**IEEE P802.11
Wireless LANs**

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| CR for PPDU End Time Alignment |
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Abstract

This submission proposes resolutions for multiple comments related to TGbe D1.0 with the following CIDs (38 CIDs):

* 4225, 4226, 4227, 4228, 4402, 4406, 4407, 4408, 4409, 4410, 4475, 4476, 4477, 4478, 4479, 5101, 5102, 5150, 5221, 5364, 5384, 5842, 5843, 5929, 5948, 5994, 6141, 6495, 6738, 6772, 6928, 6996, 7375, 7607, 7788, 7879, 8207, 8213

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 subsequent 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.***

| **CID** | **Clause** | **Page** | **Comment** | **Proposed Change** | **Resolution** |
| --- | --- | --- | --- | --- | --- |
| 7607 | 35.3.14.5 | 0.00 | This mechanism is for NSTR. So, this subclause should be under 35.3.14.3. | As in comment. | Rejected- The PPDU end time alignment is for the NSTR. But, if this subclause is moved under 35.3.16.4 (Nonsimultaneous transmit and receive (NSTR) operation), the depth of the subclause exceeds level 5.  |
| 4402 | 35.3.14.5 | 274.42 | The transmission / reception operations on the links can occur only if the setup links are enabled (i.e has at least on TID mapped to each fo these links) | Revise the sentence as follows: " After the AP MLDhas set up link 1 and link 2 with the non-AP MLD, then AP 2 may receive data frames from STA 2 on link 2, if enabled, while AP 1 contends for the WM and then transmits data frames to STA 1 on link 1, if enabled. | Rejected- Figure 35-11 is just an example. There is no reason to clarify all possible condition. |
| 6772 | 35.3.14.5 | 276.51 | The concept of NSTR MLD or NSTR non-AP MLD is not defined in the document. Currently, NSTR link pair and STA NSTR limited are defined. | Please define NSTR MLD and NSTR non-AP MLD or change the wording by using A STA affiliated with a non-AP MLD that belongs to a NSTR link pair instead of NSTR MLD | Revised- Agree in principle with the comment. TGbe editor to make the changes shown in 11-22/0077r1 under all headings that include CID 6772, 5842,8207, 7879, 5948, 7375. |
| 5842 | 35.3.14.5 | 276.57 | What's the definition of "NSTR MLD"? Is it an MLD that does not have any STR link pairs? This term needs to be clearly defined. | Provide a clear definition for "NSTR MLD". For example, in Section 3.1, add the following definition:Nonsimultaneous transmit and receive Multi-Link Device (NSTR MLD): an MLD that does not have any STR link pairs. | Revised- Agree in principle with the comment. TGbe editor to make the changes shown in 11-22/0077r1 under all headings that include CID 6772, 5842,8207, 7879, 5948, 7375. |
| 8207 | 35.3.14.5 | 276.57 | There are several places in this subclause use "NSTR MLD", base on previous discussion, the term of "NSTR MLD" is not defined in the spec. Please rewrite the sentences to avoid the use of "NSTR MLD". | as in comment | Revised- Agree in principle with the comment. TGbe editor to make the changes shown in 11-22/0077r1 under all headings that include CID 6772, 5842,8207, 7879, 5948, 7375. |
| 7879 | 35.3.14.5 | 276.58 | The definitions of 'NSTR MLD' and 'NSTR non-AP MLD' are not specified in the draft 1.0. Either define the term or substitute the corresponding to text using 'NSTR link pair'. Apply the text modification through the subclause 35.3.14.5 | As in the comment | Revised- Agree in principle with the comment. TGbe editor to make the changes shown in 11-22/0077r1 under all headings that include CID 6772, 5842,8207, 7879, 5948, 7375. |
| 5948 | 35.3.14.5 | 276.57 | Whether the first link and the second link is in the same NSTR link pair is not clear from the description. | the proposed change is:If a NSTR MLD that is receiving a PPDU on a first link of its NSTR link pair simultaneously transmits another PPDU on a second link of the NSTR link pair, then the NSTR MLD might fail to receive the PPDU on the first link because of the interference caused by its transmission on the second link. | Revised- Agree in principle with the comment. TGbe editor to make the changes shown in 11-22/0077r1 under all headings that include CID 6772, 5842,8207, 7879, 5948, 7375. |
| 7375 | 35.3.14.5 | 276.57 | What happens when there are 3 links in the MLD? The sentence only discusses first and second links. | Change the cited sentence to read "If a NSTR MLD that is receiving a PPDU on a link simultaneously transmits another PPDU on another link, then the NSTR MLD might fail to receive the PPDU on the link because of the interference caused by its transmission on the other links." | Revised- Agree in principle with the comment. TGbe editor to make the changes shown in 11-22/0077r1 under all headings that include CID 6772, 5842,8207, 7879, 5948, 7375. |
| 4406 | 35.3.14.5 | 276.58 | The term "simultaneously transmits" used in the sentence "If a NSTR MLD that is receiving a PPDU on a first link \*simultaneously transmits\* another PPDU on a second link, then the NSTR MLD might fail to receive the PPDU on the first link because of the interference caused by its transmission on the second link." has a different meaning than the definition of "simultaneously transmit" term that is defined in the first sentence of section 35.3.14.5 (P276L54) where the meaning is for transmission of two PPDUs on two different links of an MLD at the same time. Please resolve the conflict. | Propose to use "concurrent transmission" in the sentence, as follows: "If a NSTR MLD that is receiving a PPDU on a first link is concurrently transmitting another PPDU on a second link, then the NSTR MLD might fail to receive the PPDU on the first link because of the interference caused by its transmission on the second link." | Revised- Agree in principle with the comment. TGbe editor to make the changes shown in 11-22/0077r1 under all headings that include CID 4406. |
| 4475 | 35.3.14.5 | 276.62 | 1. Add "to" before the verb "reduce" in the following sentence:"....which helps reduce the chances of the occurrence of such self-interference among STAs affiliated to the same NSTR MLD"2. Use the term "NSTR non-AP MLD" instead of "NSTR MLD" in the above sentence. | The correct sentence shall be: "..."....which helps to reduce the chances of the occurrence of such self-interference among STAs affiliated to the same NSTR non-AP MLD" | Revised- Agree in principle with the comment. TGbe editor to make the changes shown in 11-22/0077r1 under all headings that include CID 4475. |
| 4225 | 35.3.14.5 | 276.54 | Replace "is transmitted" with "are transmitted". Also in the third line simply say TB PPDU rather than HE or EHT TB PPDU. | As in comment. | Revised- Agree in principle with the comment. TGbe editor to make the changes shown in 11-22/0077r1 under all headings that include CID 4225. |
| **35.3.16.5 PPDU end time alignment****35.3.16.5.1 General****TGbe Editor: *Change paragraphs below of this subclause as follows (#CID 6772, 5842, 8207, 7879, 5948, 7375, 4406, 4475, 4225):***In this subclause “simultaneously transmit” means more than one PPDU is transmitted on more than one link, where each PPDU is transmitted over one link, and those transmissions overlap in time. Likewise, “simultaneously trigger” means more than one ~~HE or EHT~~ (#4225) TB PPDU is triggered on more than one link, where each PPDU is triggered over one link, and those transmissions overlap in time. If a~~n NSTR~~ non-AP MLD that is receiving a PPDU on a ~~first~~ link on a pair of NSTR links for that MLD ~~simultaneously~~ concurrently (#4406) transmits another PPDU on ~~a second~~ another link on a pair of NSTR links for that MLD, then the ~~NSTR~~ non-AP MLD might fail to receive the PPDU on the ~~first~~ link because of the interference caused by its transmission on the ~~second~~ other link. This subclause specifies a mechanism to align the end time of PPDUs that are simultaneously transmitted to ~~the same NSTR non-AP MLD~~ the STAs of a non-AP MLD operating on a pair of NSTR links for that MLD, which helps to (#4475) reduce the chances of the occurrence of such self-interference among STAs affiliated to the same ~~NSTR~~ MLD. |
| 5994 | 35.3.14.5 | 276.52 | The PPDU ending time allignment is not complete. | Add later requirement ( 4us) and MAC frame decoding requriement (4us) | Rejected- As mentioned in NOTE 3 and NOTE 4, it is assumed that aRxTxTurnaroundTime is equal to 4 μs.And, according to Equation 10-3, aMACProcessingDelay can be greater than 4us. Also, in the spec, aMACProcessingDelay is an implementation dependent.  |
| 6495 | 35.3.14.5 | 276.54 | The meaning of "simultaneously transmit" better moved to the definition clause. | As in comment | Rejected- “Transmit simultaneously” is differently interpreated depending on the subcluse. E.g., UL MU-MIMO is a technique to allow multiple STAs to transmit simultaneously over the same frequencyGeneral definition is not quite useful.  |
| 5843 | 35.3.14.5 | 276.62 | Can all the NSTR non-AP MLDs simultaneously receive on multiple links or simultaneously transmit on multiple links? If not, then should the simultaneous-receiving and simultaneous-transmitting be signalled as capabilities?Also, in general, does NSTR only mean non-simultaneous Tx and Rx (Tx/Rx) or does it include non-simultaneous all the comibinations, Tx/Rx, Tx/Tx, and Rx/Rx? | Please address the questions asked in the comment. | Rejected- A MLD operating on NSTR links shall be able to simultaneously receive on multiple links or simultaneously transmit on multiple links.  |
| 4407 | 35.3.14.5 | 277.01 | Remove the words "more than one PPDU" and "same" from the following sentence, since it is part from the previously definition of "simultaneously transmit" term, as defined in the start of section 35.3.14.5 above | The revised sentece should be:"When an AP MLD simultaneously transmits to the associated NSTR non-AP MLD and..." | Revised- Agree in principle with the comment. TGbe editor to make the changes shown in 11-22/0077r1 under all headings that include CID 4407. |
| 4226 | 35.3.14.5 | 277.02 | Does the frame need to be a QoS Data frame? I.e., wouldn't it apply to any frame that solicits an immediate response? Please clarify | As in comment. | Revised- Agree in principle with the comment. TGbe editor to make the changes shown in 11-22/0077r1 under all headings that include CID 4226, 4408. |
| 4408 | 35.3.14.5 | 277.03 | Why only Qos Data soliciting an immediate response is the only frame included in this sentence and not any frame that solicits immediate response? | Remove the words " a QoS Data" from the sentence as follows:"...at least one of the PPDUs carries a frame that is soliciting an immediate response, ..." | Revised- Agree in principle with the comment. TGbe editor to make the changes shown in 11-22/0077r1 under all headings that include CID 4226, 4408. |
| 5221 | 35.3.14.5 | 277.04 | Why a high priority PPDU is exempted from this requirement? If the high priority PPDU carried frame requires immediate response, the same issue of Tx interference to the on-going Rx exists. | Remove "except if the PPDU carries a high priority frame" | Rejected- The group could not reach consensus the changes necessary to address the comment. |
| 5364 | 35.3.14.5 | 277.05 | except if the PPDU carries a high priority frame. there is no sub clause to introduce the high priority frame delivery on NSTR MLD | reword it, like "except the specified case in this standard" | Rejected- The group could not reach consensus the changes necessary to address the comment. |
| 4227 | 35.3.14.5 | 277.05 | There is no definition of high priority frame. Is it related to the high priority AC or is it something else? | As in comment. | Rejected- The group could not reach consensus the changes necessary to address the comment.  |
| 4409 | 35.3.14.5 | 277.05 | It is not clear what does "high priority frame" mean? | Please clarify (or refer to exist definition of) the term "high priority frame" | Rejected- The group could not reach consensus the changes necessary to address the comment. |
| 5101 | 35.3.14.5 | 277.05 | The definition of a high priority frame is missing. | Define a high priority frame. | Rejected- The group could not reach consensus the changes necessary to address the comment. |
| 5102 | 35.3.14.5 | 277.05 | Even for a PPDU including a high priority frame, there is a case where PPDU end time alignment is required.When PPDU 1 including a high priority frame started before the start of PPDU 2, if PPDU 2 ends earlier than the end of PPDU 1, the response to PPDU 2 gives interference to the high priority frame. In this case, the transmitter should align PPDU end time. | Define PPDU end time alignment for a high priority frame. | Rejected- The group could not reach consensus the changes necessary to address the comment. |
| **35.3.16.5 PPDU end time alignment****35.3.16.5.1 General****TGbe Editor: *Change paragraphs below of this subclause as follows (#CID 4407, 4226, 4408):***When an AP MLD simultaneously transmits ~~more than one PPDU~~ to ~~the same NSTR non-AP MLD~~ (#4407) the STAs of a non-AP MLD operating on a pair of NSTR links for that MLD and at least one of the PPDUs carries a frame that is ~~a QoS data~~ (#4226, 4408) soliciting an immediate response, then —The AP shall align the end time of the PPDUs soliciting an immediate response per the rules defined in this subclause, except if the PPDU carries a high priority frame.NOTE 1— In this way the response PPDU to any of the PPDUs transmitted by the AP will not overlap with any of these PPDUs. |
| 5150 | 35.3.14.5 | 277.02 | If only one of PPDUs solicits an immediate response, it is not required to align PPDU end time. | As in comment | Rejected-All PPDUs soliciting an immediate response is required to follow the PPDU end time alignment.  |
| 6141 | 35.3.14.5 | 277.04 | This requirement is excessive in that it presumes that the stated rule always produces a better outcome, but that is not true. | Change "The AP shall align the end time" to "The AP should align the end time" | Rejected- If a non-AP MLD does not need the PPDU eng time alignment, the non-AP MLD should not indicate the NSTR link. |
| 6996 | 35.3.14.5 | 277.06 | "NOTE 1-- In this way the response PPDU to any of the PPDUs transmitted by the AP will not overlap with any of these PPDUs." It is not clear if the response PPDUs need to be aligned and if yes, how that can be achieved. | Clarify in the NOTE if the response PPDUs are required to be aligned and how such alignment can be achieved. | Rejected- The NOTE is not saying that the response PPDUs shall be aligned.  |
| 5929 | 35.3.14.5 | 277.30 | TXOP sharing rule in 10.23.2.7 for SU PPDU should be revised to allow padding with lower priority ACs for end time alignment | as in comment | Rejected- The gain through the padding with the lower priority frame is limited comparing with additional implementation complexity.  |
| 6928 | 35.3.14.5 | 277.30 | Setting GI for PPDU so that total duration of each OFDM symbol is an integer time of total duration of each OFDM symbol of other transmitted PPDUs(such as 0.8us for non-HE PPDU and 3.2us for HE or EHT PPDU) can reduce end time difference between transmitted PPDUs. | Add "An AP MLD may set GI based on GI of other transmitted PPDUs." | Rejected- The GI should be determined based on the PHY layer parameters (e.g., channel characteristic), not padding.  |
| 8213 | 35.3.14.5 | 277.30 | Selecting GI duration is one of options to adjust PPDU duration. | Add "An AP MLD may select any (allowed) duration of GI to align the end time of transmitted PPDUs." | Rejected- The GI should be determined based on the PHY layer parameters (e.g., channel characteristic), not padding.  |
| 4410 | 35.3.14.5 | 277.35 | since the"simultaneously transmit" term was previously defined (in the start of section 35.3.14.5) consider moodify the sentence to use this term as follows: " When an AP MLD simultaneously solicits transmission from one or more HE or EHT TB PPDUs..." | As in comment | Revised-Agree in principle with the comment. TGbe editor to make the changes shown in 11-22/0077r1 under all headings that include CID 4410. |
| 4476 | 35.3.14.5 | 277.36 | Use "affiliated with" rather than "affiliated to" in the sentence | the revised sentece should be:"When an AP MLD simultaneously solicits one or more HE or EHT TB PPDUs from the same NSTR non-AP MLD, each AP affiliated with the AP MLD shall independently solicit..." | Revised-Agree in principle with the comment. As the resolution of CID 6581, this change was already applied in TGbe Draft 1.5.TGbe Editor needs no change on the draft. |
| 5384 | 35.3.14.5 | 277.39 | it's more clear if we change NSTR non-AP MLD to NSTR peers | An AP affiliated to the AP MLD shall not transmit a Trigger frame with the CS Required subfield set to 1 to a STA affiliated to a NSTR non-AP MLD-->...to a STA belong to a NSTR peer of non-AP MLD, when... other STAs belong to the same NSTR peer of non-AP MLD.... | Revised-The NSTR MLD terminology is removed. TGbe editor to make the changes shown in 11-22/0077r1 under all headings that include CID 5384. |
| 4228 | 35.3.14.5 | 277.39 | These seem to be conflicting conditions. Explicitly call out, in an exclusive way what applies to the first bullet and what applies to the second bullet. | As in comment. | Rejected-Two bullets are not conflicted and not exclusive. Each bullet addresses two separate topics.  |
| **35.3.16.5 PPDU end time alignment****35.3.16.5.1 General****TGbe Editor: *Change paragraphs below of this subclause as follows (#CID 4410, 5384):***When an AP MLD simultaneously solicits one or more ~~HE or EHT~~ TB PPDU~~s~~ transmissions from ~~the same NSTR non-AP MLD~~ the STAs of a non-AP MLD operating on a pair of NSTR links for that MLD, each AP affiliated with the AP MLD shall independently solicit a~~n HE or EHT~~ TB PPDU following the mechanisms defined in 26.5.2 (UL MU operation) with the following exceptions:—An AP affiliated with the AP MLD shall not transmit a Trigger frame with the CS Required subfield set to 1 to a STA ~~affiliated with an NSTR non-AP MLD~~ of a non-AP MLD operating on a pair of NSTR links for that MLD, when at least one PPDU from other STAs ~~affiliated with the same NSTR non-AP MLD~~ operating on a pair of the same NSTR links is scheduled for transmission before a timer with a value of 12 μs (see NOTE 4) has expired after the PPDU containing the Trigger frame.—If the AP MLD allows the frames in the TB PPDUs to solicit control response frames from the AP MLD, then the UL Length subfield values in the soliciting Basic Trigger frames shall be set to the same value.NOTE 4—12 μs is derived from aSIFSTime + aSignalExtension – aRxTxTurnaroundTime, where aRxTxTurnaroundTime is equal to 4 μs for the purpose of this calculation. |
| 4477 | 35.3.14.5 | 277.52 | The "STA MLD" shall be replaced with "non-AP MLD" in the following sentence: "The relationship between the end times of DL PPDUs sent over link 1, link 2, and link 3 between an AP MLD and a \*STA MLD\* is shown in Figure 35-12..." | As in comment | Revised- Agree in principle with the comment. TGbe editor to make the changes shown in 11-22/0077r1 under all headings that include CID 4477, 4478, 4479. |
| 4478 | 35.3.14.5 | 277.54 | The "STA MLD" shall be replaced with "non-AP MLD" in the following sentence: "..an HE or EHT TB PPDU requiring the carrier sense from a STA in the \*STA MLD\*." | As in comment | Revised- Agree in principle with the comment. TGbe editor to make the changes shown in 11-22/0077r1 under all headings that include CID 4477, 4478, 4479. |
| 4479 | 35.3.14.5 | 277.58 | The "STA MLD" shall be replaced with "non-AP MLD" in the following sentence: "..that is sent from any STA in the same \*STA MLD\* immediately after the soliciting DL PPDU is greater than or equal to 12 μs." | As in comment | Revised- Agree in principle with the comment. TGbe editor to make the changes shown in 11-22/0077r1 under all headings that include CID 4477, 4478, 4479. |
| **35.3.16.5 PPDU end time alignment****35.3.16.5.1 General****TGbe Editor: *Change paragraphs below of this subclause as follows (#CID 4477, 4478, 4479):***The relationship between the end times of DL PPDUs sent over link 1, link 2, and link 3 between an AP MLD and a non-AP ~~STA~~ MLD is shown in Figure 35-15 (PPDU end time alignment timing relationships). An AP in the AP MLD operating on link 1 solicits a~~n HE or EHT~~ TB PPDU requiring the carrier sense from a STA in the non-AP ~~STA~~ MLD. In this case the difference between the end time of the soliciting DL PPDU sent on link 1 and the starting time of the first solicited PPDU (in the figure, Ack frame on link 2) that is sent from any STA in the same non-AP ~~STA~~ MLD immediately after the soliciting DL PPDU is greater than or equal to 12 μs. Accordingly, the end time of the soliciting PPDU sent on link 2 cannot be more than 4 μs earlier than the end time of the soliciting PPDU sent on link 1. To avoid overlapping in time between any of the DL PPDUs and the response PPDU to any of the DL PPDUs, the difference between the end times of the DL PPDUs on link 2 and link 3 cannot be greater than 8 μs.**35.3.16.5.2 End time alignment of response PPDUs using SRC Control field**An AP that is affiliated with an AP MLD shall set the SRS Support subfield in the Common Info field of the Basic Multi-Link element it transmits to 1 if its dot11SRSOptionImplemented is true; otherwise the AP shall set it to 0. ~~A non-AP STA affiliated with an NSTR non-AP MLD~~ A STA of a non-AP MLD operating on a pair of NSTR links for that MLD shall not transmit a PPDU carrying an MPDU with SRS Control subfield to an AP unless a STA affiliated with the non-AP MLD has received from the AP MLD a Basic Multi-Link element with the SRS Support subfield equal to 1. A non-AP STA shall not transmit a TB PPDU carrying an MPDU with SRS Control subfield.An AP shall not transmit a PPDU carrying an MPDU with SRS Control subfield to a STA.NOTE 5—If the received SRS Support subfield from an AP is equal to 0, a non-AP STA might not be able to perform multiple frame transmission in a TXOP over NSTR link pair(s) with the AP, unless the expected duration of solicited PPDU transmitted on NSTR link pair(s) are the same. If ~~STAs affiliated with an NSTR non-AP MLD~~ STAs of a non-AP MLD operating on a pair of NSTR links simultaneously transmit PPDUs to the respective APs affiliated with an AP MLD that has dot11SRSOptionImplemented equal to true, the transmitted PPDUs solicit control response frames and the ~~NSTR~~ non-AP MLD intends to align the end times of the PPDUs sent in response by the peer APs, then at least one of the PPDUs soliciting a control response frame shall carry an MPDU with SRS Control subfield. The STA shall set the PPDU Response Duration subfield of the SRS Control subfield to a value that is equal to or longer than the maximum of the expected duration of the response PPDUs on all links, where the expected duration of the response PPDU is calculated based on the following parameters: |
| 6738 | 35.3.14.5 | 278.01 | "...the response PPDU to any of the DL PPDUs, the difference between the end times of the DL PPDUs on link 2 and link 3 cannot be greater than 8 μs."Is cannot the intention or is it supposed to be shall not? | Change to "...the response PPDU to any of the DL PPDUs, the difference between the end times of the DL PPDUs on link 2 and link 3 shall not be greater than 8 μs." | Rejected- This paragraph and Figrue 35-12 is not for describing normative behavior. Additional “shall” sentence is not necessary.  |
| 7788 | 35.3.14.5 | 278.06 | The Figure 35-12 somehows shows the Resoponse frames from STA MLD (TB PPDU, ACKs) end at the same time, which could be quite misleading. Because this figure is just to illustrate that the AP MLD shall align its PPDUs' end time, and there are no PPDU end time alignment about the STA MLD's response frames | Please change the figure per comments, or add a note that says the figure doesn't mean the end time of the STA MLD's response frames are not required to be aligned | Rejected-Figure 35-12 just an illustration for PPDU end time alignment. It does not say any normative behavior on the response PPDU.  |