IEEE P802.11 Wireless LANs

|  |
| --- |
| **LB 266 Resolution for Some CIDs in 35.9** |
| Date: Sept 07, 2022 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Chunyu Hu | Meta |  |  | chunyuhu07@gmail.com |
| Kumail Kaider |  |  |  |
| Binita Gupta |  |  |  |
| Chitto Ghosh |  |  |  |
| Morteza Mehrnoush |  |  |  |
|  |  |  |  |  |

 Abstract

This submission proposes resolutions for following 66 CIDs received for TGbe LB266:

~~12751, 12752, 13443, 10697, 13030, 13031, 13313, 13739, 13839, 10699, 10469, 10471, 10688, 11783, 12464, 12465,~~

~~11160~~, 13236, ~~13637~~,

10872, ~~13016~~, 13060

~~10684~~, ~~10685~~, 13238, 10466

10694, 10731, 10860, 12076, 13830;

~~10689, 13838, 13446,~~ 10931, 11244;;

~~11705, 13034, 13035, 13831;;~~

~~10874, 11782, 12692, 12748, 12749~~

12750,

12767, 10989

13646, 10435, 10048, 11650, 13091, 13305, 12424, 12443, 12444, 12527, 13032, 11164, 13237, 12526, 12724, 13054, 11157, 13642

(note: \_\_\_\_\_\_\_\_\_\_\_\_\_\_ total = 64 (16 / 10 / 18 / 2 / 18) )

13236, 10872, 13060, 13238, 10466,

10694, 10731, 10860, 12076, 13830;

10931; 11244, 12750, 12767, 10989,

13646, 10435, 10048, 11650, 13091, 13305, 12424, 12443, 12444, 12527, 13032, 11164, 13237, 12526, 12724, 13054, 11157, 13642

(highlighted in green) this r3/r4 doc)

# Revisions:

* Rev 0: Initial version of the document.
* Rev 1: remove CIDs 10063, 13086 to other doc. Excluded 10697. Revised resolutions for some CIDs (10931, 10872, 13446, 13646 etc.). Added four CIDs: 12724, 13054, 11157, 13642.
* Rev 2: deferred CIDs per request in meeting.
* Rev 3: move 11244 out of deferred one. Added two CIDs (12748, 12749) but still deferred.
* Rev 4: update of some resolution.

***TGbe editor: The baseline for this document is 11be D2.1.1, P802.11REVme\_D1.3 and P802.11ax D8.0***

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 TGbe Draft. This introduction is not part of the adopted material.

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

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

# 16 CIDs related to trigger-enabled

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 12751 | Patric Nezou | 35.9.4 | 512.07 | A medium access mechanism during the TWT service period is not specified. The AP has to control the medium access of STAs and sollicits them thanks to trigger frames to potimize the bandwidth usage during the SP. | Force using triggered communication by setting the Trigger bit to 1 during the rTWT negotitation process. | **Revised**. Agree in principle. Add the rule that R-TWT uses trigger-enabled TWT.**TGbe editor: please revise the text as indicated in this doc 11-22/1470r4 tagged by #12751.** |
| 12752 | Patrice Nezou | 35.9.4 | 512.07 | A medium access mechanism during the TWT service period is not specified. The AP has to control the medium access of STAs and sollicits them thanks to trigger frames to potimize the bandwidth usage during the SP. | Force using triggered communication by setting the Trigger bit to 1 during the rTWT negotitation process. | **Revised**. Agree in principle. Add the rule that R-TWT uses trigger-enabled TWT.**TGbe editor: please revise the text as indicated in this doc 11-22/1470r4 tagged by #12751.** |
| 13443 | Liwen Chu | 35.9.2.2 | 511.19 | per this paragraph and the aditional rules in the suclause. A r-TWT can be non triggre-enabled broadcast TWT. However non-trigger-enabled r-TWT can't guarantee the transmission of low latency traffic before the other traffic. | fix the issue mentioned in the comment | **Revised.** Agree in principal that the trigger-enabled TWT is more effective in serving R-TWT’s functionality. Add the rule that R-TWT uses trigger-enabled TWT.**TGbe editor: please revise the text as indicated in this doc 11-22/1470r4 tagged by #12751.** |
| ~~10697~~ | ~~Liangxiao Xin~~ | ~~35.9.4~~ | ~~512.07~~ | ~~Should give higher priority of member STAs and scheduling AP to gain the channel access during R-TWT SP compared with OBSS STAs.~~ | ~~A backoff procedure with higher priority needs to be added. Commenter will bring a contribution for the resolution of this CID~~ | **~~Rejected.~~**~~Adopting trigger-enabled TWT for R-TWT is a more effective way to reduce contention among member STAs and coordinate/prioritize the intra-BSS traffic. Counting on a modified boff procedure to combat the OBSS traffic is not realistic as the OBSS traffic might be also of an R-TWT schedule in that BSS.~~ |
| 13030 | Chunyu Hu | 35.9.4 | 512.07 | The effectiveness of r-TWT also relies on other STAs contending medium access on the same channel. Consider additional measures to make it more effective. | See comment. | **Revised**.**TGbe editor: please revise the text as indicated in this doc 11-22/1470r4 tagged by #12751.** |
| 13031 | Chunyu Hu | 35.9.4 | 512.07 | Should we limit the r-TWT SP to be trigger-enabled SP, or favor this type? Contention/EDCA within the SP would waste airtime and add delay. | See comment. | **Revised**. Agree in principle. Add the rule that R-TWT uses trigger-enabled TWT.**TGbe editor: please revise the text as indicated in this doc 11-22/1470r4 tagged by #12751.** |
| 13313 | Muhammad Kumail Haider | 35.9 | 510.50 | R-TWT SP is better served when AP does the scheduling, as contention between member STAs will increase probability of collisions, reduce MU opportunities and decrease efficacy. Consider trigger-enabled as the main operation mode for r-TWT. | as in comment | **Revised**. Agree in principle. Add the rule that R-TWT uses trigger-enabled TWT.**TGbe editor: please revise the text as indicated in this doc 11-22/1470r4 tagged by #12751.** |
| 13739 | Yunbo Li | 35.9.4 | 512.07 | The channel access rules for the ACs that rTWT TID belongs to, as well as the Acs that rTWT TID doesn't belongs to are missing. | Please add corresponding rules | **Revised.**The comment didn’t point out the specific issue. Assuming the comment is about increasing the chance of obtaining the medium access during the R-TWT SPs, the proposed solution of using trigger-enabled SP for R-TWT would address it.**TGbe editor: please revise the text as indicated in this doc 11-22/1470r4 tagged by #12751.** |
| 13839 | Sanghyun Kim | 35.9.4.1 | 512.12 | It would be good to provide the rules for deffering the Tx initiation of the STAs that are not members of an r-TWT SP during the r-TWT SP. | As in comment. | **Revised**. Add the rule that R-TWT uses trigger-enabled TWT.**TGbe editor: please revise the text as indicated in this doc 11-22/1470r4 tagged by #12751.** |
| 10699 | Liangxiao Xin | 35.9.4.1 | 512.12 | Mulitple member STAs will contend the channel during first few TUs of a R-TWT SP, which cause the high probability of collision | need a mechanism to avoid the collision. Commenter will bring a contribution for the resolution of this CID | **Revised.**Agree the issue pointed out by the comment and add the rule that R-TWT uses trigger-enabled TWT.**TGbe editor: please revise the text as indicated in this doc 11-22/1470r4 tagged by #12751.** |
| 10469 | Yonggang Fang | 35.9.5 | 512.44 | The spec supports up to 15 TIDs (or UPs), but it only allows 4 access categories of EDCA. When two or more TIDs use same AC in an EDCA based SP, the latency senstive TID may not have higher prioirty access. Please clarify how to make latency sensitive traffic as higher prioirty in EDCA based rTWT SP. | please clarify in the spec | **Revised.**Agree the issue pointed out by the comment and add the rule that R-TWT uses trigger-enabled TWT.**TGbe editor: please revise the text as indicated in this doc 11-22/1470r4 tagged by #12751.** |
| 10471 | Yonggang Fang | 35.9.5 | 0.00 | R-TWT should be able to support any QoS traffic with a TID in a r-TWT SP. The rules of traffic delivery for non-trigger-enabled r-TWT SP is missing. | Please define the rules of traffic delivery for non-trigger-enabled r-TWT SP. | **Revised.**The rule defined in 35.9.5, e.g. “shall ensure QoS Data frames of R-TWT TID(s) to be first delivered during the R-TWT SPs” applies regardless the R-TWT SP is trigger-enabled or not.In addition, the proposed resolution as tagged by #12751 requires the R-TWT uses trigger-enabled TWT.**TGbe editor: please revise the text as indicated in this doc 11-22/1470r4 tagged by #12751.** |
| 10688 | Liangxiao Xin | 35.9.5 | 512.47 | How does an R-TWT scheudling AP prioritize the transmission of R-TWT DL TIDs? The TIDs are classified by UPs and stilll use different EDCAFs to transmit during R-TWT SPs. | add a mechanism to define how the AP prioritizing the transmission of R-TWT DL TIDs | **Revised**Added the rule that R-TWT uses trigger-enabled TWT, that is, the medium access is trigger based as specified in the baseline.**TGbe editor: please revise the text as indicated in this doc 11-22/1470r4 tagged by #12751.** |
| 11783 | Osama Aboulmagd | 35.9.5 | 35.9.5 | It is not clear how the STA who are members of r-TWT compete for the medium during an r-TWT SP. Do they use EDCA? Or are they scheduled in some way? | Add how STA access the medium during the r-TWT SP | **Revised**Added the rule that R-TWT uses trigger-enabled TWT, that is, the medium access is trigger based as specified in the baseline.**TGbe editor: please revise the text as indicated in this doc 11-22/1470r4 tagged by #12751.** |
| 12464 | Daniel Verenzuela | 35.9.5 | 512.49 | For triggered enabled r-TWT SP there is a specific instruction to first trigger member EHT STAs. For the of a r-TWT SP operating with EDCA, there should be a similar instruction. | Add a mechanism, for r-TWT SPs where EDCA is enabled, to allow member EHT STAs to have a prioritize channel access. The commenter is willing to participate in resolution. | **Revised**Added the rule that R-TWT uses trigger-enabled TWT, where the medium access is trigger based as specified in the baseline.**TGbe editor: please revise the text as indicated in this doc 11-22/1470r4 tagged by #12751.** |
| 12465 | Daniel Verenzuela | 35.9.5 | 512.47 | For r-TWT SPs where EDCA is enabled, if there is more than one member EHT STA, collisions may occur at the r-TWT start. It would be good to have a mechanism where member EHT STAs do not access the channel at the exact same time. | Define a mechanism where r-TWT member EHT STAs in a EDCA enabled r-TWT do not perform channel access at the same time to avoid collisions at the start of the r-TWT SP. The commenter is willing to participate in resolution. | **Revised.**Agree the issue pointed out by the comment and add the rule that R-TWT uses trigger-enabled TWT.**TGbe editor: please revise the text as indicated in this doc 11-22/1470r4 tagged by #12751.** |

**Discussion**:

R-TWT SPs, following the TWT baseline, can be trigger-enabled or not trigger-enabled. In trigger-enabled SPs, the contention among the member STAs (both AP and non-AP STAs as members of the SP) can be reduced by AP’s scheduling UL transmissions. It avoids the waste of airtime and increases the effectiveness of the utilization of TWT SPs. This benefit is critical for R-TWT as it also reduces latency almost surely, even in the case where is only one pair of STAs as members (AP and one non-AP STA).

In addition, the AP as representative of medium contender for all member STAs, and as the center of intra-BSS traffic, may gain medium access and protect the SP more effectively.

Overall, we believe trigger-enabled SP is preferable for R-TWT. Otherwise, defining additional rules for EDCA access for member/non-member STAs add more complexity and incurs more potential fairness issues.

As such, we recommend to adopt the rule that R-TWT uses trigger-enabled type.

The proposed solution follows the baseline for introduced text.

Baseline definition for trigger-enabled TWT:

For individual TWT, see P802.11axD8.0 P414L57 --

“*A successful TWT agreement whose Trigger subfield in the TWT response sent by the AP is 1 is*

*a trigger-enabled TWT; otherwise it is not a trigger-enabled TWT.*”

For broadcast TWT, see P802.11axD8.0 P421L42 –

“*The TWT scheduling AP shall set the Trigger field to 1 to indicate a trigger-enabled TWT. Otherwise, it*

*shall set the Trigger field to 0 (i.e., the TWT is not a trigger-enabled TWT).”*

## 35.9.2.2 The setup procedure [for #12751]

***TGbe editor: Please insert the paragraph below after the paragraph (When included in an individually addressed TWT Setup frame …):***

(#12751)An R-TWT scheduling AP should set the Trigger field to 1 in the Restricted TWT Parameter Set field(s) it transmits.

When included in an individually addressed TWT Setup frame transmitted by an R-TWT scheduling AP or R-TWT scheduled STA, the Restricted TWT Traffic Info Present subfield of the Broadcast TWT Info field (#12336)included in a Restricted TWT Parameter Set field shall be set to 1.

# 3 CIDs in 35.9

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 11160 | Boon Loong Ng | 35.9 | 510.51 | In an MLD, if a link becomes unavailable (for example, through link muting for power saving) and if that link had r-TWT schedule established, another link should be used for the latency-sensitive traffic delivery. There needs to a procedure to seemlessly retrieve the corresponding latency-sensitive traffic from the other link. | As in comment. | **Rejected** – disagree with the problem described for reasons below:First, on a link where a member non-AP STA is in power saving but has setup a TWT or R-TWT schedule, it will still follow the rule in baseline (P802.11axD8.0 26.8.5) to transmit their frames.Second, if there is a reason that a link becomes unavailable/disabled, the traffic delivery is still supported over other links using the common rule including the delivery of latency sensitive traffic. |
| 13236 | Binita Gupta | 35.9 | 510.51 | Modify text in 35.9 to describe rTWT behavior for Multi-link/MLD devices. E.g. does a STA affiliated with an MLD set the Restricted TWT Support subfield in transmitted EHT Capabilities elements to 1 independently of other STAs affiliated with that MLD? Describe that rTWT SPs are applicable for the link over which the rTWT SP was setup. Clarify if the broadcast TWT IDs for rTWT are maintained at the MLD level or link level. | As in comment. | **Rejected**TWT (and thus R-TWT) are per link operation per baseline. Similarly, following the baseline, broadcast TWT are identified by the AP’s MAC address and the broadcast TWT ID over that link. The EHT MAC Capabilities subfields are set per instance/link, unless there is exception which would need to be pointed out explicitly. So overall, no additional clarification is needed. |
| 13637 | Rubayet Shafin | 35.9 | 510.51 | Traffic delay can be defined as the duration between the time when a packet arrives at the AP/non-AP STA and time when it is successfully transmitted by the AP/non-AP STA. This delay is determined based on queuing delays at the AP/non-AP STA, contention time, delay from deferring to other STAs and number of retransmissions (e.g., due to collisions on the wireless channel). Knowledge of traffic delay as well as its components can be very important for managing TWT SP parameters for latency-sensitive traffic. Due to the lack of traffic delay information at the TWT Requesting STA-side or rTWT scheduled STA side, the TWT Requesting STA or rTWT scheduled STA cannot set appropriate parameters for TWT operation resulting in large latency due to delayed start of TWT SP. Currently, there is no provision that allows the request and exchange of traffic delay information between the AP-STA and non-AP STA for this delay offset alignment. This may cause serious issue for latency sensitive applications. | The spec needs to define some procedure/mechanism for enabling request and exchange of traffic delay information between the AP-STA and non-AP STA, and between AP MLD and non-AP MLD. | **Rejected**The raised comment is already addressed in the baseline. Subclauses 11.8.7 (Requesting and reporting of measurements) and 9.4.2.20.11 and 9.4.2.20.21.11 defined procedure to report the traffic stats that include, e.g. {avg queueing delay, avg tx delay …}. The avg queueing delay + avg tx delay is the ‘traffic delay’ mentioned. And there are also many other stats one can leverage. Pls refer to the baseline. |

# 3 CIDs in 35.9.1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 10872 | Yousi Lin | 35.9.1 | 511.06 | EHT STAs that support r-TWT operation may not need to follow all the rules as defined in Broadcast TWT operation. Because the motivation of r-TWT and b-TWT is totally different. For example, b-TWT STA should not transmit outside the b-TWT SP but such rule is not reasonable for an r-TWT scheduled STA since r-TWT scheduled STAs need to transmit non-low latency traffic outside the r-TWT SP. | may need to point out some exceptions of b-TWT rules that are not suitable for r-TWT. | **Rejected**Clarified with the commenter that the baseline already support the desired flexibility (P802.11REVme\_D1.3, P4220). |
| 13016 | Chunyu Hu | 35.9.1 | 510.60 | The paragraph can be made conciser without losing clarity by merging the two sentences to improve readability. | As in comment | **Revised**Agree in principle. Revised following a few examples in baseline e.g. P802.11axD8.0 P436L62, P413L5.**TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #13016.** |
| 13060 | Chittabrata Ghosh | 35.9.1 | 510.55 | "Restricted TWT operation described in this subclause enables the BSS to use enhanced medium access protection and resource reservation mechanisms for delivery of latency sensitive traffic." - it does not enable the BSS, but the STAs in the BSS | Please rephrase the sentence as ""Restricted TWT operation described in this subclause enables the STAs in the BSS to use enhanced medium access protection and resource reservation mechanisms for delivery of latency sensitive traffic" | **Revised****TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #13060.** |

## 35.9.1 General [for #13060,#13016]

***TGbe editor: please modify the first two paragraphs as follows (note the baseline is D2.1.1 and doc 11-22/1280r4):***

Restricted TWT operation described in this subclause enables (#13060)the STAs in the BSS to use enhanced medium access protection and resource reservation mechanisms for delivery of latency sensitive traffic.

~~An EHT STA that supports R-TWT operation has dot11RestrictedTWTOptionImplemented set to true, otherwise, the EHT STA has dot11RestrictedTWTOptionImplemented set to false. An EHT STA with dot11RestrictedTWTOptionImplemented equal to true shall set the Restricted TWT Support subfield in the transmitted EHT Capabilities elements(#12689) to 1(#13017) and shall set the Broadcast TWT Support subfield in transmitted HE Capabilities element to 1; otherwise, the EHT STA shall set the Restricted TWT Support subfield in the transmitted EHT Capabilities elements(#12689) to 0.~~

(#13016)An EHT STA with dot11RestrictedTWTOptionImplemented equal to true shall set the Restricted TWT Support subfield in its transmitted EHT Capabilities element~~s~~(#12689) to 1 (#13017)and shall set the Broadcast TWT Support subfield in its transmitted HE Capabilities element to 1; otherwise, the EHT STA shall set the Restricted TWT Support subfield in its transmitted EHT Capabilities element~~s~~(#12689) to 0.

# 4 CIDs in 35.9.2.2 and 35.9.3

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 10684 | Liangxiao Xin | 35.9.2.2 | 511.45 | When does a non-AP STA indicate a TID in the R-TWT DL/UL TID Bitmap subfield? Any requirement or restriction besides TID-to-link mapping? The abuse of R-TWT TID should be avioided. | A TID that can be a R-TWT DL/UL TID shall have at least one SCS traffic stream established | **Rejected**The choice of TID(s) to setup a R-TWT membership for doesn’t sit in L2 and likely is made above the MAC/PHY and is out of scope of this draft.The SCS is good to have and is applicable in some scenarios but not all; adding this condition as proposed restricted the flexibility as it’s not always needed or supported. |
| 10685 | Liangxiao Xin | 35.9.2.2 | 511.41 | When does an AP indicate a TID in the R-TWT DL/UL TID Bitmap subfield? Any requirement or restriction besides TID-to-link mapping? The abuse of R-TWT TID should be avioided. | A TID that can be a R-TWT DL/UL TID shall have at least one SCS traffic stream established. | **Rejected**The choice of TID(s) to setup a R-TWT membership for doesn’t sit in L2 and likely is made above the MAC/PHY and is out of scope of this draft. In addition, the non-AP STA may select R-TWT TID(s) based on the application’s knowledge/request.The SCS is good to have and is applicable in some scenarios but not all; adding this condition as proposed restricted the flexibility as it’s not always needed or supported. |
| 13238 | Binita Gupta | 35.9.2.2 | 511.41 | Need to clarify the behavior of AP and STA for this scenario - when TID-to-link mapping is updated for a link where and rTWT SP is setup, what happens to rTWT schedules if one of the rTWT TIDs is no longer mapped to that link? Does STA or AP initiate a new rTWT setup with modified set of rTWT TIDs? | As in comment. | **Revised****TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #13238.** |
| 10466 | Yonggang Fang | 35.9.3 | 511.59 | Please clarify whether r-TWT SP schedule information should be updated through a Beacon when there is change of SP? | Please clarify in the spec | **Rejected**Following the baseline setup procedure, the change of the broadcast/restricted TWT schedule info (suspend/resume/SP duration/interval etc.) can be done via multiple ways: 1) a re-negotiation/setup of the membership; 2) TWT Information frame; 3) Broadcast TWT announcements (Table 26-6 in P802.11axD8.0 P424), which can be carried in the Beacon frames.Also please refers to Table 26-7, 9-296a in P802.11axD8.0.R-TWT follows the same rules and there is not additional rules or exceptions in this regard as of now, nor do I see any issue/reason to do so. |

## 35.9.2.2 The setup procedure

***TGbe editor: please modify the last paragraph (The TID(s) that are specified …) and insert a new paragraph afterwards as follows:***

(#12401)The TID(s) that are specified in the Restricted TWT Traffic Info field of the TWT element (as described in 9.4.2.199 (TWT element)) in a TWT Response frame that indicates Accept TWT are referred to as R-TWT DL TID(s) or R-TWT UL TID(s), and collectively as R-TWT TID(s), in (#13238)subsequent text and the following subclauses.

(#13238)When a TID-to-link mapping update results in a mapping where none of the R-TWT TID(s) are mapped onto the link on which the R-TWT membership is set up any more, the corresponding R-TWT membership is considered as torn-down.

# 18 CIDs in 35.9.4.1 and others (related to channel access and txop)

## (Part 1 – 10 CIDs)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 10694 | Liangxiao Xin | 35.9.4.1 | 512.12 | It is low efficient that a R-TWT member STA ends its TXOP before the start time of the R-TWT SP. | A R-TWT member STA can continue its TXOP at the start time of the R-TWT SP if the R-TWT member STA transmits the traffic of R-TWT TIDs during the TXOP after the R-TWT SP starts | **Rejected**When a member STA is allowed to do so, AP won’t be able to utilize the SP efficiently to deliver DL/UL to multiple member STAs when possible. This lowers the efficiency of the R-TWT utilization. Also, it’s recommended not to transmit outside of a TWT SP.In summary, the proposed change would complicate the rule unnecessarily. |
| 10731 | Insun Jang | 35.9.4.1 | 512.12 | Before the upcoming rTWT if a STA as its member is delivering the traffic corresonding to TID neogiated during rTWT setup, it should not end its TXOP. | As in the comment, the exception case should be considered | **Rejected**When a member STA is allowed to do so, AP won’t be able to utilize the SP efficiently to deliver DL/UL to multiple member STAs when possible. This lowers the efficiency of the R-TWT utilization. Also, it’s recommended not to transmit outside of a TWT SP.In summary, the proposed change would complicate the rule unnecessarily. |
| 10860 | Jinsoo Choi | 35.9.4.1 | 512.21 | Would all the non-AP EHT STAs with dot11RestrictedTWTOptionImplemented set to true as a TXOP holder need to stop the TXOP before the start time of any r-TWT SPs? For example, what about the non-AP EHT STAs operating with the TID that is same with what following r-TWT SP uses for delivering latency sensitive traffic? Do those non-AP EHT STAs need to strictly comply the rule even they are also communicating with latency sensitive traffics? This may be related to whether all such latency sensitive traffics have to be delivered only within or by rTWT SP, so we'd better clarifiy and consider a mechanism to handle this. | As in comment | **Rejected**When a member STA is allowed to do so, AP won’t be able to utilize the SP efficiently to deliver DL/UL to multiple member STAs when possible. This lowers the efficiency of the R-TWT utilization. Also, it’s recommended not to transmit outside of a TWT SP.In summary, the proposed change would complicate the rule unnecessarily. |
| 12076 | SunHee Baek | 35.9.4.1 | 512.12 | The TOXP rule for rTWT SP makes STA supported rTWT end its TXOP before the start time of rTWT SP. But if the TXOP holder before rTWT SP is one of the member STAs of the upcoming rTWT SP, this rule makes the data flow restricted before start time of the rTWT SP. | We need an updated TXOP rule for rTWT SPs to cover the case as the comment. | **Rejected**When a member STA is allowed to do so, AP won’t be able to utilize the SP efficiently to deliver DL/UL to multiple member STAs when possible. This lowers the efficiency of the R-TWT utilization. Also, it’s recommended not to transmit outside of a TWT SP.In summary, the proposed change would complicate the rule unnecessarily. |
| 13830 | Yuchen Guo | 35.9.4.1 | 512.13 | if the obtained TXOP of the non-AP EHT STA is used for low latency transmission, the non-AP EHT STA may not end its TXOP | add "unless the upcoming restricted TWT SP is a non-trigger-enabled TWT SP where the non-AP EHT STA is a member, and the TXOP is used for the transmission of QoS Data frames of r-TWT TID(s)" after "associated AP" | **Rejected**When a member STA is allowed to do so, AP won’t be able to utilize the SP efficiently to deliver DL/UL to multiple member STAs when possible. This lowers the efficiency of the R-TWT utilization. Also, it’s recommended not to transmit outside of a TWT SP.In summary, the proposed change would complicate the rule unnecessarily. |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 10689 | Liangxiao Xin | 35.9.5 | 512.47 | How does a R-TWT member STA prioritize the transmission of R-TWT UL TIDs in a non-trigger-enabled R-TWT SP? The TIDs are classified by UPs and stilll use different EDCAFs to transmit during R-TWT SPs. | The R-TWT member STA can use any EDCAF to obtain a TXOP during the R-TWT SP and transmits the frames of R-TWT UL TIDs from any AC during the TXOP | **Revised****TGbe editor: please revise the text as indicated in this doc 11-22/1470r4 tagged by #13446.** |
| 13838 | Sanghyun Kim | 35.9.5 | 512.47 | An r-TWT scheduled STA may have both the low latency traffic and the non-low latency traffic.There are cases where the EDCAF corresponding to the non-low latency traffic becomes the TXOP holder according to the EDCA rules defined in the baseline.-For the case, the TXOP holder (AC corresponds to the non-low latency traffic) shall transmit at least one MPDU following the baseline.Therefore, it is recommended to provide a channel access mechanism to prevent the AC of the non-low latency traffic becomes the primary AC during the r-TWT SP. | Please provide a channel access mechanism preventing the AC(s) of the non-low latency traffic become a TXOP holder during the r-TWT SP. | **Revised**Agree in principle.**TGbe editor: please revise the text as indicated in this doc 11-22/1470r4 tagged by #13838.** |
| 13446 | Liwen Chu | 35.9.4.1 | 512.09 | The TXOP rules are not wnough:1, what happens if the AP has TXOP for non low latency traffic at the beginning of rTWT SP? The acceptable behavior could be either stopping the TXOP at the beginning of r-TWT SP or starting to tranmit the DL low latency traffic (or scuedule the UL low latency traffic transmission) at the remaining TXOP from the start time of r-TWT SP.2, whan happens if the TBTT is in r-TWT SP? The behavior could be 1), disallow such case, 2) schedule the transmision of the Beacon at the TBTT, or 3) schedule the transmision of the Beacon until the low latency traffic is totally service.3, whan happens if the DTBTT is in r-TWT SP?4, what happens if the backoff timer of non low latency traffic becomes 0 before the low latency traffic is fully serviced in AP or r-TWT STA? | fix the issues mentioned in the comment | **Revised**Re. 1, agree in principleRe. 2,3, add text to let AP to decide Beacon tx.Re. 4, add text that the EDCAF for the AC that doesn’t have R-TWT TID(s) mapped into, its backoff counter is suspended during the time when the frames of R-TWT TID(s) haven’t completed.**TGbe editor: please revise the text as indicated in this doc 11-22/1470r4 tagged by #13446.** |
|  |
| 10931 | Thomas Handte | 35.9.4.1 | 512.13 | The 802.11be spec allows a TXOP holder to exceed TXOP duration (see 10.23.2.9 TXOP limits, p1749 of 802.11-2020) under some circumstances. What is the impact to specification of r-TWT? Given a EHT STA that exeeds TXOP duration because of existing rules, is it violating r-TWT operation in case an exceeded TXOP doesn't end before the start time of the r-TWT SP? | Suggest to add at least a Note clarifying this aspect. | **Rejected**For a TXOP, even when extended per 10.23.2.9, its holder is still subject to the rules as specified in 35.9.4.1. Hence, the concerned case is already covered. |
|  |
| 11244 | Peshal Nayak | 35.9.4.1 | 512.12 | An STA that has obtained a TXOP before an r-TWT SP may be affiliated with a MLD that has obtained EPCS authorization. In such a scenario, it may be useful to add an exception rule to allow such an STA to not end its TXOP | Add an exception rule to allow such an STA to not end the TXOP | **Rejected**Disagree with the comment. It’s crucial for STAs to support this rule to make the R-TWT mechanism as effective as possible. EPCS STAs may also, or probably should, set up R-TWT schedule to deliver applicable traffic.  |

## 35.9.5 Traffic delivery [for #13446]

***TGbe editor: Please insert a new paragraph after the last one as follows:***

(#13446)When a TBTT occurs within an R-TWT SP, the R-TWT scheduling AP may either schedule the transmission of the corresponding Beacon frame, or continue the delivery of frames of R-TWT TID(s).

## (Part 2 – 4 CIDs)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 11705 | Abdel Karim Ajami | 35.9.4.1 | 512.57 | Unless the EHT AP is transmitting latency sensitive traffic, should the AP end the TXOP before the start time of a R-TWT SP announced by itself? i.e., if at least one member R-TWT STA has indicated that it will be in the awake state during that R-TWT SP | Please clarify | **Revised**Agree in principle that AP should also respect the SP start time.**TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #11705.** |
| 13034 | Chunyu Hu | 35.9.4.1 | 512.09 | R-TWT scheduled STA needs AP to also respect the r-TWT SP start time. E.g. otherwise, they may have to stay awake wasting power for AP to complete irrelevant frame exchanges. | As in comment | **Revised**Agree in principle that AP should also respect the SP start time.**TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #13034.** |
| 13035 | Chunyu Hu | 35.9.4.1 | 512.09 | When AP is a TXOP holder, and a r-TWT SP is about to start, to respect the r-TWT SP, either the AP should terminate the TXOP before the SP start time, or consider allowing AP to preempt the TXOP and use the remaining time for delivery the traffic of r-TWT TIDs. | As in comment | **Revised**Agree in principle that AP should also respect the SP start time.**TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #11705.** |
| 13831 | Yuchen Guo | 35.9.4.1 | 512.11 | TXOP termination rules should also be applied to the AP, but the r-TWT TIDs can be treated as an exception. | add "An EHT AP with dot11RestrictedTWTOptionImplemented set to true as a TXOP holder shall ensure the TXOP ends before the start time of each r-TWT SP advertised by itself unless the EHT AP transmits DL frames of r-TWT DL TID(s) to the r-TWT member STAs at the beginning of the r-TWT SP" in this subclause | **Revised**Agree in principle that AP should also respect the SP start time.**TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #11705.** |

***TGbe editor: Please revise 35.9.4.1 title and append new paragraphs after the first one as follows:***

## 35.9.4.1 TXOP (#13446)and backoff procedure rules for R-TWT SPs(#11109)

A non-AP EHT STA with dot11RestrictedTWTOptionImplemented set to true as a TXOP holder shall ensure the TXOP ends before the start time of any (#11109)R-TWT SPs advertised by the associated AP. Before starting transmission of any MPDU, a non-AP EHT STA with dot11RestrictedTWTOptionImplemented set to true that is not a TXOP responder and not a member of the upcoming (#13012)(#10893)R-TWT SP shall check if there is enough time for the frame exchange to complete prior to the start of the R-TWT SP and, if there is not enough time then the STA shall defer transmission by selecting a random backoff count using the present CW (without advancing to the next value in the series). The QSRC[AC] for the MSDU or A-MSDU are not affected.

(#11705,13034,13446)An EHT AP with dot11RestrictedTWTOptionImplemented set to true as a TXOP holder shall ensure the TXOP ends before the start time of any R-TWT SP advertised by itself unless the EHT AP starts the frame exchange to transmit DL frames of R-TWT DL TID(s) or to solicit the UL frames of R-TWT UL TID(s) when the R-TWT SP starts.

(#13838,13446)During an R-TWT SP, a member STA may suspend decrementing the backoff counter of any AC that doesn’t have any R-TWT TID(s) mapped to until it has delivered all its frames from R-TWT TID(s), and resume the decrementing afterwards or when the SP is ended.

## (Part 3 – 4 CIDs)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 10874 | Yousi Lin | 35.9.1 | 510.51 | Currently rules are only designed trigger enabled r-TWT. May need to define rules for EDCA based r-TWT. | as in comment | **Revised.**The rules as defined in the latest draft applies to both trigger enabled and non-trigger enabled R-TWT SPs. Here are a few examples: the channel access rule as defined in 35.9.4.1 (TXOP rules for R-TWT SPs); the traffic prioritization rules as define din 35.9.5 requires member STAs (AP and non-AP STA) to first delivery packets of R-TWT TIDs regardless they are using EDCA or trigger-enabled SP chancel access rules.For the second comment, introduced TWT Protection for bTWT (rTWT).**TGbe editor: please revise the text as indicated in this doc 11-22/1470r4 tagged by #10874.** |
| 11782 | Osama Aboulmagd | 35.9.4.1 | 512.14 | If a STA is not an EHT STA it is not expected the STA would end its TXOP before the start time of any r-TWT SP. Need to define the behavior is this case | as in comment. Specify the behavior when legacy STA (802.11ac or 802.11ax) exists | **Revised**Agree in principle. Added text to introduce TWT Protection for broadcast TWT. In addition, note that when there are legacy STA (pre-EHT) exist, the draft provides one optional mechanism (Quiet interval) as specified in 35.9.4.2. **TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #11782.** |
| 12692 | Arik Klein | 35.9.4.1 | 512.16 | It is not clear how the r-TWT SP is not interfered by legacy non-AP STA (i.e. non-AP STA that has dot11RestrictedTWTOptionImplemented set to false) which is not aware to the existence of the r-TWT SPs (and therefore does not defer any transmission when the r-TWT SP begins)? Please clarify this point in the text | As in comment | **Revised**Agree in principle. Added text to introduce TWT Protection for broadcast TWT. In addition, note that when there are legacy STA (pre-EHT) exist, the draft provides one optional mechanism (Quiet interval) as specified in 35.9.4.2. **TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #10874.** |
| 12748 | Patrice Nezou | 35.9.4.2 | 512.25 | An r-TWT scheduling AP may schedule at most one quiet interval that overlaps with a r-TWT SP. Each such quiet interval, referred to as an overlapping quiet interval in this subclause, if scheduled, shall have a duration of 1 TU, and shall start at the same time as the corresponding r-TWT SP.Comment: Usage of quiet element is not sufficient to ensure an accurate starting time of the service period because the support of the quiet element is not mandatory for all STAs. | Additional mechanism is required. | **Revised**Agree in principle. Added TWT protection (NAV protection) for broadcast TWT.**TGbe editor: no further change is needed as the proposed change has been implemented by 11-22/1470 tagged by #10874,11782.** |
| 12749 | Patrice Nezou | 35.9.4.2 | 512.25 | An r-TWT scheduling AP may schedule at most one quiet interval that overlaps with a r-TWT SP. Each such quiet interval, referred to as an overlapping quiet interval in this subclause, if scheduled, shall have a duration of 1 TU, and shall start at the same time as the corresponding r-TWT SP.Comment: It is unfair for legacy STAs to stop their transmission at the beginning of the service period because legacy STAs cannot be registered to transmit low latency traffics during the service period. | A mecanism to address the unfairness should be introduced | **Revised**Agree in principle. Added TWT protection (NAV protection) for broadcast TWT.**TGbe editor: no further change is needed as the proposed change has been implemented by 11-22/1470 tagged by #10874,11782.** |
|  |
| 12750 | Patrice Nezou | 35.9.4.1 | 512.12 | It is unfair for non low latency STAs to stop their transmission during the service period. Some penalties has to be applied for low latency STAs that successfully transmitted low latency data frames during the previous service period. | A method to penalize low latency STAs outside the service period has to be introduced. | **Rejected**Disagree with the comment. Other than the optional usage of Quiet intervals, non low latency STA still can still contend the medium in R-TWT SPs following EDCA/MU-EDCA procedure. In addition, the R-TWT is designed to serve a specific category of differentiated QoS requirement (vs equality / ‘fairness?’). |

**Discussion for CID 11782 etc.**

When there are legacy STA (pre-EHT) present, the draft provides one optional mechanism (Quiet interval) as specified in 35.9.4.2. AP can also leverage any possible means to improve the R-TWT effectiveness, e.g. MU-EDCA and NAV protection. For the latter, define the TWT Protection subfield, which is defined for individual TWT already.

## 9.4.2.199 TWT element [for #10874 …]

***TGbe editor: please modify Figure 9-768—Request Type field format in Broadcast TWT Parameter Set field as follows:***

(11ax)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | B0 | B1 B3 | B4 | B5 | B6 | B7 B9 | B10 B14 | B15 |
|  | TWT Request | TWT SetupCommand | Trigger | Last Broadcast Parameter Set | Flow Type | Broadcast TWT Recommendation | TWT Wake Interval Exponent | (#10874,11782)TWT Protection |
| Bits:  | 1 | 3 | 1 | 1 | 1 | 3 | 5 | 1 |
| **Figure 9-768 –Request Type field format in Broadcast TWT Parameter Set field(11ax)** |

***TGbe editor: please modify the last paragraph in P802.11REVme\_D1.3 P1614L64 as following:***

(#10874,11782)(11ax)A TWT requesting STA or TWT scheduled STA sets the TWT Protection subfield to 1 to request the TWT responding STA or TWT scheduling AP to provide protection of the set of TWT SPs corresponding to the requested TWT flow identifier by

1. Allocating RAW(s) that restrict access to the medium during the TWT SP(s) for the TWTs that are set up within an S1G BSS.
2. Enabling NAV protection during the TWT SP(s) for the TWTs that are set up within an HE BSS.

(11ax)A TWT requesting STA (#10874,11782)or TWT scheduled STA sets the TWT Protection subfield to 0 if TWT protection is not requested for the corresponding TWT(s).

(11ax)A TWT responding STA or TWT scheduling AP sets the TWT Protection subfield to 1 to indicate that the TWT SP(s) corresponding to the TWT flow identifier(s) of the TWT element will be protected by

1. Allocating RAW(s) that restrict access to the medium during the TWT SP(s) for the TWT(s) where the TWT responding STA is an S1G STA.
2. Enabling NAV protection during the TWT SP(s) for the TWTs where the TWT responding STE is an HE STA.

(11ax)A TWT responding STA (#10874,11782)or TWT scheduling AP sets the TWT Protection subfield to 0 to indicate that the TWT SP(s) identified in the TWT element might not be protected.

***TGbe editor: please insert a new subclause to 35.8 as follows:***

## 35.8.3 Broadcast TWT operation(#10874,11782)

(#10874,11782)An TWT scheduling AP or TWT scheduled STA may set the TWT Protection field to 1 to indicate the TWT SPs shall be initiated with a NAV protection mechanism, such as (MU) RTS/CTS or CTS-to-self frame; otherwise, shall set it to 0.

# 2 CIDs in misc places

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 12767 | Romain GUIGNARD | 4.5.6.3 | 60.37 | As the latency and the reliability are not well-defined, the mechanism defined to improve the latency can be used for a large category of traffic that may lead to drop its overall efficiency | Please, define different levels of requirement for the latency and the reliability otherwise we cannot know exactly what is supported and what is characterised as low latency traffic (Low latency is for traffic with a requirement below 1ms or 10ms or 100 ms) | **Rejected**It’s not clear how defining different levels of requirements, as proposed, would help, in particular, in context of R-TWT as mentioned in the subclause – fail to observe any parameters in R-TWT, e.g., have direct relation with specific latency value ranges. |
| 10989 | Yanjun Sun | 9.4.2.199 | 206.60 | It's unclear how to interpret "unlikely". Is the intention that "the AP is not expected to"? Please clarify. | As in comment | **Rejected**“Unlikely” in my interpretation means “AP will not, unless some situations change”, e.g. one existing member STA terminates the membership. It is more relevant to the context IMO. Prefer to keeping the current wording. |

# 18 CIDs related to NSTR/EMLSR/EMLMR MLDs

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 13646 | Rubayet Shafin | 35.9.4 | 512.07 | For the scenario where a restricted TWT schedule is established on a link (say, the first link) between an AP MLD and a non-AP MLD that forms NSTR link pair with another link (say, the second link) between the same AP MLD and the non-AP MLD and the second link also has another restricted TWT schedule established such that the restricted TWT SP on the second link overlaps in time with the restricted TWT SP on the first link, while UL PPDU is being transmitted during the restricted TWT SP on the first link, if DL PPDU is being transmitted on the second link during its restricted TWT SP, then the overlapped portions of UL PPDU and DL PPDU will suffer from interference due to NSTR constraints. This can seriously affect the latency-sensitive applications for the non-AP MLD. | The spec needs to provide mechanisms to handle the NSTR issue when multiple r-TWT schedules are established on both NSTR links of an NSTR link pair. | **Revised****Agree in principle.****TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #13646.** |
| 10435 | Liuming Lu | 35.9.4.1 TXOP rules for r-TWT SPs | 512.12 | If a non-AP MLD is operating in the EMLSR mode and a STA affiliated with the non-AP MLD that is operating on one of the EMLSR links is a member r-TWT scheduled STA that has established membership for the r-TWT SPs with its associated AP affiliated with an AP MLD, the STA cannot listen to its EMLSR link at the start of or during the r-TWT SPs when one of the other STAs operating on the other EMLSR links, which are affiliated with the same non-AP MLD, exchanges frames with one of the other APs affiliated with the AP MLD. This would impact the scheduled transimission of latency sensitive traffic during the r-TWT SPs, especilly for trigger-enabled r-TWT SPs. | Suggest to add a rule:If a non-AP MLD is operating in the EMLSR mode and a STA (STA1) affiliated with the non-AP MLD that is operating on one of the EMLSR links is a member r-TWT scheduled STA that has established membership for the r-TWT SPs with its associated AP, anther STA affiliated with the same non-AP MLD that is operating on one of the other EMLSR links as a TXOP holder shall ensure the TXOP ends the link switch delay before the start time of the corresponding r-TWT SPs for STA1 advertised by its associated AP on the EMLSR link. | **Revised****Agree in principle.****TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #10435.** |
| 10048 | Morteza Mehrnoush | 35.9.4 | 512.07 | For the MLO devices with different operation modes like NSTR, EMLSR, and EMLMR, the spec should define the frame exchange procedure for AP of AP MLD or STA of non-AP MLD operating over one of those links and reach to the r-TWT SP start time over the other link. | Add the procedure for the AP and non-AP MLD as in comment. | **Revised****Agree in principle.****TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #13646 and #10435.** |
| 11650 | Morteza Mehrnoush | 35.9.4 | 512.07 | For the MLO devices with different operation modes like NSTR, EMLSR, and EMLMR, the spec should define the frame exchange procedure for AP of AP MLD or STA of non-AP MLD operating over one of those links which is part of NSTR link pair or EMLSR/EMLSR links and reach to the r-TWT SP start time over the other link. | Add the procedure for the AP and non-AP MLD as in comment. | **Revised****Agree in principle.****TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #13646 and #10435.** |
| 13091 | Chittabrata Ghosh | 35.9.4 | 512.07 | For the MLO devices with different operation modes like NSTR, EMLSR, and EMLMR, the spec should define the frame exchange procedure for AP of AP MLD or STA of non-AP MLD operating over one of those links and reach to the r-TWT SP start time over the other link. | Add the procedure for the AP and non-AP MLD as in comment. | **Revised****Agree in principle.****TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #13646 and #10435.** |
| 13305 | Muhammad Kumail Haider | 35.9.4 | 512.07 | Channel access rules for the cases when an r-TWT scheduled STA is afflliated with an MLD operating in NSTR/EMLSR/EMLMR mode on the link with r-TWT membership established and another link should be considered and necessary provisions made. |  | **Revised****Agree in principle.****TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #13646 and #10435.** |
| 12424 | Yongho Kim | 35.9.4.1 | 512.21 | When rTWT SP includes NSTR rTWT member STAs, NSTR blindness caused by frame exchange on the NSTR link may interrupt timely rTWT SP operation and may increase latency. NSTR non-AP STAs or APs communicating with the NSTR non-AP STAs should end TXOP on the one of the NSTR link pair, before the start of rTWT SP on the other NSTR link of the NSTR link pair. | As in comment | **Revised****Agree in principle.****TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #13646 and #10435.** |
| 12443 | Ryuichi Hirata | 35.9.4.1 | 512.09 | TXOP holder in a first link of EMLMR links should ensure the TXOP ends before the start time of a r-TWT SP in a second link of EMLMR links. | as in the comment | **Revised****Agree in principle.****TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #13646 and #10435.** |
| 12444 | Ryuichi Hirata | 35.9.4.1 | 512.09 | TXOP holder in a first link of NSTR link pair should ensure the TXOP ends before the start time of a r-TWT SP in a second link of NSTR link pair. | as in the comment | **Revised****Agree in principle.****TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #13646 and #10435.** |
| 12527 | Yusuke Tanaka | 35.9.4.1 | 512.09 | The behavior of a NSTR MLD whose affiliated STA has an r-TWT agreement should be defined, otherwise r-TWT SP on a link and TXOP on another link may overlapped and latency sensitive traffic cannot be delivered in the r-TWT. | Please define TXOP setting rule of NSTR MLD that avoid overlapping of r-TWT SP on a link and TXOP on another link. | **Revised****Agree in principle.****TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #13646 and #10435.** |
| 13032 | Chunyu Hu | 35.9.4.1 | 512.09 | Consder the case where a r-TWT member STA is operating in the EMLSR. It has a r-TWT SP coming over one link (link1), the AP initiates a frame exchange with it on link2 such that this STA cannot performs the intended latency sensitive traffic tx/rx. AP MLD should give priority to the pre-setup schedule: either not initiate the frame exchange if no sufficient time to complete before the r-TWT SP start on link1; or to terminate the current TXOP on link2 so it ends transition delay time before the r-TWT SP start time on link1. Same or similar problem exists for EMLMR as well. | Add necessary design and/or procedure. | **Revised****Agree in principle.****TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #13646 and #10435.** |
| 11164 | Boon Loong Ng | 35.9 | 510.51 | r-TWT operation under NSTR constraints needs to be clarified in the spec. | under NSTR contraints, there needs to be some guideline to prioritize r-TWT SP. | **Revised****Agree in principle.****TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #13646 and #10435.** |
| 13237  | Binita Gupta | 35.9 | 510.51 | rTWT schedules can be established on a link which is part of NSTR, eMLSR or eMLMR link pairs for an MLD. How does rTWT operation work together with procedures defined for MLO for NSTR, eMLSR or eMLMR need to be evaluated and any necessary spec changes should be added. | As in comment. | **Revised****Agree in principle.****TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #13646 and #10435.** |
| 12526 | Yusuke Tanaka | 35.9.2.2 | 511.16 | R-TWT set-up procedure considering STR/NSTR MLD shuold be defined. If r-TWT SP is configured by ignoring other links in NSTR MLD, latency sensitive traffic may not be delivered. In addition, by setting SPs that are coordinated with multiple links in STR / NSTR MLD, transmission opportunities can be improved by MLO, and low latency transmission can be performed. | Please define r-TWT set-up procedure considering STR/NSTR MLD. | **Revised****Agree in principle.****TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #13646 and #10435.** |
| 12724 | Pascal VIGER | 35.3.17 | 461.55 | "EMLSR STAs may want to take profit of TWT/rTWT mechanisms, but there is missing specific rules for this operation. | Please provide rules for EMLSR STAs operating TWT, with avoiding IC frame overhead | **Revised****Agree in principle.****TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #13646 and #10435.** |
| 13054 | Chittabrata Ghosh | 35.3.17 | 463.46 | "In ML concept, how do we consider a scenario where a (NSTR or eMLSR) STA on one link approaches a scheduled R-TWT SP start time, while it gains channel access on another linkExample: STA 1 on link 1 has an R-TWT SP start time in 0.5ms, while STA 2 gains channel access on link 2 and starts transmitting dataDoes the STA prioritize Tx on link 2 and disregards waking up at beginning of R-TWT SP in link 1? Similar requirements might be needed for an EHT AP while scheduling an RU/MRU in an TF to an eMLSR or NSTR STA, which is also a member of an forthcoming R-TWT SP" | Please add specific behavior for eMLSR/NSTR STA and AP scheduling to consider the scenario | **Revised****Agree in principle.****TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #13646 and #10435.** |
| 11157 | Boon Loong Ng | 35.3.18 | 466.55 | How TWT/bTWT/rTWT operation will coexist with EMLSR is not clear. | Please provide procedures and rules to enable TWT operation with EMLSR | **Revised****Agree in principle.****TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #13646 and #10435.** |
| 13642 | Rubayet Shafin | 35.9 | 510.51 | According to current specifications, for PPDU transmission on a link that forms an NSTR link pair with other STA(s) affiliated with the same non-AP MLD, the end time of the PPDUs transmitted on those links need to be aligned in order to prevent self-interference at the non-AP MLD side due to NSTR constraints. However, if a restricted TWT schedule is established on a link that is a part of an NSTR link pair and if PPDUs transmitted during restricted TWT service period (SP) need to be aligned, for example through adding extra padding, with PPDU transmitted on other links, then the traffic flow for the low-latency traffic during restricted TWT SP can get severely interrupted. This can disrupt the latency-sensitive applications at the client side. | Please provide text to handle the NSTR constraints as depicted in the comment when an rTWT schedule is established on a link of an NSTR link pair. | **Revised****Agree in principle.****TGbe editor: please make the change indicated in this doc 11-22/1470r4 tagged by #13646 and #10435.** |

**Discussion on R-TWT for EMLSR or NSTR MLD**:

There are many CIDs raising the issue for a R-TWT member non-AP STA when it’s affiliated with a MLD that has links operating in the EMLSR or NSTR mode. The diagrams below illustrate the issue:

|  |  |
| --- | --- |
| Diagram  Description automatically generated | Diagram  Description automatically generated |

In the two scenarios illustrated above, STA1 and STA2 are affiliated with a non-AP MLD and belong to a pair of NSTR links. When the R-TWT SP starts and AP1 transmits the trigger frame to member STAs including STA1, STA1 either cannot receive the trigger frame successfully (case 2), or cannot respond to it as otherwise its transmission will corrupt the reception at STA2 over link 2.

On the other hand, if instead AP1 doesn’t trigger STA1, they may both lose the best opportunity to gain the medium access for their traffic of R-TWT TID(s). Note that the traffic over link2 may not include frames of R-TWT TID(s), either due to traffic availability or scheduling, or due to that the R-TWT TID(s) are not mapped to link2.

For these illustrated scenarios, both AP and non-AP MLDs should prioritize their pre-setup scheduled transmission (R-TWT SPs) (otherwise, there is no point of setting up the schedule). Furthermore, the non-AP MLD needs the AP MLD to facilitate this by that –

1. ***AP2 should end the TXOP that requires STA2 to respond before the start of R-TWT SP start time on link1.***
2. Note – the rule won’t prevent AP2/STA2 to still utilize link2 for any frame transmission subject to the power saving mode and state, and TID-to-Link mapping configuration.

For the EMLSR/EMLMR case, similar issues exist and the same solution applies.

Further discussion:

It was brought up that the non AP MLD that have EMLSR or NSTR links may set up R-TWT on both EMLSR/NSTR links. They may choose either of them (e.g. in EMLSR case) or both of them and conduct synchronous tx (e.g. in NSTR case). But there are a few reasons for that this way cannot be the only way for such a non-AP MLD to set up R-TWT as explained below:

1. The network may not support R-TWT over all links, either from deployment or capability point of view. E.g. AP may only want to launch the service for latency sensitive traffic only one selected link that has most clean channel (e.g. no OBSS; e.g. more R-TWT supporting STAs operating on that link)
2. If due to the constraints of the non-AP STA’s capability or AP’s scheduling, the member STAs only utilizes one of the link; then the effort of other supporting STAs (but not members) to stop their TXOPs to protect the R-TWT SP start time on the other link is wasted. It’s a waste of network resources and would be a poor design.
3. The TID-to-Link mapping can be such that the R-TWT TIDs are not mapped onto the link that the R-TWT schedule wasn’t set up on.

In addition, when the R-TWT schedule is setup only over one of the EMLSR/NSTR links:

1. The non-AP MLD may very legitimately to give priority to the scheduled transmission using the already-setup R-TWT.

Overall, it is imperative to support the non-AP MLD, which sets up a R-TWT schedule over one of the EMLSR/NSTR links, to prioritize the scheduled traffic delivery.

To harmonize the solution, add condition where *the R-TWT schedule for the same member non-AP STAs don’t overlap*.

## 35.9.4.1 TXOP rules for R-TWT SPs(#11109) [for #13646,#10435]

***TGbe editor: Please append the following text in 35.9.4.1 after the last paragraph:***

(#13646,10435)When a non-AP STA, which is affiliated with a non-AP MLD and operates on one of a pair of NSTR or EMLSR or EMLMR links, is a member of a R-TWT SP on the first link; if the second non-AP STA affiliated with the same MLD is not a member of any other R-TWT SPs on the second link that overlap with the first SP, then the second non-AP STA and its associated AP (referred as the second AP), if their respective dot11restrictedtwtoptionimplemented equal to true, should follow the rules below:

* The second AP as a TXOP holder on the second link should ensure its TXOP ends no later than T amount of time before the start time of the R-TWT SP on the first link.
* The second non-AP STA as a TXOP holder on the second link should ensure its TXOP ends no later than T amount of time before the start time of the R-TWT SP on the first link.

Where T equals to one of the following values:

* 0 if the two non-AP STAs operate on a pair of NSTR links,
* the EMLSR transition delay, indicated in the EMLSR Transition Delay subfield, as specified for the pair of EMLSR links if the two non-AP STAs belong to a pair of EMLSR links,
* the EMLMR delay, indicated in the EMLMR Delay subfield, as specified for the pair of EMLMR links if the two non-AP STAs belong to a pair of EMLMR links.