**IEEE P802.11  
Wireless LANs**

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| **LB266: CR for R-TWT Related CIDs Part 2** | | | | |
| **Date:** 2022-11-15 | | | | |
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|  |  |  |  |  |

**Abstract**

This submission proposes resolutions for the following CIDs (**25**) for TGbe LB266:

Group 1 (SP Termination): 13041, 10693, 10917, 12270, 13106, 13108, 13234, 13631, 11154, 13664

Group 2 (Misc): 10683, 11159, 13656, 11316, 12075, 12474, 12966

Group 3 (SP Extension): 10858, 10916, 12473, 13040, 13650, 10064, 13087, 11659

Revisions:

* Rev 0: Initial version of the document

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.***

***TGbe editor: The baseline for this document is P802.11be D2.2 and P802.11meD1.3***

**Group 1: CIDs related to SP Early Termination**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 13041 | Chunyu Hu | 35.9.4 | 512.44 | The SP early termination in the baseline has some critical limitations: a) an AP may terminate the SP without requiring to know STA's buffer status; b) STA may have some critical task and needs to initiate/request the early termination of current SP. Also the Queue size in BSR is not accurate enough for the STA to decide if the SP can be terminated after the current frame exhcange. Early termination signaling should be able to support these scenarios with minimum overhead (save power). | Add necessary design and/or procedure. | **Revised**  Agree in principle. Additional signaling for R-TWT SP termination is defined in this document to address the issues raised by commenter.  **TGbe editor, please make change as shown in 22/1959r0 tagged by #13041** |
| 10693 | Liangxiao Xin | 35.9 | 510.51 | It is possible that all the traffic of R-TWT TIDs is transmitted before the scheduled end time of the R-TWT SP, then the R-TWT SP should be terminated. | add a mechanism to terminate a R-TWT SP when all the traffic of R-TWT TIDs is transmitted | **Revised**  Rules for broadcast TWT SP early termination are defined in 802.11ax (26.8.3 Broadcast TWT operation) that apply to R-TWT as well.Additional signaling for R-TWT SP termination is defined in this document.  **TGbe editor, please make change as shown in 22/1959r0 tagged by #13041** |
| 10917 | Kiseon Ryu | 35.9.5 | 512.55 | Rule for early termination of the r-TWT SP needs to be clarified for non-member r-TWT STAs as well as for member r-TWT STAs. | As in the comment. | **Revised**  Rules for broadcast TWT SP early termination are defined in 802.11ax (26.8.3 Broadcast TWT operation) that apply to R-TWT as well.Additional signaling for R-TWT SP termination is defined in this document.  **TGbe editor, please make change as shown in 22/1959r0 tagged by #13041** |
| 12270 | Rajat Pushkarna | 35.9.4.1 | 512.15 | For channel access rules during r-TWT, if a STA has no latency sensitive traffic to transmit during an ongoing r-TWT SP, the STA shall terminate the r-TWT setup to maintain fairness for STAs which have latency tolerant data. | As in comment. | **Revised**  Rules for broadcast TWT SP early termination are defined in 802.11ax (26.8.3 Broadcast TWT operation) that apply to R-TWT as well.Additional guidance for R-TWT SP termination is defined in this document.  **TGbe editor, please make change as shown in 22/1959r0 tagged by #13041** |
| 13106 | Chittabrata Ghosh | 35.9.4 | 512.07 | Early SP termination mechanism of baseline bTWT should be revised in context of r-TWT and necessary spec changes should be made. Some key issues with existing mechanism is that there is no "handshake" in signaling; an AP may terminate the SP without requiring to know STA's buffer status and a STA cannot initiate/request an early termination. Queue size in BSR mechanism is also not highly accurate and must include buffer size of MPDUs included in the carrying frame. Early SP termination mechanism would benefit from new signaling to explicity request/notify SP termination | as in comment | **Revised**  Agree in principle. Additional signaling for R-TWT SP termination is defined in this document to address the issues raised by commenter.  **TGbe editor, please make change as shown in 22/1959r0 tagged by #13041** |
| 13108 | Chittabrata Ghosh | 35.9 | 510.51 | In an rTWT SP, if both the AP and a member STA have completed their exchange of LS traffic, for DL and UL, then the rTWT SP should end for that member STA to improve STA's power saving operation. A mechanism needs to be defined either using existing signaling or new signaling for rTWT SP termination for a member STA which ensures that the rTWT SP is terminated only after LS traffic has been delivered in both DL and U L for that STA.. | Add support for rTWT early termination after LS traffic exchange has been completed both for UL and DL in the rTWT SP. | **Revised**  Agree in principle. Additional signaling for R-TWT SP termination is defined in this document to address the issues raised by commenter.  **TGbe editor, please make change as shown in 22/1959r0 tagged by #13041** |
| 13234 | Binita Gupta | 35.9 | 510.51 | In an rTWT SP, if both the AP and a member STA have completed their exchange of LS traffic, for DL and UL, then the rTWT SP should end for that member STA to improve STA's power saving operation. A mechanism needs to be defined either using existing signaling or new signaling for rTWT SP termination for a member STA which ensures that the rTWT SP is terminated only after LS traffic has been delivered in both DL and U L for that STA.. | Add support for rTWT early termination after LS traffic exchange has been completed both for UL and DL in the rTWT SP. | **Revised**  Agree in principle. Additional signaling for R-TWT SP termination is defined in this document to address the issues raised by commenter.  **TGbe editor, please make change as shown in 22/1959r0 tagged by #13041** |
| 13631 | Rubayet Shafin | 35.9.5 | 512.44 | For Restricted TWT (rTWT) operation, if an STA is done with transmitting latency-sensitive packets in uplink before the end of restricted TWT service period (SP) and there is no packet waiting for that STA in downlink for remainder of the SP, then it causes channel under-utilization for that STA if the STA is prohibited to transmit latency-tolerant traffic for remainder of the SP. Channel under-utilization due to under-utilized restricted TWT SP can be reduced by allowing latency-tolerant traffic in addition to latency-sensitive traffic for transmission during rTWT SP. Once the scheduled STA is done transmitting latency-sensitive traffic during rTWT SP, and if there is still time remaining in the SP, the scheduled STA can choose to transmit its latency-tolerant packets (if any) during remaining of the SP. This will improve the channel utilization for the STA . However, it creates fairness issue. Regarding contention among the scheduled STAs, if one scheduled STA starts transmitting latency-tolerant traffic during the restricted TWT SP, it is not fair for other scheduled STAs that are still transmitting latency-sensitive traffic during the SP. Also, an STA with ill intention may abuse this functionality by setting up TWT parameters such that there is always additional time left in the restricted TWT SP after transmitting latency-sensitive packets. How to handle these situation is not clear. | The spec needs to provide mechanisms and procedures to handle the r-TWT fairness issue as described in the comment. | **Revised**  As per spec text in 35.8.5 regarding traffic rules during R-TWT SPs, STAs that are not members of on-going R-TWT SP are not prohibited from accessing the channel. Further, for member STAs the rules are about prioritizing their latency sensitive traffic, and they are not prohibited from sending traffic of non R-TWT TIDs after they are done delivering their LST. Therefore the channel under-utilization concern raised in the comment is not applicable.  However, member R-TWT STAs may terminate SP after delivering LST as per baseline rules of broadcast TWT to help with power saving or scheduling. Additional signaling for R-TWT SP termination is defined in this document to facilitate in SP termination.  **TGbe editor, please make change as shown in 22/1959r0 tagged by #13041** |
| 11154 | Boon Loong Ng | 35.9.5 | 512.44 | If latency-tolerant traffic transmission is allowed during an r-TWT SP, it creates fairness issue for non-members. On the other hand, if an r-TWT member STA finishes transmitting latency sensitive traffic much earlier than r-TWT SP and lantecy-tolerant traffic transmission is prohibited for the remaining portion of the SP, then it can cause channel under utilization for the STA. | There needs to be some rules/procedures describing how to address the r-TWT fairness issue. | **Revised**  R-TWT traffic prioritization rules defined in 35.8.5 apply to member STAs only, and don’t prohibit non-members from accessing channel. Member STAs may also transmit latency tolerant traffic after prioritizing delivery of latency sensitive traffic. So rules already exist to address under-utilization.  Additional signaling for R-TWT SP termination is defined in this document to facilitate in SP termination.  **TGbe editor, please make change as shown in 22/1959r0 tagged by #13041** |
| 13664 | Rubayet Shafin | 35.9.4.1 | 512.09 | An r-TWT scheduled STA can be done with transmitting latency-sensitive traffic much earlier than the nominal r-TWT SP end time. Currently there is no guidance in the spec on the behavior of the STA for the remaining portion of the r-TWT SP. | Please provide rules/guidance depicting the behavior of STA and AP in regards with TWT SP termination specific for restricted TWT operation. | **Revised**  Rules for broadcast TWT SP early termination are defined in 802.11ax (26.8.3 Broadcast TWT operation) that apply to R-TWT as well.Additional signaling for R-TWT SP termination is defined in this document.  **TGbe editor, please make change as shown in 22/1959r0 tagged by #13041** |

**Discussion**

TWT SP early termination rules are defined in 26.8.5, and R-TWT STAs may follow the baseline procedures to early terminate an on-going SP.

As discussed in detail in 22/0304, a key issue with baseline rules is that an AP may early terminate the SP without checking with the STA if it is ready to terminate the SP. That is, the early termination procedure is not a handshake but rather a single notification from the AP (e.g., using EOSP=1). Conversely, there is no explicit signaling for a STA to request an early termination of the SP e.g., if it is done transmitting its traffic for the SP, or if the STA needs to go into doze state for power saving.

One possibility in existing spec is to use buffer status report by the STA to indicate to the AP its end of pending traffic. However, there are a few gaps in this implicit approach (please refer to 22/0304 for detailed discussion):

* The AP is not required/recommended to wait for or inquire the buffer status of the STA before terminating the SP
* In trigger-enabled TWT, or if the non-AP STA supports UL MU, then AP can inquire buffer status using BSRP. However:
* **Problem 1**: BSR A-control reports buffer status for AC, not TID
* **Problem 2**: QoS-Control reports status per TID, but Queue Size is for one TID. Note: STA *could* aggregate up to 8 QoS Control in Qos Null to report buffer of all desired TIDs (which needs Multi-TID BA to respond): added overhead and onerous effort.
* **Problem 3:** Queue Size for both BSR Control and QoS Control has to **include buffer** for any DATA in carrying frames, and the report may not be precise due to scaling factor-based encoding (see slide 17 in 22/0304r0). Cannot always clearly convey that DATA included in carrying frame is the only remaining buffer

As highlighted by above discussion and several comments in LB266 stated above, there is a need for an explicit indication from the STA side that it is ready to terminate the on-going SP after end of traffic at its end. And the AP is recommended to wait to receive this indication from the STA before terminating the SP.

Therefore, as a resolution to above CIDs, we propose to redefine bit 7 of the QoS Control subfield of QoS Null frames sent by non-AP STAs as the EOT (End of Traffic) indication.

**9.2.4.5 QoS Control field**

**9.2.4.5.1 QoS Control field structure**

***TGbe editor: please modify row 6 of Table 9-10 (QoS Control field) as follows:***

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Applicable frame (sub)types** | **Bits 0-3** | **Bit 4** | **Bits 5-6** | **Bit 7** | **Bits 8** | **Bit 9** | **Bit 10** | **Bit 11-15** |
| … | … | … | … | … | … | | | |
| QoS Data and QoS Data+CF-Ack frames sent in a nonmesh BSS by non-AP STAs that are not a TPU buffer STA or a TPU sleep STA | TID | 0 | Ack Policy Indicator | AMSDU Present | TXOP Duration Requested | | | |
| TID | 1 | Ack Policy Indicator | AMSDU Present | Queue Size | | | |
| QoS Null frames sent in a nonmesh BSS by non-AP STAs that are not a TPU buffer STA or a TPU sleep STA | TID | 0 | Ack Policy Indicator | Reserved | TXOP Duration Requested | | | |
| TID | 1 | Ack Policy Indicator | (#13041)~~Reserved~~  EOT | Queue Size | | | |
| … | … | … | … | … | … | … | … | … |

***TGbe editor: please add a new subclause in 9.2.5.5 as follows:***

(#13041)**9.2.4.5.xxx EOT subfield**

﻿The End of Traffic (EOT) subfield indicates if there is pending traffic from the transmitting STA during the current service period. The EOT subfield is set to 1 if the transmitting non-AP STA does not have any more pending traffic to be delivered during the current service period; otherwise, it is set to 0.

***TGbe editor: please add new subclause 35.3.24.3 and insert the following paragraphs:***

**35.3.24 TWT operation**

**35.3.24.1 General**

﻿(#13041)A TWT requesting STA or a TWT scheduled STA may set the EOT subfield to 1 in a QoS Null frame it transmits to a TWT responding STA or a TWT scheduling AP during an on-going TWT SP to indicate that the STA does not have any pending traffic for the remainder of the current TWT SP.

(#13041)A TWT responding STA or a TWT scheduling AP, which receives a QoS Null frame with the EOT subfield equal to 1 from a TWT requesting STA or a TWT scheduled STA during a TWT SP, may terminate the TWT SP for that STA as described in 26.8 (TWT Operation).

**Group 2: Misc CIDs**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 10683 | Liangxiao Xin | 35.9 | 511.31 | If the Restricted TWT Traffic Info Present subfield is always set to 1 in setup frame and set to 0 in beacon frame, then why is this subfield needed? | Remove this subfield | **Rejected**  The presence subfield is needed to indicate presence of Restricted TWT Traffic Info field to help correctly parse the element. Beacon and setup frames are not the only frames carrying the element, and in future the IE may be added to other frames. This subfield is needed and is inline with numerous other examples of presence subfields. |
| 11159 | Boon Loong Ng | 35.9 | 510.51 | P2P STAs can benefit from r-TWT operation for their P2P traffic. How the TDLS peer STAs can utilize an r-TWT schedule for communication over the TDLS direct link is currently missing in the spec. | Please provide description on how to harmonize TDLS operation with r-TWT/bTWT schedules. | **Rejected**  P2p support in R-TWT schedules was discussed in 22/1463 as part of resolution to several related CIDs and SP and motion ran on 1463r3 failed. As such there is no consensus in the group on this topic yet. |
| 13656 | Rubayet Shafin | 35.2.1.2 | 399.52 | Currently there is no guidance in the spec on how to enable Triggered TXOP sharing for P2P communication during a restricted TWT SP of an r-TWT scheduled STA. Such procedure would be essential so that the STA can utilize the TXOP during the r-TWT SP to coordinate with its peer STA for P2P communication. | Please provide mechanisms and frameworks for enabling Trigger TXOP Sharing for P2P communication during r-TWT operation. | **Rejected**  P2p support in R-TWT and scheduling of MU RTS TXS Trigger with TXOP sharing was discussed in 22/1463 as part of resolution to several related CIDs and SP and motion ran on 1463r3 failed. As such there is no consensus in the group on this topic yet. |
| 11316 | Yong Liu | 35.9.4.1 | 512.12 | Once an EHT STA declares that it supports rTWT and associates with an EHT AP, it has to follow the TXOP rules for r-TWT SPs without any exception. There could be extreme cases an EHT STA may not be able to follow the rTWT TXOP rules occasionally, or the EHT STA is not able to send UL data for a long period due to very aggressive r-TWT SP placement/occupations. There should be means to enable an EHT STA to opt out from the rTWT TXOP rules temporarily for extreme cases. | Define ways to allow an rTWT capable EHT STA to opt out from the rTWT TXOP rules temporarily for extreme cases. | **Rejected**  The comment fails to identify what extreme cases may cause a STA to not follow R-TWT TXOP rules after declaring support for the feature. Further, there is no restriction for a non-member R-TWT scheduled STA from transmitting inside an SP. The ending of TXOP at SP start is mandatory for all R-TWT supporting STAs and facilitates predictable transmission of R-TWT TID traffic of member STAs. |
| 12075 | SunHee Baek | 35.9.4.2 | 512.23 | A new method is needed to distinguish all EHT STAs, including the EHT STA that does not support rTWT between the quiet interval and overlapping quiet interval for rTWT SP. | As the comment. | **Rejected**  “35.8.4.2. Quieting STAs during R-TWT” already covers the rules for overlapping quiet intervals for R-TWT supporting and non-supporting EHT STAs. The comment fails to identify what’s missing in existing spec. |
| 12474 | Rajat Pushkarna | 35.9.4.1 | 512.12 | It may be possible that some STAs do not support rTWT capability becuase of which the rTWT SP may need to be delayed. A signaling method needs to be proposed to announce the delay in rTWT SP to the STAs. | As in comment. | **Rejected**  It is already possible in baseline broadcast TWT operation to change the start time of a future TWT SP using a TWT Information frame (Please refer to 26.8.4 Use of TWT Information frames). Same signalling applies to R-TWT as well. |
| 12966 | Chunyu Hu | 9.4.2.199 | 206.25 | With the abbreviation "r-TWT" introduced for "restricted TWT", the phrase in text (not in field name) "restricted TWT" can be changed to "r-TWT". | Make the corresponding change and examine other relevant places to make the same change. | **Revised**  The proposed change has already been applied to latest draft as resolution to #13012 (22/1098r4).  **TGbe editor: No further changes are required** |

**Group 3: CIDs related to SP Extension**

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| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Pg/Ln** | **Comment** | **Proposed Change** | **Resolution** |
| 10858 | Jinsoo Choi | 35.9.3 | 512.06 | The start time of the restricted TWT SP may be affected due to the busy WM or unpredictable situation/randomness of the low latency traffic. (e.g. EHT STAs that are not capable of the restricted TWT cannot obtain the announcement of the restricted TWT SP, or OBSS STAs during the restricted TWT SP also disturb the transmission) Then the total duration of the restricted TWT SP to be used is reduced, which may occur insufficient time for satisfying the requirement of latency sensitive data/traffic delivery. In this case, the AP may need to delay the start time of the restricted TWT SP and this extended SP needs to be informed to the member STAs accordingly. | Need to define a protocol regarding how to extend the restricted TWT SP and announce this information to the member STAs. | **Revised**  Please see discussion  **TGbe editor: please implement the changes in 22/1959r0 tagged by #10858.** |
| 10916 | Kiseon Ryu | 35.9.5 | 512.55 | The EOSP subfield in the QoS Control field may be used for an AP to indicate extension of the r-TWT SP (e.g., EOSP subfield set to 0) to an r-TWT scheduled STA when the AP is not able to schedule all the latency sensitive traffic within the r-TWT SP, due to the overlapping non-zero NAV at the AP. | As in the comment. | **Revised**  Please see discussion  **TGbe editor: please implement the changes in 22/1959r0 tagged by #10858.** |
| 12473 | Rajat Pushkarna | 35.9.4 | 512.12 | During a rTWT how is the SP mamanged to cater all the available latency sensitive trafffic during an SP. There needs to be some signalling proposed for rTWT to manage the SP based on the latency sensitive traffic flow. | As in comment. | **Revised**  Please see discussion  **TGbe editor: please implement the changes in 22/1959r0 tagged by #10858.** |
| 13040 | Chunyu Hu | 35.9.5 | 512.44 | It's not possible to gurantee all the intended traffic can complete within a r-TWT SP due to various legitimate reasons: channel variation, traffic fluctration, overlap with TBTT time, interference from other BSS/channels etc. Need to define a procedure to allow either AP and/or STA to signal its intention to extend the SP. | Add necessary design and/or procedure. | **Revised**  Please see discussion  **TGbe editor: please implement the changes in 22/1959r0 tagged by #10858.** |
| 13650 | Rubayet Shafin | 35.9.4 | 512.07 | In different scenarios, a TWT scheduled STA or TWT requesting STA may not be able to start transmission at the nominal TWT start time,i.e., the scheduled SP start time and actual SP start time can be different. For DL transmission, the scheduled STA may not be awake beyond AdjustedMinimumTWTWakeDuration. For UL, the STA may not have enough time to finish UL transmission within the remainder of the SP. In general, the current specification doesn't provide any kind of remedy to compensate for the missed portion of the r-TWT SP.This may severely impact the STA's latency-sensitive applications. | Procedures and mechanisms need to be described in the spec to handle the issue with insufficient r-TWT SP time remaining. | **Revised**  Please see discussion  **TGbe editor: please implement the changes in 22/1959r0 tagged by #10858.** |
| 10064 | Morteza Mehrnoush | 35.9.4 | 512.07 | In some scenairos the AP can't deliver all the DL traffic to STA during the rTWT SP, and so the STA may enter Doze state at the end of rTWT SP (with that assumption AP won't deliver BU after the rTWT SP). If the scheduled STA by the end of the rTWT SP determines that AP has more DL traffic, it shall send a U-APSD trigger frame after rTWT SP to indicate that it's in awake state and the AP can deliver the remianing BU during the U-APSD SP. The U-APSD Coexistence element (which contains the info for the durtion of U-APSD SP, etc) are send via the ADDTS request frame; in order to use the U-APSD coexistence mechanism more flexibly, please add other ways to send the U-APSD Coexistence element. | as in comment | **Revised**  Please see discussion  **TGbe editor: please implement the changes in 22/1959r0 tagged by #10858.** |
| 13087 | Chittabrata Ghosh | 35.9.4 | 512.07 | In some scenairos the AP can't deliver all the DL traffic to STA during the rTWT SP, and so the STA may enter Doze state at the end of rTWT SP (with that assumption AP won't deliver BU after the rTWT SP). If the scheduled STA by the end of the rTWT SP determines that AP has more DL traffic, it shall send a U-APSD trigger frame after rTWT SP to indicate that it's in awake state and the AP can deliver the remianing BU during the U-APSD SP. The U-APSD Coexistence element (which contains the info for the durtion of U-APSD SP, etc) are send via the ADDTS request frame; in order to use the U-APSD coexistence mechanism more flexibly, please add other ways to send the U-APSD Coexistence element. | as in comment | **Revised**  Please see discussion  **TGbe editor: please implement the changes in 22/1959r0 tagged by #10858.** |
| 11659 | Morteza Mehrnoush | 35.9.4 | 512.07 | In some scenarios the AP can't deliver all the DL traffic to STA during the rTWT SP, and so the STA may enter Doze state at the end of rTWT SP (the AP can't deliver BU after the rTWT SP). If the scheduled STA by the end of the rTWT SP determines that AP has more DL traffic, it shall send a U-APSD trigger frame after rTWT SP to indicate that it's in awake state and the AP can deliver the remaining BU during the U-APSD SP. The U-APSD Coexistence element (which contains the info for the duration of U-APSD SP, etc) are announced via the ADDTS request frame; in order to use the U-APSD coexistence mechanism more flexibly, please add other ways to announce the U-APSD Coexistence element. | as in comment | **Revised**  Please see discussion  **TGbe editor: please implement the changes in 22/1959r0 tagged by #10858.** |

**Discussion**

Choosing the right SP duration is not straight-forward. It makes sense to allocate some margin in duration. However, it may not be ideal to allocate too much e.g., due to power saving or considering the capacity of the whole BSS/network.

If the SP is over-allocated and traffic is delivered earlier, then AP/STA may early terminate the SP using termination procedure in 26.8.5. However, if SP is under-allocated (or SP start was delayed due to legacy STA traffic, or some portion of SP was occupied by traffic from non R-TWT TIDs), there is possibility that R-TWT TID traffic is still remaining at SP end. In such cases, as identified by several LB266 comments above, there is a need to extend the SP.

We discuss this tradeoff of SP allocation and current signaling possibilities for SP extension within the spec in detail in 22/0303r0, posted to mentor in Aug22. We further propose explicit signaling solution to bridge the gap.

To summarize, within current specification an R-TWT scheduled STA may transition from PS mode to Active mode before the end of SP if it still has pending traffic, or if it receives indication from AP about pending DL BUs (e.g., via AP PS Buffer State). However, there are still challenges that may only be mitigated by explicit signaling for SP extension. Some key challenges are:

1. In case of AP with responder PM mode activated, the TWT scheduled STA needs to notify AP for intention of extending SP – its switching to Active mode is not sufficient.
2. The R-TWT SP traffic prioritization rule does \***NOT**\* apply to the time outside of the time that is defined as SP, even it’s right after it
3. In certain cases, AP may not want the SP to be extended (implicitly), or wants to let the scheduled STA know maximum amount of time allowed to extend, e.g., due to next R-TWT SP for a different schedule.

Therefore, for explicit request/grant of SP extension, one solution is to add a new A-Control field which enables:

* A TWT scheduled STA to request an extension of the on-going SP, with option to provide additional duration required.
* A TWT scheduling AP to grant/confirm extension of SP, with option to provide extension duration.

(Please refer to 22/0303r0 for detailed discussion)

Here we want to collect group’s feedback on whether additional signaling (A-control) should be added in 802.11be spec, as a resolution to related CIDs in LB266. Otherwise, aforementioned implicit signaling methods may be used.

**SP:** **Do you support to add a new HE variant A-control field to signal TWT SP Extension as resolution to related LB266 CIDs included in 22/1959r0 as Group 3?**

* **Yes**
* **No**
* **Abstain**