IEEE P802.11
Wireless LANs

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| CIDs related to P2P TWT |
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Abstract

This document discusses and proposes resolutions for CIDs 6125, 6131, 6132, 6134.

The discussion and proposed changes are based on Draft P802.11REVme\_D4.0.

Revision history:

R0 – Initial version

# Introduction

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| --- | --- | --- | --- | --- | --- |
| **CID** | **Page** | **Line** | **Comment** | **Proposed Change** | **Proposed resolution** |
| 6125 | 2614 | 12 | In reference to "An AP that successfully sets up (#3150)a peer-to-peer TWT agreement  (#3156)shall consider the non-AP STA to be in power save mode and doze state at the start of the peer-to-peer TWT SP and back to its original power management mode at the end of the peer-to-peer TWT SP unless the AP receives a frame addressed to it from the non-AP STA within the time that overlaps with the peer-to-peer TWT SP." an early termination of a P2P TWT SP is described. Given that P2P activity period may have some jitter to start, it'd be good if ways for early or late start of a P2P TWT SP is also described within this framework. The drawback of not having such options is that the STA may have to schedule a more aggressive P2P TWT SPs to satisfy its P2P traffic needs, which could reduce the effectiveness of the BSS operation. | As in the comment, describe ways for the STA to start a SP earlier or later than the starting time of a specific SP. | Revised.Combined with CID 6131.Instruction to the 802.11me editors: Please incorporate text changes tagged with (#6125) in document 23/xxxr0 |
| 6131 | 2611 | 34 | Peer-to-Peer(P2P) TWT is a promising method to help the coex between infrastructure network and other network activities that the STA is participating in. However, in reality, the P2P clock can drift against the infrastructure BSS clock. The STA should be able to indicate to the AP an uncertainty window around the scheduled p2p TWT SP start time. So at any time in such uncertainty window, the AP should take into account that the p2p activity may have started already. | Please include uncertainty window to the P2P TWT SPs as defined in the comment. | Revised.Instruction to the 802.11me editors: Please incorporate text changes tagged with (#6131) in document 23/xxxr0 |
| 6132 | 2614 | 12 | The P2P clock can drift against the infrastructure BSS clock. This may cause poor alignment of theP2P TWT SPs operated in A) infrastructure network and B) P2P network. The P2P TWT should have a mechanism to update the P2P TWT SP start time to avoid the cumulative clock drift error to exceed certain threshold error duration. | Please provides tools for STA to adjust the P2P TWT SP start time. | Revised.Instruction to the 802.11me editors: Please incorporate text changes tagged with (#6132) in document 23/xxxr0 |
| 6134 | 2614 | 12 | peer-to-peer TWT schedule timing parameters may require update to handle the clock drift | Add necessary mechanism to allow the update of a peer-to-peer TWT schedule | Revised.nstruction to the 802.11me editors: Please incorporate text changes tagged with (#6134) in document 23/xxxr0 |

## CIDs 6125, 6131, 6132, 6134

***Discussion:***

Network interfaces may have different reference clock tolerance, ranging from tens of ppm to hundreds of ppm. Hence, during a continuous running session on the network interface using p2p TWT to co-exist with the infrastructure network, clock drift will greatly impact the starting time of the p2p TWT SP. For example, in 100ms, a ±500ppm clock drift could accumulate up to 100us offset to the *nominal* starting time in the ideal case when there is no clock drift. There are two possible solutions to address this issue.:

* The first approach is to update the starting time for each TWT SP such that the clock drift is corrected immediately before the next SP. However, this may incur quite some overhead not only to the necessary signaling airtime but also added AP scheduling complexity due to frequently updated TWT schedule.
* The second approach is to define an uncertainty window which should cover the max accumulated clock drift for a certain duration (e.g., if the clock drift is ±n ppm, the duration is t, the uncertain window size is at least 2nt). During the uncertainty window, AP should refrain from sending data to the non-AP STA without precautionary mechanism such as RTS/CTS exchange. For each such duration, the non-AP STA does not need to update the AP the TWT SP starting time, but can update the AP just once to adjust TWT SP starting times and hence the p2p TWT schedule. In this way, the signaling overhead and frequent TWT schedule updates are reduced. See the following figure as an example.
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## *Proposed resolution for CID* 6125, 6131, 6132, 6134*:*

***TGm editor: Please insert the following paragraphs in this subclause as shown below:***

**9.4.2.xxx Uncertainty Window element** (#6125, #6131)

The Uncertainty Window element is used to signal a time window of which the centre is the TWT Service Period starting time. The format of the Uncertainty Window element is shown in Figure 9-xxxx (Uncertainty Window element format).

 

**Figure 9-xxxx – Uncertainty Window element format**

The Element ID, Length, and Element ID Extension fields are defined in 9.4.2.1 (General).

TWT Flow Identifier field identifies the specific information of the TWT agreement whose Service Periods this uncertainty window applies to. Values 8 to 255 are reserved.

The Uncertainty Window field contains the duration of the uncertainty window in the unit of microsecond. Value 0 is reserved.

**9.6.13.24 Channel Usage Request frame format**

***TGm editor: Please note that there is no change to the following paragraph, added for discussion only:***

The Channel Usage Request frame is sent by a non-AP STA to the AP to request the specified Channel

Usage information. The format of the Channel Usage Request frame Action field is defined in Figure 9-1174 (Channel Usage Request frame Action field format)

***TGm editor: Please update Figure 9-1174 in this subclause as shown below:***

**Figure 9-1174 — Channel Usage Request frame Action field format**



(#6125, #6131) The Uncertainty Window element field is optionally present when the TWT Elements fields contains at least one TWT element; if present, the field contains one or more Uncertainty Window elements. Otherwise, the Uncertainty Window element is not present.

**9.6.13.25 Channel Usage Response frame format**

***TGm editor: Please note that there is no change to the following paragraph, added for discussion only:***

The Channel Usage Response frame is sent by an AP in response to a Channel Usage Request frame, or autonomously. The format of the Channel Usage Response frame Action field is shown in Figure 9-1175 (Channel Usage Response frame Action field format).

 

**Figure 9-1175—Channel Usage Response frame Action field format**

***TGm editor: Please modify the following paragraphs in this subclause as shown below:***

…

(#3390) The Timeout Interval Element field is present when the TWT Elements field contains at least one TWT element; if present it contains a TIE. Otherwise, the Timeout Interval Element field is not present in this frame. (#3390) The subfields of the TIE are set as described in 11.21.15 (Channel usage procedures).

(#6125, #6131) The Uncertainty Window element field may be present when the TWT Elements fields contains at least one TWT element; if present it contains one Uncertainty Window element. Otherwise, the Uncertainty Window element is not present in this frame. The subfields of the Uncertainty Window Element are set as described in 11.21.15 (Channel usage procedures).

**11.21.15 Channel usage procedures**

***TGm editor: Please update this subclause as shown below:***

* Channel usage procedures

The channel usage procedures may be used to assist the STA that operates a noninfrastructure BSS(#3349) or an off-channel TDLS direct link to better coexist with the infrastructure network by exchanging Channel Usage Request and Response frames.(#3311)(#4009)

Implementation of (#3311)channel usage is optional for a WNM STA. A STA that implements (#3311)channel usage has dot11ChannelUsageImplemented equal to true. When dot11ChannelUsageImplemented is true, dot11WirelessManagementImplemented shall be true, or the STA shall support(#546) acting as an S-AP within a CCSS. A STA with dot11ChannelUsageActivated equal to true shall support channel usage and shall set to 1 the Channel Usage field of the Extended Capabilities elements that it transmits.

(#1024)(#3145)A TWT agreement that is established between a STA and its associated AP, by exchanging Channel Usage Request and Response frames, is referred to as (#3150)a peer-to-peer TWT agreement and the corresponding TWT schedules are referred to as (#3150) peer-to-peer TWT schedules. (#3145)In this case, the Channel Usage element carried in the Channel Usage Request and Response frames may:

* include a single Channel Entry field with Operating Class and Channel field(s) that are different from the associated AP's BSS channel, or
* include a single Channel Entry field with Operating Class and Channel field(s) that are the same as the associated AP's BSS channel, or
* include no Channel Entry field.

(#3148)Unless explicitly indicated in this subclause, the rules defined in 10.46 (Target wake time (TWT)) and in 26.8 (TWT operation) shall be ignored when establishing and operating with a peer-to-peer TWT agreement.

NOTE 1—The TWT element is used for a peer-to-peer TWT agreement only to determine the timing parameters of the peer-to-peer TWT schedule.

(#3150)An HE AP that has dot11ChannelUsageActivated equal to true and supports negotiating a peer-to-peer TWT schedule that is requested by a non-AP STA to establish a noninfrastructure BSS(#3349) or an off-channel TDLS direct link shall set to 1 the (#3022)Peer-to-peer TWT Support field of the Extended Capabilities elements that it transmits.

(#1024)NOTE 2—An HE AP has dot11TWTOptionImplemented equal to true and has the TWT Responder Support subfield set to 1 in the Extended Capabilities element and the HE Capabilities element.

A non-AP STA that supports (#3311)channel usage and is not associated to an AP prior to using a noninfrastructure BSS(#3349) or an off channel TDLS direct link may transmit a Probe Request frame including both Supported Operating Classes and Channel Usage elements. A non-AP STA supporting (#3311)channel usage may send a Channel Usage Request frame at any time after association to the AP that supports the use of (#3311)channel usage to request the (#3311)channel usage information for supported operating classes. (#1024)A non-AP STA that transmits a Channel Usage Request frame shall set the Usage Mode field of the Channel Usage element to 2 if it requests assistance to setup a noninfrastructure BSS(#3349) on an off-channel that does not have any infrastructure BSSs operated by any AP that belongs to the ESS of its associated AP. Otherwise, the non-AP STA shall set the Usage Mode field of the Channel Usage element to (#4337)0, 1 or 3.(#3145)

(#1024)A non-AP STA that supports channel usage and has the TWT Requester Support subfield set to 1 (#3391)in the HE Capabilities element that it transmits, may negotiate (#3150)a peer-to-peer TWT schedule with its associated AP, (#3155)to indicate up the service period, and optionally the channel operation, of a noninfrastructure BSS(#3349) or an off-channel TDLS direct link, by transmitting a Channel Usage Request frame that includes TWT Elements and Timeout Interval Element fields (#6125, #6131,6134) and optionally Uncertainty Window element, if the AP has the (#3022)(#3150)Peer-to-peer TWT Support field set to 1 in the Extended Capabilities element. Each TWT element carried in the TWT Elements field includes a single Individual TWT Parameter Set field whose subfields shall be set as described in 26.8.2 (Individual TWT agreements) (#3155)and 9.4.2.198 (TWT element) except that the TWT Group Assignment subfield shall be set to zero and the Responder PM Mode subfield, the Trigger subfield, the Flow Type subfield, and the TWT Channel subfield shall be reserved. Each TWT element in the TWT Elements field applies to all the Channel Entry subfields of the Channel Usage Elements field. The non-AP STA may indicate the lifetime of the requested peer-to-peer TWT agreement in the Timeout Interval Value field of the TIE that it includes in the Channel Usage Request frame and shall set the Timeout Interval Type field to 5. (#3155) (#6125, #6131,6134)The non-AP STA may indicate the uncertainty window of the requested peer-to-peer TWT SP start time in the Uncertainty Window field of the Uncertainty Window element that it includes in the Channel Usage Request frame.

(#3148)A non-AP STA may send a Channel Usage Request frame to its associated AP with a TWT element configured as a TWT request. In this case, if the non-AP STA receives a Channel Usage Response frame from the AP that includes a TWT element configured as a TWT response with the TWT Setup Command field indicating Accept TWT, then the non-AP STA has successfully completed the peer-to-peer TWT agreement with the AP for the TWT flow identifier indicated in the TWT element that is carried in the Channel Usage Response frame. Otherwise, that peer-to-peer TWT agreement has not been established. The TWT flow identifier, together with the MAC addresses of the requesting STA and the responding AP, identifies the peer-to-peer TWT agreement.

(#3145)A non-AP STA that has already selected a Channel for peer-to-peer communication may transmit a Channel Usage Request frame with the Usage Mode field of the Channel Usage element set to 3 and without a Channel Entry field to inform the AP about its unavailability during the peer-to-peer TWT agreement. Otherwise, the non-AP STA (#4337)shall set the Usage Mode field to 0, 1 or 2.

(#1024)A non-AP STA that has successfully set up (#3150)a peer-to-peer TWT schedule with its associated AP should use the negotiated (#3150)peer-to-peer TWT SPs for (#3349)(#4311)communication not via the AP.(#3052)

(#3157)A non-AP STA may teardown a peer-to-peer TWT agreement by sending a TWT Teardown frame with the Negotiation Type subfield set to 0 and the TWT Flow Identifier field set to the value of the corresponding TWT flow identifier.

NOTE 3—The total number of peer-to-peer TWT agreements and of individual TWT agreements between a non-AP STA and its AP can be up to 8, since the TWT Flow Identifier field of the TWT element comprises 3 bits.(#4010)

(#3157)A non-AP STA may suspend a peer-to-peer TWT agreement by sending a TWT Information frame with the TWT Flow Identifier field set to the value of the TWT Flow Identifier field of the TWT element in the Channel Usage Response frame that concluded the setup of the corresponding peer-to-peer TWT agreement if the AP has set the TWT Information Frame Disabled field to 0 in the TWT element sent during the TWT setup; otherwise, the non-AP STA shall not transmit a TWT Information frame to the AP. If the Next TWT subfield is present in the TWT Information frame, the value of the Next TWT subfield shall be selected from existing TWT values for the peer-to-peer TWT agreement.

NOTE 4—If the Next TWT subfield is present in the TWT Information frame, the peer-to-peer TWT agreement will resume at the time indicated in the Next TWT subfield.(#3157)

Upon receipt of a Channel Usage element in the Probe Request frame, the AP supporting (#3311)channel usage shall send a Probe Response frame including one or more Channel Usage elements. Upon receiving a Channel Usage Request frame (#1024)with the Usage Mode field set to 0 or 1, the AP supporting channel usage shall send a Channel Usage Response frame including one or more Channel Usage elements. Channel Usage elements shall include channels that are valid for the regulatory domain in which the AP transmitting the element is operating and consistent with the Country element in the Beacon or Probe Response frame; the Channel Usage elements shall not include any other channels. (#1024)Upon receiving a Channel Usage Request frame with the Usage Mode field set to 2 in a Channel Usage element, an AP that supports channel usage shall send a Channel Usage Response frame with the Usage Mode field in the Channel Usage element set to 2 if the AP can determine that none of the APs belonging to the same ESS operate BSSs on the channels indicated by the Channel Entry field in the Channel Usage element of the response. Otherwise, the AP shall set the Usage Mode field of the Channel Usage element to (#4337)0, 1 or 3. (#3145)

NOTE 5—The determination of which APs belonging to the same ESS operate BSSs on a particular channel is implementation dependent and beyond the scope of this standard.(#1024)

(#1024)Upon receiving a Channel Usage Request frame with a TWT element, an AP that supports (#3150)peer-to-peer TWT scheduling shall send a Channel Usage Response frame including (#3145)zero or one Channel Usage element that includes a Channel Entry field with only one Operating Class and Channel field, a TWT Elements field and may include a Timeout Interval Element field. Each TWT element carried in the TWT Elements field includes a single Individual TWT Parameter Set field whose subfields shall be set as described in 26.8.2 (Individual TWT agreements) except that the TWT Group Assignment subfield shall be set to zero and the Responder PM Mode subfield, the Trigger subfield, the Flow Type subfield, and the TWT Channel subfield shall be reserved. (#3155)The TWT element(s) in the TWT Elements field apply to the Channel Entry subfield of the Channel Usage Elements field, if present. When the lifetime of the peer-to-peer TWT agreement expires, the AP shall send a TWT Teardown frame to terminate that peer-to-peer TWT agreement.

NOTE 6—If the Usage Mode field set to 3, it is possible that the Channel Usage Request frame does not include a Channel Entry field. In such case, the TWT element indicates the unavailability of the requesting non-AP STA for communication with the AP during the peer-to-peer TWT schedule.(#3145)

(#3148)The outcome of the TWT setup when negotiating a peer-to-peer TWT agreement initiated by the exchange of Channel Usage Request and Channel Usage Response frames that carry a TWT element as described in this clause is the same as that defined in Table 10-40 (TWT setup exchange command interpretation(11ax)).

(#3152)The AP shall not send an unsolicited Channel Usage Response frame with a TWT element to a non-AP STA.

(#1024)An AP that successfully sets up (#3150)a peer-to-peer TWT agreement (#3146)after receiving a Channel Usage Request frame with a TWT Elements field from a non-AP STA may indicate the lifetime of the (#3150)peer-to-peer TWT agreement for the corresponding TWT element(s) in the Timeout Interval Value field of the (#3146)TIE that it includes in the Channel Usage Response frame and shall set the corresponding Timeout Interval Type field to 5. An AP that successfully sets up (#3150)a peer-to-peer TWT agreement (#3156)shall consider the non-AP STA to be in power save mode and doze state at the start of the peer-to-peer TWT SP and back to its original power management mode at the end of the peer-to-peer TWT SP unless the AP receives a frame addressed to it from the non-AP STA within the time that overlaps with the peer-to-peer TWT SP. (#6125, #6131,6134) If an Uncertainty Window element is included in the Channel Usage Request frame, the AP shall consider the non-AP STA might be in power save mode and doze state at earliest a half of the uncertainty window prior to the corresponding TWT SP starting time until a half of the uncertainty window after the TWT SP starting time. During this time, the AP shall also refrain from transmitting to the non-AP STA unless certain mechanisms are used to ensure that the non-AP STA is not yet in power save mode and doze state.

(#6125, #6131,6134) Note 7—During the uncertainty window, the AP may transmit RTS or MU-RTS frame as the first frame of the TXOP to decide whether the non-AP STA is already in power save mode and doze state. In case the non-AP STA does not respond to the RTS or MU-RTS frame, the AP can consider the non-response as a result of the non-AP STA in the power save mode and doze state.

(#3145)Upon receiving a Channel Usage Request frame with a TWT element configured as a TWT request and a Channel Usage element with the Usage Mode field set to 3 (Peer-to-peer link) that does not carry a Channel Entry field, an AP that supports peer-to-peer TWT scheduling shall transmit a Channel Usage Response frame that includes a Channel Usage element without a Channel Entry field and a TWT element configured as a TWT response (i.e., TWT Request field set to 0) with a TWT Setup Command field indicating Accept TWT and all other fields of that TWT element set to the same value as the fields of the TWT element carried in the Channel Usage Request frame. In this case, the Timeout Interval Value field of the TIE (#6131,6134) and the Uncertainty Window field of the Uncertainty Window Element, if any, in the Channel Usage Response frame includes the same value as that of the Channel Usage Request frame.

(#6125, #6132,6134) After a non-AP STA has successfully set up a peer-to-peer TWT agreement, the non-AP STA may send another Channel Usage Request frame with a TWT element configured as a TWT request, which includes the same TWT flow identifier and updated Individual TWT Parameter Set field. For example, the Target Wake Time field of the Individual TWT Parameter Set field could be adjusted such that all future TWT SP starting times are updated accordingly.

(#6125, #6132,6134) If an AP, that has successfully set up a peer-to-peer TWT agreement with a non-AP STA, receives a Channel Usage Request frame with a TWT element configured as TWT request with the same TWT flow identifier and updated Individual TWT Parameter Set field, and the AP shall:

* send a Channel Usage Response frame containing the TWT element set to the values of updated Individual TWT Parameter Set field and
* consider the non-AP STA is in power save and doze state according to the updated parameters starting from the next TWT Service Period.

When the Channel Usage element in a received Probe Request or Channel Usage Request frame includes one or more Operating Class/Channel Pair fields, the Operating Class/Channel Pair field(s) indicate(s) the requested non-AP STA operating class/channels for the usage mode indicated in the frame. (#4006)If the Usage Mode field in the Channel Usage element carries a value that is unknown to the AP, the AP should send in the Probe Response or Channel Usage Response frame a Channel Usage element without a Channel Entry field and with a Usage Mode field value indicating Unknown request, to inform the client that the AP does not support the usage mode indicated in the request. Usage mode Unknown request shall not be used in a Probe Request frame, in a Channel Usage Request frame, or in a Channel Usage Response frame that is sent in response to a Channel Usage Request frame that includes a Channel Usage element with usage modes 0 to 3.

The AP may send an unsolicited group addressed or individually addressed Channel Usage Response frame to the STAs that have requested (#3311)channel usage information if the corresponding (#3311)channel usage information needs to be updated. The Country element shall be included in the unsolicited and/or group addressed Channel Usage Response frame. The AP may include the Power Constraint information and EDCA Parameter in the Channel Usage Response frame. The values of the fields in the Power Constraint and EDCA Parameter Set elements included in the Channel Usage Response frame shall be the same values of the fields in the Power Constraint and EDCA Parameter Set elements that are transmitted by the AP.

Upon receipt of a Channel Usage element in the Probe Response or Channel Usage Response frame, the receiving STA may use the following:

* The channel usage information as part of channel selection processing to start a (#3349)noninfrastructure BSS or an off-channel TDLS direct link
* The Power Constraint element, if present, as part of determining its maximum transmit power for transmissions for the (#3349)noninfrastructure BSS or an off-channel TDLS direct link
* The EDCA Parameter Set element, if present, as part of determining its EDCA parameters for transmissions for the noninfrastructure BSS(#3349) or an off-channel TDLS direct link
* The QMF Policy element, if present and dot11QMFActivated is true, as part of determining its classification of Management frames for transmissions for the noninfrastructure BSS(#3349) or an off-channel TDLS direct link

(#4028)A non-AP STA that is operating in a noninfrastructure BSS may send a Channel Usage Request frame with a Channel Usage element that carries a Usage Mode field with a value equal to 4 to a peer STA to indicate that it prefers to switch the operating channel of the noninfrastructure BSS to another channel. A non-AP STA may indicate the preferred operating channels by including one or more Operating class and Channel fields in the Channel Entry field of the Channel Usage element carried in the corresponding Channel Usage Request frame.

(#4028)Upon receiving a Channel Usage Request frame with a Channel Usage element that carries a Usage Mode field with a value equal to 4, a STA that supports noninfrastructure BSS channel switch requests and is operating in a noninfrastructure BSS should consider switching the operating channel of the noninfrastructure BSS to a new channel that is one of the preferred channels indicated in the received Channel Entry field of the Channel Usage element, if present. The STA shall transmit a Channel Usage Response frame in response to the reception of a Channel Usage Request frame with the Usage Mode field equal to 4 that includes a Channel Usage element with the Usage Mode field set to 4. If the channel switch request is accepted, the STA shall include the target operating class and channel in the Channel Entry field of the Channel Usage element in the Channel Usage Response frame. Otherwise, no Channel Entry field shall be included. (#4028)When the Channel Usage element is carried in a Probe Request or Probe Response frame, the Usage Mode field shall not be set to 4.

If either a recommended operating class, or a recommended channel, or both are not supported or understood by the recipient, or if the operating country of the sender is unknown, the recipient shall discard the corresponding channel usage recommendation. A STA that has not requested (#3311)channel usage information shall discard an unsolicited group addressed Channel Usage Response frame.