3.59.1.4 Effect of receipt

On receipt of this primitive, the MLME constructs a Timing Measurement frame with the specified parameters. This frame is then scheduled for transmission.

10.3.59.2 MLME-TIMINGMSMT.confirm

10.3.59.2.1 Function

This primitive indicates that a Timing Measurement frame has been successfully received by the peer STA to which it was sent.

10.3.59.2.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-TIMINGMSMT.confirm (

Peer MAC Address,

Dialog Token,

t1,

Max t1 Error,

t4,

Max t4 Error)

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Valid range | Description |
| Peer MAC Address | MACAddress | Any valid individual addressed MAC Address | The address of the peer MAC entity to which acknowledges the receipt of the Timing Measurement frame |
| Dialog Token | Integer | 1-255 | The dialog token to identify the Timing Measurement transaction. |
| t1 | 32 bit unsigned Integer | 0 - 232-1 | Set to the value of t1 (see Figure 10-6k) expressed in 10 nanosecond units. |
| Max t1 Error | Integer | 0-255 | Maximum error in the t1 value expressed in 10 nanosecond units. |
| t4 | 32 bit unsigned Integer | 0 - 232-1 | Set to the value of t4 (see Figure 10-6k) expressed in 10 nanosecond units. |
| Max t4 Error | Integer | 0-255 | Maximum error in t4 value expressed in 10 nanosecond units. |

10.3.59.2.3 When generated

This primitive is generated by the MLME when an ACK corresponding to the Timing Measurement frame is received from the peer STA.

10.3.59.2.4 Effect of receipt

On receipt of this primitive, the SME uses the information contained within the notification.

10.3.59.3 MLME-TIMINGMSMT.indication

10.3.59.3.1 Function

This primitive indicates that a Timing Measurement frame has been received and the corresponding ACK has been transmitted.

10.3.59.3.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-TIMINGMSMT.indication (

Peer MAC Address,

Dialog Token,

Follow Up Dialog Token,

t1,

Max t1 Error,

t4,

Max t4 Error,

t2,

Max t2 Error,

t3,

Max t3 Error,

VendorSpecific)

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Valid range | Description |
| Peer MAC Address | MACAddress | Any valid individual addressed MAC Address | The address of the peer MAC entity from which the Timing Measurement frame was sent. |
| Dialog Token | Integer | 1-255 | The dialog token to identify this Timing Measurement transaction. |
| Follow Up Dialog Token | Integer | 1-255 | The dialog token of a Timing Measurement frame which the current frame follows. See 11.22.5. |
| t1 | 32 bit unsigned Integer | 0 - 232-1 | Set to the value of t1 (see Figure 10-6k) expressed in 10 nanosecond units. |
| Max t2 Error | Integer | 0-255 | Maximum error in the t1 value expressed in 10 nanosecond units. |
| t4 | 32 bit unsigned Integer | 0 - 232-1 | Set to the value of t4 (see Figure 10-6k) expressed in 10 nanosecond units. |
| Max t4 Error | Integer | 0-255 | Maximum error in t4 value expressed in 10 nanosecond units. |
| t2  | 32 bit unsigned Integer | 0 - 232-1 | Set to the value of t2 (See Figure 10-6k) expressed in 10 nanosecond units. |
| Max t2 Error  | Integer | 0-255  | Maximum error in t2 value expressed in 10 nanosecond units. |
| t3  | 32 bit unsigned Integer | 0 - 232-1 | Set to the value of t3 (See Figure 10-6k) expressed in 10 nanosecond units. |
| Max t3 Error | Integer | 0-255  | Maximum error in t3 value expressed in 10 nanosecond units. |
| VendorSpecific  | A set of informationelements | As defined in 7.3.2.26 | Zero or more information elements. |

10.3.59.3.3 When generated

This primitive is generated by the MLME when a valid Timing Measurement frame is received.

10.3.59.3.4 Effect of receipt

On receipt of this primitive, the SME uses the information contained within the notification.

# 11. MLME

11.22.5 Timing measurement procedure

Implementation of Timing Measurement is optional for a WNM STA. A STA that has a value of true for the MIB attribute dot11MgmtOptionTimingMsmtImplemented is defined as a STA that supports timing measurement. A STA for which the MIB attribute dot11MgmtOptionTimingMsmtImplemented is set to true shall set the Timing Measurement field of the Extended Capabilities information element to 1..

If dot11MgmtOptionTimingMsmtEnabled is set to true, the Timing Measurement field in the Extended Capabilities information element shall be set to 1 and the STA supports the timing measurement procedure. If dot11MgmtOptionTimingMsmtEnabled is false the STA shall set the Timing Measurement field in the Extended Capabilities information element to 0 and STA does not support the timing measurement procedure. A STA that does not support the timing measurement procedure shall ignore a received Timing Measurement frame.

A STA that supports the timing measurement procedure may transmit Timing Measurement frames addressed to a peer STA that also supports the timing measurement procedure. The means by which a STA determines that it should transmit Timing Measurement frames to a peer STA is beyond the scope of this standard. One higher-layer protocol for synchronizing time between STAs using this feature is specified in IEEE 802.1AS.

A sending STA transmits Timing Measurement action frames in overlapping pairs. The first Timing Measurement action frame of a pair contains a non-zero Dialog Token. The follow up Timing Measurement action frame contains a Follow Up Dialog Token set the value of the Dialog Token in the first frame of the pair. With the first Timing Measurement action frame, both STAs capture timestamps. The sending STA captures the time at which the Timing Measurement frame is transmitted (t1). The receiving STA captures the time at which the Timing Measurement frame arrives (t2) and the time at which the ACK response is transmitted (t3). The sending STA captures the time at which the ACK arrives (t4). See Figure v10-6k in 10.3.59. In the follow up Timing Measurement action frame, the sending STA transfers the timestamp values it captured (t1 and t4) to the receiving STA.

Note: A Timing Measurement action frame may contain non-zero 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 Timing Measurement action frame.

Note: A possible implementation is a free running oscillator clocking the modules in the transmit path (e.g., digital to analog converter(s), a monotonically increasing counter and a PMD transmit FSM, etc.) and in the receive path (e.g., a PMD receive FSM, a monotonically increasing counter and analog to digital converter(s), etc.). In this implementation the value of the monotonically increasing counter corresponding when the frame gets transmitted corresponds to t1 and t3 while the value of the monotonically increasing counter in the receive path corresponding to when the frame is received corresponds to t2 and t4. Also note that the free running clocks in sending and receiving STA are not the same.

The offset of the clock at the receiving STA with respect to the clock at the sending STA may be calculated using the equation below (assuming a symmetric wireless channel). See Figure v10-6k in 10.3.59.

 Clock offset at receiving STA relative to sending STA = [(t2 -t1) - (t4 -t3)]/2

Note: State machines and other computations (e.g. rate ratios and link delay) for synchronizing time between 802.11 stations using the values of t1, t2, t3 and t4 provided by the Timing Measurement feature are found in Clause 12 of IEEE P802.1AS.

The acknowledgement procedure for Timing Measurement action frames is the same as that for regular management frames (see 9.2.8). If the ACK for a transmitted Timing Measurement frame is not received, the sending STA may retransmit the frame. The sending STA shall capture a new set of timestamps for the retransmitted frame and its ACK

On receiving a Timing Measurement action frame with a Dialog Token for which timestamps have previously been captured, the receiving STA shall discard previously captured timestamps and capture a new set of timestamps.



Figure 11-17d—Timing Measurement Procedure

# 12. PHY service specification

12.3.5.5.3 When generated

This primitive will be issued by the PHY to the MAC entity once all of the following conditions are met:

— the PHY has received a PHYTXSTART. request from the MAC entity

— the PLCP has issued PMD.TX STATUS.request if the MIB variable dot11MgmtOptionLocationTODEnabled is set to true and the TXVECTOR parameter TIME\_OF\_DEPARTURE\_REQUESTED in PHY-TXSTART.request(TXVECTOR) is set to true, and

— the PHY is ready to begin accepting outgoing data octets from the MAC.

# 15. DSSS PHY specification for the 2.4 GHz band designated for ISM applications

15.2.7 Receive PLCP

change the paragraph starting with sentence “If the PLCP header reception is successful...” as follows:

If the PLCP header reception is successful (and the SIGNAL field is completely recognizable and supported), a PHY-RXSTART.indication(RXVECTOR) shall be issued. If the MIB variable dot11MgmtOptionTimingMsmtEnabled is set to true, the PLCP shall do the following:

— Complete receiving the PLCP header and verify the validity of the PLCP Header,

— If the PLCP header reception is successful (and the SIGNAL field is completely recognizable and supported), a PHY-RXSTART.indication(RXVECTOR) shall be issued and RX\_START\_OF\_FRAME\_OFFSET parameter within the RXVECTOR shall be forwarded (see 15.4.4.2).

NOTE — The RX\_START\_OF\_FRAME\_OFFSET value is used as described in 10.3.51 in order to estimate when the start of the preamble for the incoming frame was detected on the medium at the receive antenna port.

The RXVECTOR associated with this primitive includes the SIGNAL field, the SERVICE field, the MPDU length in octets (calculated from the LENGTH field in microseconds), the antenna used for receive (RX\_ANTENNA), RSSI, and SQ.

# 17. Orthogonal frequency division multiplexing (OFDM) PHY specification for the 5 GHz band

17.3.12 Receive PLCP

Change the paragraph starting with sentence “If the PLCP header reception is successful...” as follows:

If the PLCP header reception is successful (and the SIGNAL field is completely recognizable and supported), a PHY-RXSTART.indication(RXVECTOR) shall be issued. If the MIB variable dot11MgmtOptionTimingMsmtEnabled is set to true, the PLCP shall do the following:

— Complete receiving the PLCP header and verify the validity of the PLCP Header,

— If the PLCP header reception is successful (and the SIGNAL field is completely recognizable and supported), a PHY-RXSTART.indication(RXVECTOR) shall be issued and RX\_START\_OF\_FRAME\_OFFSET parameter within the RXVECTOR shall be forwarded (see 17.2.3).

NOTE — The RX\_START\_OF\_FRAME\_OFFSET value is used as described in 10.3.51 in order to estimate when the start of the preamble for the incoming frame was detected on the medium at the receive antenna port.

The RXVECTOR associated with this primitive includes the SIGNAL field, the SERVICE field, the PSDU length in octets, and the RSSI. Also, in this case, the OFDM PHY will ensure that the CCA shall indicate a busy medium for the intended duration of the transmitted frame, as indicated by the LENGTH field.

## 18. High Rate direct sequence spread spectrum (HR/DSSS) PHY specification

18.2.6 Receive PLCP

Insert a new paragraph before the paragraph starting with sentence “The received PSDU bits are assembled into octets...” as follows:

If the MIB variable dot11MgmtOptionTimingMsmtEnabled is set to true, the PLCP shall do the following:

— Complete receiving the PLCP header and verify the validity of the PLCP Header,

— If the PLCP header reception is successful (and the SIGNAL field is completely recognizable and supported), a PHY-RXSTART.indication(RXVECTOR) shall be issued and RX\_START\_OF\_FRAME\_OFFSET parameter within the RXVECTOR shall be forwarded (see 18.3.5).

NOTE — The RX\_START\_OF\_FRAME\_OFFSET value is used as described in 10.3.51 in order to estimate when the start of the preamble for the incoming frame was detected on the medium at the receive antenna port.

# 20. High Throughput (HT) PHY specification

20.3.24 PLCP receive procedure

Change the paragraph starting with sentence “Subsequent to an indication of a valid HT-SIG CRC...” as follows:

Subsequent to an indication of a valid HT-SIG CRC, a PHY-RXSTART.indication(RXVECTOR) shall be issued. If the MIB variable dot11MgmtOptionTimingMsmtEnabled is set to true, the PLCP shall do the following:

— Complete receiving the PLCP header and verify the validity of the PLCP Header,

— If the PLCP header reception is successful (and the SIGNAL field is completely recognizable and supported), a PHY-RXSTART.indication(RXVECTOR) shall be issued and RX\_START\_OF\_FRAME\_OFFSET parameter within the RXVECTOR shall be forwarded (see 20.2.2).

NOTE — The RX\_START\_OF\_FRAME\_OFFSET value is used as described in 10.3.51 in order to estimate when the start of the preamble for the incoming frame was detected on the medium at the receive antenna port.

The RXVECTOR associated with this primitive includes the parameters specified in Table 20-1. Upon reception of a GF preamble by an HT STA that does not support GF, the FORMAT field of RXVECTOR is set to HT\_GF and the remaining fields may be empty, and the PHY shall issue the error condition PHY-RXEND.indication(FormatViolation). If the HT-SIG indicates an unsupported mode or Reserved HTSIG Indication the PHY shall issue the error condition PHY-RXEND.indication(UnsupportedRate).