IEEE P802.11  
Wireless LANs

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| LB200 Proposed Resolutions for Subclause 9.41 | | | | |
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Abstract

Addressing all CIDs from LB200 which relate to Subclause 9.41.

**REVISION NOTES:**

R0: initial

Interpretation of a Motion to Adopt

A motion to approve this submission means that the editing instructions and any changed or added material are actioned in the TGah Draft. This introduction is not part of the adopted material.

***Editing instructions formatted like this are intended to be copied into the TGah Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).***

***TGah Editor: Editing instructions preceded by “Instruction to Editor” are instructions to the TGah editor to modify existing material in the TGah draft. As a result of adopting the changes, the TGah editor will execute the instructions rather than copy them to the TGah Draft.***

**CID LIST:**

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| 1226 | Adrian Stephens | 181.48 | 9.41.1 | " a TWT STA shall be in the awake state for at least the Nominal Minimum Wake Duration time associated with a TWT Flow Identifier "  I don't know where these durations are defined. | Add a reference here to where these values are defined. | Revise - generally agree with commenter, TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID1226 |
| 1227 | Adrian Stephens | 181.56 | 9.41.1 | "A TWT STA should transmit frames only within TWT SPs"  The term TST STA is undefined. However, presumably this statement should exclude the AP, because otherwise there wouldn't be very much beaconing going on. | Review all use of TWT STA, and replace with TWT non-AP STA where the behaviour is specific to a non-AP STA. Alternatively make it clear at 180.58 that this term excludes the AP. | Revise - generally agree with commenter, TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID1227 |
| 1228 | Adrian Stephens | 182.05 | 9.41.1 | "The MAC parameter Adjusted Minimum Wake Duration is equal to (Nominal Minimum Wake Duration + 40+∙10-6 +∙ Wake Interval)."  parameter to what? MAC-SAP primitives have parameters. Structures have fields. PHYs have characteristic attributes. Just which of this is this?  Also, there is no such thing as a "Wake Interval" with no further qualification. But there is the value of the Wake Interval field transmitted in a particular time by a particular STA in a particular frame. | I think this should be described as a mapping. Also add a "where" clause that saying things like "Wake Interval is the value of the Wake Interval field in <description of frame> frame". | Revise - generally agree with commenter, TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID1228 |
| 1237 | Adrian Stephens | 186.21 | 9.41.7 | "the TWT agreement corresponding to the TWT Flow Identifier field of the TWT Teardown frame is deleted." -- as this is the only place this is said, it should be normative. | Replace with " .. frame shall be deleted." | Revise - generally agree with commenter, TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID1237 |
| 1510 | amin jafarian | 182.21 | 9.41.2 | Change all the AP's to the TWT Responding STA or TWT peer STA, note that this may apply for uplink as well as downlink throught out the whole sub-clause | as in the comment | Revise - generally agree with commenter, TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID1510 |
| 1511 | amin jafarian | 182.40 | 9.41.2 | "If the AP receives a frame from the TWT STA that solicits a response that contains a Next TWT value" | what type of frames solicits a response that contains a Next TWT value? Are they defined somewhere? | Revise - add a management action frame to solicit the next TWT value and allow for a QOS NULL frame to be used to solicit a TACK or other control response frame that can contain a next TWT value, TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID1511 |
| 1512 | amin jafarian | 182.54 | 9.41.3 | "An AP that receives a frame from a TWT STA for an Implicit TWT may ..." | 1- change the AP to the TWT Responding STA or something equivalent 2- This is not clear what the "for an implicit TWT" mean. Change it to: "The TWT Responding STA that setup an Implicit TWT and recieves a frame from the TWT STA may ..." | Revise - generally agree with commenter, TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID1512 |
| 1553 | Andrew Myles | 180.63 | 9.41.1 | The text states, "the TWT STA can calculate each next TWT in an implicit series of TWT values". This does not make a great deal of sense grammatically. | None yet. Clarify the intent of the sentence | Revise - generally agree with commenter, TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID1553 |
| 1849 | Graham Smith | 202.56 | 9.41.1 | "...STA utilizing a power management mode needs to be awake to exchange frames with other STAs." Is it only for exchanging frames? | Delete "to exchange frames with other STAs" | Revise - generally agree with commenter, TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID1849 |
| 1850 | Graham Smith | 202.57 | 9.41.1 | "The principle mechanism to facilitate TWT is the assignment of specific times...." Seems awkward wording | Replace "The principle mechanism to facilitate TWT is the assignment of specific times..." with "TWT assigns specic times..." | Revise - generally agree with commenter, TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID1850 |
| 1851 | Graham Smith | 202.59 | 9.41.1 | "TWT STAs need to communicate their wake requirements to APs and APs need to devise a schedule and deliver TWT values to STAs." The use of "need to" seems wrong and is not needed. Also is "TWT STA" a correct term? Is it intended that TWT can be used by any STA not just S1G STAs, it reads a such. Introduce that a STA using TWT is a TWT STA as per the suggeted change. | Replace "TWT STAs need to communicate their wake requirements to APs and APs need to devise a schedule and deliver TWT values to STAs ", with " STAs using TWT, TWT STAs, communicates their wake requirements to the APs and APs devise a schedule and deliver TWT values to the TWT STA." | Revise - generally agree with commenter, TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID1851 |
| 1852 | Graham Smith | 202.61 | 9.41.1 | When a TWT STA wakes and performs a frame exchange, it receives the next TWT information if Explicit TWT is being used, otherwise " - good practice to put "Explicit TWT" at the beginning and rephrase. Furthermore, in 8.4.2.170j you do introduce "Implicit TWT" so you should use that instead of 'otherwise" | Replace "When a TWT STA wakes and performs a frame exchange, it receives the next TWT information if Explicit TWT is being used otherwise,the TWT STA can calculate each next TWT in an implicit series of TWT values." with "If Explicit TWT is being used, a TWT STA wakes, performs a frame exchange and receives the next TWT information, when using Implicit TWT the TWT STA can calculate each next TWT. " | Revise - generally agree with commenter, TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID1852 |
| 1853 | Graham Smith | 202.62 | 9.41.1 | "Individual STAs need not be made aware.." "Individual" is not required. | Delete "Individual" | Revise - generally agree with commenter, TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID1853 |
| 1858 | Graham Smith | 202.64 | 9.41.1 | "There are no restrictions on TWT values assigned to each STA", well there are it is about 38 trillion years. This is perhaps not a valuable sentence. As I read this I am struggling at the moment to understand the limits for TWT, is it intended to be a short term or long term thing? Milliseconds, seconds, minutes, hours, days, years? Is it for extreme power saving or is it to meter out the medium so as to restrict contention, in which case it is short term? I hope as I read further it becomes a bit clearer. | Delete "There are no restrictions on TWT values assigned to each STA", or add some indication as to what the intention of TWT is , i.e. short term or long term. | Revise - generally agree with commenter, TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID1858 |
| 1859 | Graham Smith | 203.21 | 9.41.1 | "...and the STA may sleep until the TSF matches the next TWT value of the STA, provided that the STA has indicated that it is in a power save mode and no other condition requires the STA to remain awake." Not sure why the last part is needed. The STA 'may sleep' is good enough without all the conditionals. | Delete "provided that the STA has indicated that it is in a power save mode and no other condition requires the STA to remain awake" | Reject - there was a strong desire expressed by several members to include the language that the commenter wishes to delete because without this phrasing, one must ask whether the other requriements of power saving in other subclauses is overridden for this case or not. This is a general issue that arises in the construction of language that might create behavior that is related to existing behavior in another subclause. If no other conditions are specified, then the allowance indicated by the use of “may” explicity does NOT include any other conditions. |
| 1860 | Graham Smith | 203.56 | 9.41.1 | "A TWT STA should transmit frames only within TWT SPs." ut this is the only time the TWT STA is awake according to Line 50? Hence it cannot transmit outside of TWT if it is a TWT STA. Confused? | Delete sentence "A TWT STA should transmit frames only within TWT SPs." or explain it. | Revise - keep sentence in, but add a new one that indicates that a TWT STA may wake at times other than TWT. TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID1860 |
| 1861 | Graham Smith | 204.01 | 9.41.1 | "There are no explicit restrictions on the use of any specific TWT (e.g. EDCA AC restrictions) when multiple TWTs have been assigned to a single STA." I am confused. You are saying that the TWT STA does not need to use the EDCA AC parameters (CWmin, AIFSN)? Does it send everything at SIFS? AC\_VO? Is it not true that TWT STAs are not provided with unique non contention periods in the TWT, i.e. they still need to compete during the TWT, for example see P205L57? I think this sentence needs to e explained etter, I have probably misread it. | Please reword this sentence to make clear what the intention is. | Revise - sentence reworded to indicate that there are no restrictions on the AC of frames transmitted during a TWT SP. As for access rules, there is no guarantee that a TWT peer STA has assigned a TWT to a single STA - there is no requirement to do this - nor is there a requirement to provide protection to the TWT SP by the TWT peer STA, although the TWT peer STA may do this - a previous sentence makes it clear that the normal rules of access apply during a TWT SP. TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID1861 |
| 1862 | Graham Smith | 204.19 | 9.41.2 | "If the AP has already transmitted a Next TWT field to the STA within this TWT SP, the AP may respond to the STA with a frame that contains a Next TWT field." Is the idea more the AP does not need to respond again if already sent? If so suggest it is put that way. | Replace "If the AP has already transmitted a Next TWT field to the STA within this TWT SP, the AP may respond to the STA with a frame that contains a Next TWT field." With "If the AP has already transmitted a Next TWT field to the STA within this TWT SP, the AP is not required to respond to the STA with a frame that contains a Next TWT field." | Revise - the proposed language does not include a normative verb, but the existing text does and is therefore more appropriate. However, the wording of the previous sentence should be modified. TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID1862 |
| 1863 | Graham Smith | 204.25 | 9.41.2 | "A TWT STA awake for an Explicit TWT SP shall not transition to doze state until it has received a Next TWT field from the AP" needs some additional words | Replace "A TWT STA awake for an Explicit TWT SP shall not transition to doze state until it has received a Next TWT field from the AP" With "A TWT STA that is awake for an Explicit TWT SP shall not transition to doze state until after it has received a Next TWT field from the AP" | Accept - TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID1863 |
| 1864 | Graham Smith | 204.47 | 9.41.3 | "...shall determine the next TWT SP start time by adding to the current TWT, the value of Wake Interval associated with this TWT SP. Delete comma. | Delete comma | Revise - the sentence was correctly formed - the comma was needed because of the reverse sense of the addends - the change instead, is to swap the order of the addends which then allows the elimination of the comma. TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID1864 |
| 1865 | Graham Smith | 204.59 | 9.41.3 | "Subsequent TWT are calculated.." Should be plural | Make TWT pural, "Subsequent TWTs are calculated..." | Revise - generally agree with commenter. TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID1865 |
| 1983 | Haiguang Wang | 182.45 | 9.41.3 | In the paragraph, it says that "A TWT STA operating in an Implicit TWT SP shall determine the next TWT SP start time by adding to the current TWT, the value of Wake Interval associated with this TWT SP.".  It is unclear what the meaning of the current TWT is. | Propose to change to " ... adding to the start time of current TWT ..." | Revise - generally agree with commenter. TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID1983 |
| 2048 | Jae Seung Lee | 180.50 | 9.41 | It is not specified that whether TWT is applied only to S1G STA or not | Use the term like 'S1G AP' or 'S1G STA' if this is only applied to S1G STAs | Reject - there is no need to restrict TWT to S1G. The technique can be applied when the MAC is coupled with other PHY technologies as well. |
| 2085 | Jerome Henry | 203.41 | 9.41.1 | this mechanism efficientcy may need to be improved, for 2 reasons: 1. it reduces the deterministic aspect of wi-fi transmission:a sensor may need to report an emergency value (fire etc) and be unable to do so because the AP is sleeping. This reduces the chances of adoption for this protocol in sensor networks where emergency reports are needed. Authors may reply that in these networks the AP would not sleep, but then this mechanism should be configurable and described as optional for APs. Some configuration should be able to say "no TWT for APs" somewhere in these deployments. 2. The mechanism may force stations to be awake, just to hear that the Ap goes to sleep. This may happen for every twt cycle, and may greatly reduce the stations battery time, especially as the AP would only sleep after each non-AP STA accepted the TWT, which can result in hundreds of frame exchanges in large cells (especially with relays), just to allow the AP to sleep for a few intervals. | Add a mechanism by which a station may request "never sleep" from the AP. In that case, the Ap would not sleep even if other stations allow it. Alternatively, allow that the admin may configure an "APs can't sleep" option even if the Ap has the ability to sleep and thus save power... or remove the option for an Ap to sleep altogether, which would be the most effiecient way of saving non AP STA battery time IMHO. | Revise - it is true that the TWT mechanism facilitates the ability of an AP to sleep. The mechanism is already optional with support signaled in the S1G Cap element. Configuration of this bit to a condition of “AP shall not sleep” using normal MIB access procedures is allowed. The creation of a guarantee that this MIB is configurable by an admin is beyond the scope of 802.11. That is, 802.11 can only create a MIB and indicate that specific variables in the MIB are writeable, but an implementation can fail to provide access to any given MIB variable. Adding a mechanism allowing a STA to request that the AP does not sleep is complicated - if the AP is already up and running with many STA associated, then switching from “AP can sleep” mode to “AP shall not sleep” mode in response to the request for this mode by a STA will require that all STA be disassociated and then re-associated in order to communicate the updated information. Existing TWT agreements would all have to be cancelled, hence this portion of the proposed change is rejected. There was no statement requiring the setting of the TWT Support bit, so this has been added. . TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID2085 |
| 2141 | kaiying Lv | 180.59 | 9.41.1 TWT overview | the TWT responding STA can be a STA or an AP as described in pg181/ln41 | clarify whether AP is a TWT requesting STA or a TWT responding STA when AP is mentioned; or only allow AP to be the TWT responding STA. | Revise - generally agree wi the commenter - clarify the roles by using new term “TWT peer STA” to describe the counterpart to the TWT STA. TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID 2141 |
| 2142 | kaiying Lv | 181.43 | 9.41.1 TWT overview | the reference is wrong | chenge "10.2.1.19"to "10.2.2.19" | Accept - TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID 2142 |
| 2143 | kaiying Lv | 181.38 | 9.41.1 TWT overview | the operation of AP as a TWT STA is not clear, e.g. how for a AP to be a TWT STA when there're STAs in power save mode? | Clarify the operation or remove it. | Revise - as made clear in the text, the AP may become a TWT STA with the acceptance of a single agreement with any STA and having a TWT agreement is not an automatic license for the AP to sleep. The AP can only sleep if it has established a TWT agreement with every STA with which it is associated. TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID 2143 |
| 2144 | kaiying Lv | 182.27 | 9.41.1 TWT overview | the"Adjusted Minimum Wake Duration "has no reference | please clarify it | Revise - AMTWD is defined and used in two places. TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID 2144 |
| 2196 | Lei Wang | 180.58 | 9.41.1 | The use of plurals of STAs and APs in the sentence in line 58 page 180 causes unnecessary confusions, e.g., does it mean a TWT STA communicates with multiple APs for TWT values? | Change the sentence in line 58 and 59 on page 180 to the following:  A TWT STA needs to communicate its wake requirements to its associated AP and the AP needs to devise and deliver TWT values to the STA. | Revise - generally agree with commenter. TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID 2196 |
| 2197 | Lei Wang | 180.62 | 9.41.1 | why use "is being used", not just "is used"? | Delete the word "being" in line 62 page 180. | Accept - agree with commenter. TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID 2197 |
| 2198 | Lei Wang | 181.01 | 9.41.1 | There is one problem with the sentence in line 1 page 181, i.e., the TWT values are not always assigned by one STA to another STA, based on the TWT command in the TWT element. | change the sentence in line 1 and 2 on page 181 to the following:  The maximum number of outstanding TWT values of a TWT STA cannot exceed 8, since the TWT Flow ID field of the TWT element comprises 3 bits. | Revise - the commenter is incorrect in both the original comment and the proposed solution, but the resolution committee feels that the language can be clarified. TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID 2198 |
| 2199 | Lei Wang | 181.11 | 9.41.1 | The parameter "dot11TWTOptionActivated" is not defined. | Define "dot11TWTOptionActivated" in Annex C. | Revise - generally agree with the commenter. TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID 2199 |
| 2200 | Lei Wang | 181.14 | 9.41.1 | What is the appropriate response frame to the received frame in the sentence in line 14 page 181? In addition, another question: which frames can carriy TWT element? | Please clarify which frames can carry TWT element and also what is the appropriate response frame. | Reject - the frame formats in clause 8 clearly describe the frames that can carry the TWT element. This information does not need to be repeated here and repeating it here would only create an opportunity for mismatch between a possible list of frames here and the frames that can carry the element, should there be edits in the future that modify which frames can carry the element. A similar argument exists for the other point, that other subclauses describe the correct and appropriate responses to the frames that can carry the TWT element and again, this information need not be repeated here. |
| 2201 | Lei Wang | 181.17 | 9.41.1 | There are multiple issues with the sentence in line 17 to 19 on page 181, including: 1) what's the TWT value in the new TWT request? Same as that given in the Response just received from AP? 2) The word "should" means "recommended to do", not have to. Then what happens if the STA does not send a new TWT request? 3). if the STA sends a new TWT request, then what happens? waiting for the response? if not "accept" nor "reject", then continue sending new TWT request? | Please provide clarifications to address the questions asked by this comment. | Revise - the contents of the questions being asked are generally beyond the scope of the amendment and 802.11. The purpose of the standard is to provide a common communication exchange that allows entities to engage various services. For every service that is offered within 802.11 and for which a setup exchange is required, there always exists the possibility of a refusal to grant that service. What the STA should do when the response contains a refusal is generally an implementation question and in this case, that general disposition is true. However, at least two refusal cases include “alternate” and “dictate” in which case, a possible path to acceptance of the service is indicated and therefore, the requester should attempt a new request using the offered alternative TWT values. TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID 2201 |
| 2203 | Lei Wang | 181.35 | 9.41.1 | What is the appropriate response frame to the received frame in the sentence in line 35 page 181? In addition, another question: which frames can carriy TWT element? | Please clarify which frames can carry TWT element and also what is the appropriate response frame. | Reject - the frame formats in clause 8 clearly describe the frames that can carry the TWT element. This information does not need to be repeated here and repeating it here would only create an opportunity for mismatch between a possible list of frames here and the frames that can carry the element, should there be edits in the future that modify which frames can carry the element. A similar argument exists for the other point, that other subclauses describe the correct and appropriate responses to the frames that can carry the TWT element and again, this information need not be repeated here. |
| 2204 | Lei Wang | 181.38 | 9.41.1 | There are multiple issues with the sentence in line 38 to 41 on page 181, including: 1) what's the TWT value in the new TWT request? Same as that given in the Response just received from non-AP STA? 2) The word "should" means "recommended to do", not have to. Then what happens if the AP does not send a new TWT request? 3). if the AP sends a new TWT request, then what happens? waiting for the response? if not "accept" nor "reject", then continue sending new TWT request? | Please provide clarifications to address the questions asked by this comment. | Revise - the contents of the questions being asked are generally beyond the scope of the amendment and 802.11. The purpose of the standard is to provide a common communication exchange that allows entities to engage various services. For every service that is offered within 802.11 and for which a setup exchange is required, there always exists the possibility of a refusal to grant that service. What the STA should do when the response contains a refusal is generally an implementation question and in this case, that general disposition is true. However, at least two refusal cases include “alternate” and “dictate” in which case, a possible path to acceptance of the service is indicated and therefore, the requester should attempt a new request using the offered alternative TWT values. TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID 2204 |
| 2205 | Lei Wang | 181.41 | 9.41.1 | Have multiple questions with the AP as TWT STA as described by the sentence in line 41 to 45 on page 181: 1) what's the TWT value in "until the TSF matches the TWT value"? Note that the AP needs to have TWT setups with all its associated non-AP STAs, before it goes to sleep. Therefore, the next TWT value of the AP may not be the TWT value of the most recent TWT setup. 2) when an AP becomes a TWT STA, does it also limit to max 8 outstanding TWT values? Note that a TWT AP may have multiple STAs, each STA may have mutliple flows. | Please provide clarifications to address the questions asked by this comment. | Revise - generally agree with commenter, except that the maximum of 8 is per pair, not per requesting STA, so an AP could have hundreds of TWT agreements, not just 8. TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID 2205 |
| 2206 | Lei Wang | 181.46 | 9.41.1 | The sentence in line 46 to 51 page 181 is long and hard to understand. After reading multiple times, I can guess what it may mean, but still not so sure. | Please revise the sentence in the line 46 to 51 to make it more readable. The following is just what I guessed:  If the NDP Paging field was not present during the TWT setup, a TWT STA shall be in the awake state for at least the Nominal Minimum Wake Duration time for the TWT SP cooresponding to a TWT Flow, even if no PS-Poll or U-APSD trigger frame has been transmitted by the STA. | Revise - generally agree with commenter - TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID 2206 |
| 2207 | Lei Wang | 181.59 | 9.41.1 | The sentence in line 59 page 181 needs to be more specific, particular, the use of the referrence to Clause 9. Please note that Clause is very big, covering so many different things, and the setence itself is in Clause 9 too. | Please clarify what the "normal rules for transmission" are for the text in line 59 page 181. | Revise - generally agree with commenter - TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID 2207 |
| 2208 | Lei Wang | 181.63 | 9.41.1 | The sentence in line 63 page 181 about max TWTs per STA is incorrect. It should be per STA pair, or per WiFi link, as a TWT STA may have multiple assoicated STAs, e.g., a TWT AP. | Change the sentence in line 63 page 181 to the following:  Because the TWT Flow ID field is 3 bits in length, the maximum number of TWTs per STA pair is 8. | Revise - generally agree with commenter - TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID 2208 |
| 2209 | Lei Wang | 182.05 | 9.41.1 | What's the Adjusted Minimum Wake Duration used for? Where is the calculation formula comeing from? Particularly, why 40\*10^(-6)? | Please clarify the text in line 5 page 182 to address the questions asked by this comment. | Revise - generally agree with commenter, adjusted time is intended to account for TSF inaccuracy at the non-AP STA. TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID 2209 |
| 2210 | Lei Wang | 182.08 | 9.41.1 | The second sentence in line 8 page 182 is redundant, as the first sentence uses "may", which already means "not required". | Change the paragraph in line 8 page 182 to the following:  A TWT STA may wake to receive Beacons. | Revise - generally agree with commenter. TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID 2210 |
| 2211 | Lei Wang | 182.11 | 9.41.1 | why do we need both Pentapartial Timestamp (LBS 5 bytes of TSF timer) and Tetrapartial Timestamp (LSB 4 bytes of TSF timer) in 11ah spec? | please clarify | Reject - pentapartial is 5 bytes to make the size of the BAT equal to the size of the compressed BA frame at 32 bytes. 4 Bytes is considered the minimum resolution desired and makes the frames that carry it shorter. |
| 2216 | Lei Wang | 182.36 | 9.41.2 | The sentence in line 36 page 182, starting with "The AP shall assume that the TWT STA is in the doze state if......", is confusing, regarding the other two sentences following the if-statement, i.e., the one about power saving state and the one about "not receive" a frame from the TWT STA. Are those also part of the if-statement? | Please clarify. The following is a suggestion to make the sentence clear: change the sentence in line 36 to 39 on page 182 to the following text:  The AP shall assume that the TWT STA is in the doze state if all of the following conditions are met:  a) the TWT SP has ended;  b) the TWT STA is in a Power Save mode; and  c) the AP has not received a frame from the TWT STA that solicits a response that contains a Next TWT value. | Revise - generally agree with commenter. TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID 2216 |
| 2217 | Lei Wang | 182.30 | 9.41.2 | Don't think the approach described in line 30 to 33 on page 182 is a right approach to deal with the lack of Next TWT Time issue with the explicit TWT scheme, because: 1. the use of "may" causes uncertainty of the STA awake-doze state, e.g., what state the STA will be if it does not send a frame to solicit the Next TWT Time infor? Does the AP need to know which state the STA is? if so, how? 2). the use of "trasmit any frame ..." is another problematic issue, for multiple reasons, e.g., a). the AP may not correctly understand the intention of "any frame" that is just used for asking for Next TWT Time info; b). "any frame" may have its own protocol sequences, too much risk to give the STA such an open approach to choose any frame. | Please clarify the text in line 30 to 33 on page 182 to address the issues identified by the comment. The following is a suggestion: 1) change the "may" to "shall", to define a deterministic procedure to handle the lack of Next TWT time info issue for Explicit TWT scheme; 2) change the "any frame" to some specific frame with specific indication for the STA to request AP's provision of Next TWT Time info. | Revise - the behavior on transition to doze described here exactly matches the baseline behavior and description. Generally speaking for PS operation, the non-AP STA is in charge of deciding when to sleep and the AP always assumes that the STA is asleep, unless it receives explcit indication that the STA is awake. In some PS modes, there is a requirement that a STA that woke and signaled its state change must remain awake until the AP allows it to sleep (e.g. EOSP=0) and in other cases, there is a specific time during which the STA must remain awake (e.g. S-APSD, TWT) and in other cases, it is per a fixed number of exchanges (e.g. U-APSD, PS-Poll) - in all cases, the STA, once the requirement for minimal wake time has been met, has the OPTION of returning to doze, and in all cases, the AP has no idea whether the STA has made that transition and therefore must assume that it has done so. Allowing ANY frame to be used to signal the fact hat the STA is not asleep is clear and unambiguous in that if the AP receives the frame, it knows tha the STA is awake at least until the next TWT field is sent ot the STA. Slight change to wording to add that last tiny bit about “until receipt of Next TWT value.” TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID 2217 |
| 2624 | Osama Aboulmagd | 181.27 | 9.41.1 | "to an assoiated non-AP STA" is repeated twice in the same sentence | delete one of the occurances | Revise - generally agree with commenter. TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID 2624 |
| 2653 | Rojan Chitrakar | 180.50 | 9.41 | The term TWT Service Period (SP) is used throughout the section which implies EDCA. Since S1G devices may use DCF as well, use a more generic term to describe the TWT period. | As stated in comment | Reject - neither the term TWT SP nor “service period” implies EDCA. Service period is simply a name for a period of time on the air during which something happens. Note that all activity on the air happens on top of the DCF - that is, both EDCA and HCCA are built on top of DCF and so is TWT. Some newer access mechanisms like RAW are not directly related to EDCA - that is, RAW is only known to a STA that can read the RPS IE and is therefore ineffective at restricting access unless some DCF mechanism is used to prevent non-RPS aware STAs from accessing the channel during the RAW. |
| 2705 | Santosh Ghanshyam Pandey | 181.02 | 9.41.1 | Missing preposition | Change "field of the TWT element comprises 3 bits." to "field of the TWT element comprises of 3 bits." | Reject - there are at least two common uses of the verb “comprise” - one is to say that “item A comprises items B and C” and the other is to say that “item A is comprised of items B and C” - the first option, which does not employ a preposition, has been used in the draft and is recognized historically as the more correct form and indeed, was the only accepted form back in those long-past days when American society ranked certain groups of people as having a higher, naturally endowed value than others, all men wore hats, women did not have jobs or careers or an education, children addressed adults, including their own parents as “sir” and “ma’am”, attendance at religious services was mandatory and our national enemy was clearly identifiable and locatable on a map, but we have evolved as a society, so your desire to abandon that rapidly decaying older form of use in order to employ the more modern-sounding prepositional phrasing is understandable, unless of course, your use of three full names in the commeter field indicates that you are a radical member of the wealthy elite who would understandably possess a strong desire to push the people of this culture backwards in time so that we may devolve to that more utopian, rigid society that existed in the past, because it was easier back then, to ascertain what your position was in life and what you needed to do to maintain it, including, using the verb “comprise” without a preposition, knowing that the presence of a preposition used to be the shibboleth that separated the unfit from the worthy, in which case, I am puzzled by your desire. See: <http://www.merriam-webster.com/dictionary/comprise> and <http://www.quickanddirtytips.com/education/grammar/comprise-versus-compose> |
| 2706 | Santosh Ghanshyam Pandey | 181.01 | 9.41.1 | Since the TWT values are always assigned by AP and has been referend to as such previously in the subclause - it will be more clear to be specific in this sentence too. | Change "TWT values assigned by one STA to a second STA cannot exceed" to "TWT values assigned by a AP to a non-AP STA cannot exceed" | Revise - instead of what the commenter is suggesting, the identities of the STAs involved in the TWT agreement are relabeled as TWT STA and TWT peer STA. TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID 2706 |
| 2707 | Santosh Ghanshyam Pandey | 181.18 | 9.41.1 | If the AP's response to TWT is Alternate TWT or Dictate TWT, the STA "should send a new request for a TWT value". Can this TWT value be the same as previsouly requested by the STA or it has to be the one that AP has sent in the response. | Please clarify the comment question in the draft text. | Revise - does not have to be anything, but clarity added by mentioning that it “should be” what the TWT peer STA suggested. TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID 2707 |
| 2708 | Santosh Ghanshyam Pandey | 181.39 | 9.41.1 | Not quite sure why the AP has to negotiate the TWT with STAs, rather than just give the TWT schedule to all associated STAs. With increasing number of STAs (TGah use case) this seems a rather complicated and wasteful procedure due to increased message exchanges from battery constrained STAs. | Simplify behavior in this paragraph such that the STA proposes a TWT and AP may either Accept, Reject or provide Alternative (Alternative should be same as Dictate). The STA should either accept it or reject it. | Revise - generally agree with commenter. TGah editor to execute proposed changes from 11-14-0396r0 found under all headings which include CID 2708 |
| 2709 | Santosh Ghanshyam Pandey | 181.41 | 9.41.1 | Since the AP is powered up why should there be a provision for AP to sleep. For TGah there are going to be soft AP seem impractical, any reason for AP to sleep? Note that AP sleeping may affect its discovery when new non-AP STAs try to join. | Specify how new non-AP STAs will discover APs when the APs are sleeping. Alternatively, remove the capability of APs to sleep. | Reject - the question of how frequently an AP should sleep is scenario and implementation-dependent. There are scenarios in which the tradeoff in extra time needed for discovery is adequately and desirably balanced against the gain in energy savings from the ability of the AP to sleep. Discovery in such cases is likely to be through a passive method, rather than an active method and the implication to passive scanning if the AP is allowed to sleep is potentially null (i.e. provided tha the AP wakes to send Beacons at the same rate as when the AP does not sleep, discovery time is unchanged for passive scanners). |
| 2779 | SHOUKANG ZHENG | 181.51 | 9.41.2 | The definition for TWT SP is that the time during which the TWT STA is awake is a TWT Service Period (TWT SP). Is TWT STA no more awake after the end of TWT SP? | Please clarify | Reject - the description of when a STA shall be awake and when it may return to sleep is in the draft. An example of one of the several instances of such a description is provided here: “A TWT STA awake for an Explicit TWT SP shall not transition to doze state until after it has received a Next TWT field from the TWT peer STA and has been in the awake state for at least Adjusted Minimum TWT Wake Duration time from the TWT SP start time as identified by the TWT STA or has received an EOSP field with a value of 1.” |

**Discussion**

**Proposed changes**

**CID 1226, 1227, 1228, 1237, 1510, 1511, 1512, 1553, 1849, 1850, 1851, 1852, 1853, 1858, 1860, 1861, 1862, 1863, 1864, 1865, 1983, 2085, 2141, 2142, 2143, 2144, 2146, 2147, 2148, 2149, 2201, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2216, 2217, 2624, 2706, 2707, 2708**

**8.2.4.1.1 General**

***TGah editor: modify Figure 8-3b Frame Control field when Type is equal to 1 and Subtype is equal to <ANA> by changing the name of the Next TWT Present field to the Next TWT Info Present field***

***TGah editor: modify the nth paragraph of 8.2.4.1.1 General as shown:***

The Next TWT Info Present field is 1 bit in length and is set to 1 if the Next TWT Info field is present in the frame. Otherwise, it is set to 0.

**8.3.1.21 TACK frame format**

***TGah editor: modify Figure 8-29m TACK frame format by changing the name of the Next TWT field to the Next TWT Info field***

***TGah editor: add a new Figure 8-29maNext TWT Info field as shown:***

|  |  |  |
| --- | --- | --- |
|  | Next TWT | TWT Identifier |
| bits | 45 | 3 |

**Figure 8-29ma Next TWT Info field format**

***TGah editor: modify the sixth paragraph of subclause 8.3.1.21 TACK frame format as shown:***

**8.3.1.21 TACK frame format**

If t Present field of the FC field is equal to 1 and the Flow Control bit of the FC field is equal to 0, then the Next TWTInfo/Suspend Duration and contains the value of bits [47:3] of the TSF timer value corresponding to the next scheduled TWT SP for the TWT agreement identified by the TWT Identifier subfield for the STA that is the intended recipient of the frame. . If the Next TWT Present field of the FC field is equal to 1 and the Flow Control bit of the FC field is equal to 0 and the Next TWT Info/Suspend Duration subfield has a value of all zeroes, the transmitter does not currently have a Next TWT value available for transmission for the TWT agreement identified by the TWT Identifier subfield for the STA that is the intended recipient of the frame. If the Next TWT Present field of the FC field is equal to 1 and the Flow Control bit of the FC field is equal to 1, then the Next TWT Info/Suspend Duration field is present and contains a flow suspend duration in microseconds during which the intended recipient TWT STA is not allowed to transmit data frames to the STA identified by the A2 field of the TACK frame. If the Next TWT Present field is set to 0 in the Frame Control field, the Next TWT Info/Suspend Duration field is not present in the TACK frame.

***TGah editor: add a new subclause 8.4.1.54a TWT Information field as shown, in the appropriate location in the draft:***

**8.4.1.54a TWT Information field**

The TWT Information field is present in the TWT Information frame (see 8.6.24.9a). The TWT Information field format is shown in Figure 8-80x (TWT Information field format).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **B0 B2** | **B3** | **B4** | **B5 B6** | **B7** | **B8 Bn** |
|  | TWT ID | Reserved | Next TWT Request | Next TWT Subfield Size | Reserved | Next TWT |
| Bits: | 3 | 1 | 1 | 2 | 1 | 0 or 32 or 48 or 64 |

**Figure 8-363x—TWT Information field format**

The TWT Information field size is variable and depends on the value of the Next TWT Size field.

The TWT ID subfield contains the 3 bit TWT Identifier for which TWT Information is requested or being provided.

The Next TWT Request subfield is set to 1 to indicate that the TWT Information frame is a request for the delivery of a Next TWT value. The Next TWT Request subfield is set to 0 if a Next TWT value is not requested.

The Next TWT Subfield Size subfield is 2 bits which describe the size of the Next TWT subfield according to Table 8-xxx Next TWT Subfield Size subfield encoding.

Table 8-xxx Next TWT Subfield Size subfield encoding

|  |  |
| --- | --- |
| **Next TWT Subfield Size subfield value** | **Size of the Next TWT subfield in bits** |
| 0 | 0 |
| 1 | 32 |
| 2 | 48 |
| 3 | 64 |

The Next TWT subfield is of a variable size as determined by the Next TWT Subfield Size subfield value according to Table 8-xxx Next TWT Subfield Size subfield encoding. The value contained in the Next TWT subfield is the least significant portion of the TSF at the next TWT for the TWT specified by the TWT Idenfier subfield.

***TGah editor: add a row to Table 8-363a S1G Action field values in 8.6.24.1 S1G Action field as shown:***

**8.6.24.1 S1G Action field**

Table 8-363a—S1G Action field values

|  |  |  |
| --- | --- | --- |
| **Value** | **Meaning** | **Time Priority** |
| <TBD> | TWT Information | No |

***TGah editor: add anew subclause 8.6.24.9a TWT Information frame format as shown, in the appropriate location in the TGah draft:***

**8.6.24.9a TWT Information frame format**

The TWT Information frame is an Action frame of category S1G. It is sent by a STA to request or deliver information about a TWT agreement and is transmitted by either STA of an existing TWT agreement. The action field of the TWT Information frame contains the information shown in Table 8-363x (TWT Information frame action field format).

Table 8-363x—TWT Information frame action field format

|  |  |
| --- | --- |
| **Order** | **Information** |
| 1 | Category |
| 2 | S1G Action |
| 3 | TWT Information Field (8.4.1.54a) |

The category field is set to the value for S1G specified in Table 8-38 (Category values).

The S1G Action field is set to the value for TWT Information frame specified in Table 8-363a (S1G Action field values).

***TGah editor: modify Figure 8-532e STACK frame format by changing the name of the Tetrapartial Timestamp/Next TWT field to the Tetrapartial Timestamp/Next TWT Info field***

***TGah editor: modify the sixth paragraph of subclause 8.7.4.1 STACK frame format as shown:***

**8.7.4.1 STACK frame format**

If the Next TWT Info Present field in the FC is set to 0, the Tetrapartial Timestamp/Next TWT Info field contains the least significant four octets of the value of the transmittings STA’s TSF timer at the time that the data symbol containing the first bit of the Teteraparital Timestamp is transmitted to the PHY plus the transmitting STA’s delays through its local PHY from the MAC-PHY interface to its interface with the WM [e.g. antenna, light emitting diode (LED) emission surface].

If the Next TWT Info Present field in the FC is set to 1 and the Flow Control bit of the Frame Control field is equal to 0, then the Tetrapartial Timestamp field contains the the lowest four bytes of the TSF time for a next TWT logically ANDed with the value 0xFFFFFFF8 and then added to the value of the TWT Identifier that corresponds to that Next TWT value. If the Next TWT Info Present field in the FC is equal to 1 and the Flow Control bit of the Frame Control field is equal to 0 and the 29 MSbits of the Next TWT Info subfield has a value of all zeroes, the transmitter does not currently have a Next TWT value available for transmission for the TWT indicated by the TWT Identifier corresponding to the value of the 3 LSbits of the Next TWT Info field. If the Next TWT Info Present field in the FC is set to 1 and the Flow Control bit of the Frame Control field is equal to 1, then the Tetrapartial Timestamp field contains a flow suspend duration, in microseconds, during which the intended recipient TWT STAs are not allowed to transmit data frames to the STA identified by the RA field of the frame that elicited the STACK frame.

***TGah editor: modify Figure 8-532f BAT frame format by changing the name of the Next TWT field to the Next TWT Info field***

***TGah editor: modify the sixth paragraph of subclause 8.7.4.2 BAT frame format as shown:***

**8.7.4.2 BAT frame format**

If the Next TWT Info Present field in the FC field is equal to 1and the Flow Control bit of the Frame Control field is equal to 0, then the Next TWT Info/Suspend Duration field is present in the BAT frame and contains a next TWT value for the intended recipient of the frame corresponding to the lowest six bytes of the TSF time for the next TWT logically ANDed with the value 0xFFFFFFF8 and then added to the value of the TWT Identifier that corresponds to that Next TWT value. If the Next TWT Info Present field in the FC is equal to 1and the Flow Control bit of the Frame Control field is equal to 0 and the 45 MSbits of the Next TWT Info/Suspend Duration subfield has a value of all zeroes, the transmitter does not currently have a Next TWT value available for transmission for the TWT indicated by the TWT Identifier corresponding to the value of the 3 LSbits of the Next TWT Info/Suspend Duration field. If the Next TWT Info Present field in the FC field is equal to 1and the Flow Control bit of the Frame Control field is equal to 1, then the Next TWT Info/Suspend Duration field is present in the BAT frame and contains a flow suspend duration in microseconds during which the intended recipient TWT STA is not allowed to transmit data frames to the STA identified by the A2 field of the BAT frame. If the Next TWT Info Present field in the FC field is equal to 0, then the Next TWT Info/Suspend Duration field is not present in the BAT frame.

***TGah editor: modify subclause 9.3.2.9 Ack procedure as shown:***

**9.3.2.9 Ack procedure**

The cases when an Ack frame can be generated are shown in the frame exchange sequences listed in Annex G. During a TWT SP, either the STACK or TACK frame is used in place of the Ack frame, according to the procedure described in 9.41 (Target Wake Time (TWT)) and otherwise, shall not be used. During a TWT SP, the BAT frame is used in place of the BA frame, as described in 9.22 (Block Acknowledgement (Block Ack)) and otherwise, is not used.

***TGah editor: modify subclause 9.41 Target Wake Time (TWT) and its subclauses as shown:***

**9.41 Target Wake Time (TWT)**

**9.41.1 TWT overview**

Target Wake Times (TWTs) allow STAs to manage activity in the BSS by scheduling STAs to operate at different times in order to minimize contention and to reduce the required amount of time that a STA utilizing a power management mode needs to be awake. STAs that request and set up a TWT agreement are called TWT STAs and the STAs with which they have such an agreement are TWT peer STAs. A TWT STA is assigned specific times to wake and exchange frames with the TWT peer STA. A TWT STA communicates wake scheduling information to its TWT peer STA and the TWT peer STA devises a schedule and delivers TWT values to the TWT STA. During a TWT, the TWT peer STA can send information about the next TWT to each participating TWT STA. When Explicit TWT is employed, a TWT STA wakes and performs a frame exchange and receives the next TWT information in a response from the TWT peer STA. When Implicit TWT is used the TWT STA calculates the Next TWT by adding a fixed value to the current TWT value . STAs need not be made aware of the TWT values of other STAs. The maximum number of outstanding TWT values assigned by a single TWT peer STA to a single TWT STA cannot exceed 8, since the TWT Flow ID field of the TWT element comprises 3 bits. TWT peer STAs may protect TWT times with protection mechanisms including, but not limited to NAV-setting frame exchanges. TWT peer STAs that are APs may additionally protect TWT times usingRAW scheduling. TWT STAs may wake at times other than TWT.

A STA with dot11TWTOptionActivated set to true shall set the TWT Support subfield to 1 in all S1G Capabilities elements that it transmits.

A non-AP STA with dot11TWTOptionActivated set to true may transmit a TWT element to its associated AP with a value of Request TWT, Suggest TWT or Demand TWT in the TWT Command field and a value of 1 in the TWT Request field if the most recently received S1G Capabilities element received from the AP included a value of 1 in the TWT Support subfield.

An AP with dot11TWTOptionActivated set to true shall transmit a TWT element to a STA with which it is associated and from which it received a frame containing a TWT element that contained a value of Request TWT, Suggest TWT or Demand TWT in the TWT Command field and a value of 1 in the TWT Request field. The transmitted TWT element shall be included in the frame that is the appropriate response frame to the received frame. The AP shall include a value of Accept TWT, Alternate TWT, Dictate TWT or Reject TWT in the TWT Command field of the response and shall set the TWT Request field to 0. If the AP response’s TWT Command field includes anything other than Accept TWT or Reject TWT, the STA should send a new request for a TWT value by sending another frame that contains a TWT element, modifying the parameters of the request to for example, indicate an acceptance of a proposed alternate TWT or dictated TWT value. If the STA receives a TWT response to a TWT request with the TWT Command value of Accept TWT, then the STA has successfully completed a TWT setup with that STA for the TWT Flow Identifier indicated in the TWT response and the STA becomes a TWT STA and the STA may sleep until the TSF matches the next TWT value of the STA, provided that the STA has indicated that it is in a power save mode and no other condition requires the STA to remain awake. The AP becomes a TWT peer STA of the TWT STA.

The MAC addresses of the TWT STA and the TWT peer STA and the TWT Flow Identifier indicated in the TWT Response of a successful TWT setup between those two STAs uniquely identifies a TWT agreement. A MAC variable Adjusted Minimum TWT Wake Duration is defined for each TWT of each TWT agreement and has a value equal to Nominal Minimum TWT Wake Duration minus the elapsed time from the start of the TWT SP, where the start of the TWT SP is determined after any necessary TSF adjustment.

The TWT Wake Interval of a TWT agreement is the value calculated as shown in 8.4.2.170j (TWT element) from the TWT Wake Interval Manitssa and TWT Wake Interval Exponent of the TWT response that successfully completed the TWT agreement.

An AP may transmit a TWT element in an individually addressed TWT Setup frame with a value of Request TWT, Suggest TWT or Demand TWT in the TWT Command field and a value of 1 in the TWT Request field to an associated non-AP STA if the most recently received S1G Capabilities element received from the STA included a value of 1 in the TWT Support subfield. An AP may transmit TWT Setup frames to more than one of its associated non-AP STAs.A non-AP STA with dot11TWTOptionActivated set to true shall transmit a frame containing a TWT element to the AP with which it is associated and from which it received an individually addressed frame continaing a TWT element that contained a value of Request TWT, Suggest TWT or Demand TWT in the TWT Command field and a value of 1 in the TWT Request field. The transmitted TWT element shall be included in the frame that is the appropriate response frame to the received frame. The non-AP STA shall include a value of Accept TWT, Alternate TWT, Dictate TWT or Reject TWT in the TWT Command field of the response and shall set the TWT Request field to 0. If the non-AP STA response’s TWT Command field includes anything other than Accept TWT or Reject TWT, the AP should send a new request for a TWT value by sending another frame that contains a TWT element, modifying the parameters of the request to for example, indicate an acceptance of a proposed alternate TWT or dictated TWT value. If the AP receives a TWT response to a TWT request with the TWT Command value of Accept TWT from an associated non-AP STA, then the AP has successfully completed a TWT setup with that STA for the TWT Flow Identifier indicated in the TWT response and the AP becomes a TWT STA with respect to that STA.

A non-AP STA shall not queue a frame containing a TWT element to the AP with which it is associated and from which it received a group addressed frame continaing a value of 1 in the TWT Request field as a response to the reception of that frame.

If the NDP Paging field was not present in the TWT response corresponding to a TWT agreement, the TWT STA shall be in the awake state following each TWT associated with each TWT agreement for at least the Adjusted Nominal Minimum Wake Duration time associated with that TWT agreement even if no PS-Poll or U-APSD trigger frame has been transmitted by the STA. The nominal time during which the TWT STA is awake is called a TWT Service Period (TWT SP). If the Implicit bit is equal to 1 in the TWT response for a TWT agreement, the TWT associated with that TWT agreement is an Implicit TWT and the SP associated with that TWT is an Implicit TWT SP. A TWT SP that is not an Implicit TWT is an Explicit TWT SP. If the NDP Paging field was present in the TWT response, the TWT STA shall follow the TWT operational rules defined in 9.41.5 (NDP Paging Setup).

A TWT STA that is a non-AP STA should transmit frames only within TWT SPs.

A TWT STA that transmits a frame during a TWT SP is not granted any special medium access privileges, nor is there any guarantee that the TWT peer STA assigned the TWT SP to only one TWT STA.

A single pair of STAs can create multiple TWT agreements. Each unique TWT agreement is identified by a Flow Identifier and the MAC addresses of the TWT STA and TWT peer STA. Because the TWT Flow ID field is 3 bits in length, the maximum number of TWTs per STA pair is 8. There are no explicit restrictions on the class of traffic (i.e. EDCA Access Category) that can be transmitted within any specific TWT SP when multiple TWT agreements have been set up by a single TWT STA.

A TWT STA may wake to receive Beacons that are transmitted outside of a TWT SP.

A TWT peer STA should include a Pentapartial Timestamp field or a Tetrapartial Timestamp field or a Timestamp field in at least one frame transmitted to a TWT STA during aTWT SP for that STA.

**9.41.2a TWT acknowledgement procedure**

A TWT peer STA shall transmit a STACK frame in response to a frame received from a TWT STA which has the value NORMAL\_RESPONSE in the RXVECTOR parameter RESPONSE\_INDICATION and that is not an AMPDU or a VHT single MPDU. A TWT peer STA shall transmit a TACK frame in response to a frame received from a TWT STA which has the value NORMAL\_RESPONSE in the RXVECTOR parameter RESPONSE\_INDICATION and that is a VHT single MPDU unless the VHT single MPDU contains a BAR frame, in which case, the response frame is a BAT frame. A TWT peer STA shall transmit a BAT frame in response to a frame received from a TWT STA which has the value NORMAL\_RESPONSE in the RXVECTOR parameter RESPONSE\_INDICATION and that is an AMPDU.

A TWT STA shall transmit a STACK frame in response to a frame received from a TWT peer STA which has the value NORMAL\_RESPONSE in the RXVECTOR parameter RESPONSE\_INDICATION and that is not an AMPDU or a VHT single MPDU. A TWT STA shall transmit a TACK frame in response to a frame received from a TWT peer STA which has the value NORMAL\_RESPONSE in the RXVECTOR parameter RESPONSE\_INDICATION and that is a VHT single MPDU unless the VHT single MPDU contains a BAR frame, in which case, the response frame is a BAT frame. A TWT STA shall transmit a BAT frame in response to a frame received from a TWT peer STA which has the value NORMAL\_RESPONSE in the RXVECTOR parameter RESPONSE\_INDICATION and that is an AMPDU.

If a TWT peer STA or a TWT STA receives a frame within a TWT SP and that has a value other than NORMAL\_RESPONSE in the RXVECTOR parameter RESPONSE\_INDICATION, the appropriate response is as determined in other subclauses.

**9.41.2 Explicit TWT operation**

During an Explicit TWT SP, if a TWT peer STA receives a frame from a TWT STA that permits a BAT, TACK or STACK to be sent in response the TWT peer STA shall respond with a frame that includes a Next TWT Info field if it has not already transmitted a Next TWT Info field to the STA within this TWT SP. If the TWT peer STA has already transmitted a Next TWT Info field to the STA within this TWT SP, the TWT peer STA may respond to the STA with a frame that contains a Next TWT Info field. When present in the response frame, the Next TWT Info field shall contain the value of the TSF timer corresponding to the next scheduled TWT SP for the STA that is the intended recipient of the frame.

A TWT STA awake for an Explicit TWT SP shall not transition to doze state until after it has received a Next TWT Info field from the TWT peer STA and has been in the awake state for at least Nominal Minimum TWT Wake Duration time from the TWT SP start time as identified by the TWT peer STA or has received an EOSP field with a value of 1. If more than one Next TWT Info field is received from the TWT peer STA during a TWT SP, the STA shall discard all but the most recently received value. If no Next TWT Info field is received from the TWT peer STA during the TWT SP, then following the end of the TWT SP when not otherwise prohibited from transmitting, the STA may transmit a frame that is addressed to the TWT peer STA as a means to solicit a response frame that contains a Next TWT value. Examples of frames that will solicit a Next TWT Info field include:

* a TWT Information frame with the Next TWT Request subfield set to 1 and the TWT ID subfield set to the TWT Identifier corresponding to the TWT agreement for which a Next TWT value is requested and with the Next TWT Size subfield set to 0
* a VHT-single MPDU containing a QOS NULL with QOS Control field bit 7 equal to 1, the MSbit of the TID subfield set to 0 and the 3 LSbits of the TID subfield set to the TWT Identifier corresponding to the TWT agreement for which a Next TWT value is requested, soliciting a TACK response
* a QoS Null frame with QOS Control field bit 7 equal to 1, the MSbit of the TID subfield set to 0 and the 3 LSbits of the TID subfield set to the TWT Identifier corresponding to the TWT agreement for which a Next TWT value is requested, soliciting a STACK response

A STA that has transmitted a frame continaing a Next TWT subfield with a value of 0 shall queue for transmission a frame to the same recipient but containing the non-zero Next TWT corresponding to the TWT Identifier indicated in the frame with a value of 0 in the Next TWT subfield.

If a TWT STA has transmitted a frame soliciting a response that contains a Next TWT value and the STA is in a Power Save mode, the STA shall remain in the awake state following the transmission until it receives a response from the TWT peer STA that contains a Next TWT value. The TWT peer STA shall assume that the TWT STA is in the doze state if the TWT STA is in a Power Save mode, the TWT SP has ended and the TWT peer STA has not received a frame from the TWT STA that solicits a response that contains a Next TWT value. If a TWT peer STA receives a TWT Information frame from a TWT STA with the Next TWT Request subfield equal to 1, then the TWT peer STA shall perform one of the following actions:

* transmit a STACK frame that contains a non-zero Next TWT value corresponding to the TWT Identifier of the received TWT Information frame
* transmit a TACK frame and queue for transmission a TWT Information frame that contains a non-zero Next TWT value corresponding to the TWT Identifier of the received TWT Information frame

In either case, the TWT peer STA shall assume that the TWT STA is in the awake state until the TWT peer STA has transmitted the frame containing the non-zero Next TWT value.

A TWT peer STA may include a non-zero Next TWT value in any TACK or STACK or BAT frame that is transmitted as a response to a TWT STA.

The initial TWT SP start time is contained in the TWT field of the element.

An AP TWT initiation frame indicates the start time for a series of TWT SPs corresponding to a single TWT Identifier if the Implicit bit of the TWT element in the frame is equal to 1. The start time of the series indicates the beginning time of the first TWT SP in the series. Subsequent TWT SPs start times are determined by adding the value of TWT Wake Interval to the current TWT SP start time.

**9.41.3 Implicit TWT operation**

The TWT values for an Implicit TWT are periodic. A TWT STA operating in with an Implicit TWT agreement shall determine the next TWT SP start time by adding the value of TWT Wake Interval associated with this TWT agreement to the value of the start time of the current TWT SP.

A TWT STA awake for an Implicit TWT SP may transition to the doze state after Adjusted Minimum TWT Wake Duration time has elapsed from the TWT SP start time as identified by the TWT STA.

A TWT peer STA that receives a frame from a TWT STA with which it has established an Implicit TWT agreement may respond to the STA with a frame that contains a Next TWT Info field (e.g. BAT, TACK, STACK). A TWT STA that is awake for an Implicit TWT SP and receives a frame with a Next TWT Info field from its TWT peer STA shall use the received Next TWT Info field value as the start of the next TWT, instead of the TWT value calculated by adding the value of Wake Interval associated with the TWT SP to the current TWT. Subsequent TWT start times associated with the same TWT agreement are calculated based on the next TWT that was sent by the TWT peer STA.

***NOTE: Changes to subclause 9.41.4 TWT Grouping are addressed by a different proposed comment resolution document.***

**9.41.5 NDP Paging Setup**

This section defines a protocol for power saving at a STA by using the TWT protocol to setup scheduled wakeup intervals and by defining an efficient signalling for the presence of BUs and synchronization.

For the purpose of this clause, a frame including a TWT element with NDP Paging field present is referred to as NDP Paging Request or NDP Paging Response as clarified later. A STA sending an NDP Paging Request is referred to as NDP Paging Requester. A STA sending a NDP Paging Response in a response to an NDP Paging Request is referred to as NDP Paging Responder.

A STA can request an NDP Paging TWT by sending an NDP Paging Request as described in this clause.

The setup procedure follows the protocol described in 9.41.1 (TWT overview), unless otherwise described in this subclause.

A non-AP STA sending an NDP Paging Request to a NDP Paging Responder STA, shall set the P-ID field to one of the partial AIDs assigned to the non-AP STA (see 9.17b).

An AP sending an NDP Paging Request to a NDP Paging Responder should set the P-ID field of the NDP Paging Request to the Partial BSSID.

Upon receiving an NDP Paging Request, the recipient STA shall respond with an NDP Paging Response with an NDP Paging Field defined as follows:

—The P-ID should be set to the same value as the P-ID field in the NDP Paging Request.

—The Max NDP Paging period field shall be set to any value that is less than or equal to the Max NDP Paging period in the NDP Paging Request.

—The Action field shall be set to one of the values in Table 8-191c (Action field).

—The Partial TSF Offset field and Min Sleep Duration field are reserved.

The NDP Paging setup is successful if the TWT Command Reply field of NDP Paging Response TWT element is set to 4 (Accept TWT), otherwise the setup is considered as failed.

A STA which has sent an NDP Paging Response frame with the TWT Command Reply field set to 4 (Accept TWT) shall schedule an NDP Paging frame as the first frame for transmission at the TWTs indicated by the NDP Paging Response, if any of the following conditions is satisfied:

—There are BUs for the Requesting STA

—No NDP Paging frame was sent in the N consecutive preceding TWT(s), where N is equal to the value of the Max NDP Paging Period field in the NDP Paging Response.

The AP shall schedule an NDP Paging frame if there are critical updates to the (Short) Beacon as defined in clause 10.46.1 (System information update procedure) and 10.2.2.17 (TIM Broadcast). An AP may additionally send an NDP Paging frame as the first frame for transmission at any of the TWT times indicated by the NDP Paging Response.

If any frame is sent by the AP to an NDP Paging Requester during its indicated TWT duration then the first frame sent shall be an NDP Paging frame with Direction field set to 1.

If any frame is sent by a non-AP STA to an NDP Paging Requesters during its indicated TWT duration then the first frame sent shall be an NDP Paging frame with Direction field set to 0.

The P-ID field of the NDP Paging frame shall be set to the same value as P-ID field in the NDP Paging Response if and only if there are BUs for the STA identified by the Partial AID indicated in the P-ID field of the NDP Paging Request. The value of the P-ID field shall be set to 0 to indicate the presence of group addressed BUs.

If the Direction field ofin the NDP Paging frame is set to 1, the APDI field of the NDP Paging frame shall be set as follows:

—The PTSF field is set to TSF[Partial TSF Offset+4: Partial TSF Offset+11] (inclusive), where TSF is the 8 bytes value of the TSF and Partial TSF Offset is the value of the Partial TSF Offset field in the NDP Paging Request.

—The Check Beacon field is initialized to 0 and incremented after each critical update to the Beacon frame; the value of the Check Beacon field shall be same as the LSB of the Check Beacon field in the most recent TIM Broadcast frame, if any was sent before the NDP Paging frame.

If the Direction field ofin the NDP Paging frame is set to 0, the PAID field of NDP Paging frame indicates the Partial AID of the STA transmitting the NDP Paging frame.

If no NDP Paging frame is received during the TWT, the TWT requester STA may transition to Doze state at the end of the Minimum Awake Duration for the TWT. If an NDP Paging frame is received, the TWT requester STA may transition to Doze state immediately after receiving the NDP Paging frame, unless Min Sleep Duration was set to 0 and Action field set to 1 in the NDP Paging Response frame that successfully completed the NDP Paging setup, in which the STA shall be in Active mode.

Upon reception of a NDP Paging frame with the P-ID field matching the value of the P-ID field in the NDP Paging Response, the NDP Paging Requester STA shall behave as follows:

—If the Action subfield of the NDP Paging Response is 0: If the NDP Paging Requester STA is a non-AP STA, it shall send a (NDP) PS-Poll or uplink trigger frame addressed to the NDP Paging Responder. If the NDP Paging Requester STA is an AP, it shall send an NDP CTS to self with the duration field set to zero.

—If the Action subfield of the NDP Paging Response is 1, the STA shall be in the Active state starting at a time indicated by the Min Sleep Duration field after the end of reception of the NDP Paging frame.

—If the Action subfield of the NDP Paging Response is 2, the STA shall be in the Awake state at the first TBTT that occurs after a time indicated by the Min Sleep Duration field in the NDP Paging Response after the end of reception of the NDP Paging frame to receive the (Short) Beacon.

—If the Action subfield of the NDP Paging Response is 3, the STA shall be in the Awake state at the first DTIM that happens after a time indicated by the Min Sleep Duration field in the NDP Paging Response after the end of reception of the NDP Paging frame to receive the DTIM Beacon.

If the NDP Paging Requester is an AP, values 2-7 (inclusive) of the Action subfield are reserved.

A non-AP STA which has setup NDP Paging shall wake at the next TSBTT to attempt to receive the next expected Beacon or Short Beacon frame if it receives an NDP Paging frame with Direction field set to 1 and the Check Beacon field value different from the most recently received value.

**9.41.6 TWT Sleep Setup**

A Responder PM Mode bit in the Control field of the TWT response set to 1 indicates that the Responder STA may be in Doze state outside the indicated TWT SP.

**9.41.7 TWT Teardown**

Either STA that is a party to an established TWT agreement may delete the TWT agreement by successfully transmitting a TWT Teardown frame. The TWT Flow Identifier field of the TWT Teardown frame shall be set to the value of the TWT Flow Identifier field of the TWT element of the frame that successfully concluded the setup of the TWT agreement that is the subject of the teardown request.

When a TWT Teardown frame is successfully transmitted or received, the TWT agreement corresponding to the TWT Flow Identifier field, TWT STA MAC address and TWT peer STA MAC address of the TWT Teardown frame shall be deleted.

***TGah editor: modify the first paragraph of 10.1.2 TSF for infrastructure networks as shown:***

**10.1.2 TSF for infrastructure networks**

***Change the 1st and 2nd paragraphs of the subclause as follows:***

In an infrastructure BSS or in a PBSS, the AP in the infrastructure BSS or the PCP in the PBSS shall be the timing master for the TSF. A STA that is the AP or the PCP shall initialize its TSF timer independently of any simultaneously started APs or PCPs, respectively in an effort to minimize the synchronization of the TSF timers of multiple APs or PCPs. In a non-DMG BSS, the AP that is not an S1G AP with dot11ShortBeaconOptionImplemented equal to true shall periodically transmit special frames called Beacon frames. An S1G AP with dot11ShortBeaconOptionImplemented equal to true shall periodically transmit Short Beacon frames as described in 10.1.3.10.1 (General). In a DMG BSS, the PCP/AP shall periodically transmit special frames called DMG Beacon and Announce frames, which provide a similar function to the Beacon frame in a non-DMG BSS. (Short) Beacon, DMG Beacon, and Announce frames contain the value of the PCP's or AP's TSF timer in order to synchronize the TSF timers of other STAs in a BSS. A receiving STA shall accept the timing information in (Short) Beacon, DMG Beacon, and Announce frames sent from the AP or PCP servicing its BSS. An S1G STA that receives a Short Beacon shall update its TSF timer according to the algorithm described in 10.1.3.10.3 (TSF timer accuracy with Short Beacon). If a STA's TSF timer is different from the timestamp in the received (Short) Beacon, DMG Beacon, or Announce frame, the receiving STA shall set its local TSF timer to the received timestamp value. A STA that receives a frame from its AP containing a Tetrapartial Timestamp or a Pentapartial Timestamp may update the portion of its local TSF that corresponds to the received timestamp information by replacing those bits of its local TSF counter.

***TGah editor: add a new MIB variable to C.3 MIB Detail as shown:***

**C.3 MIB Detail**

dot11TWTOptionActivated OBJECT-TYPE

SYNTAX TruthValue

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"This is a control variable.

It is written by an external management entity.

Changes take effect as soon as practical in the implementation.

This attribute, when true, indicates that the station capability for the Target Wake Time function is enabled. A value of false indicates that the station has no capability for the Target Wake Time function, or that the capability is present, but disabled.

."

::= { dot11S1GEntry <ANA> }

**References:**