IEEE P802.11  
Wireless LANs

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| Submission  CR 35.3.13.3 NSTR operation | | | | |
| Date: 2021-04-13 | | | | |
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Abstract

This submission proposes resolutions to TGbe CC34 CIDs as listed:

1176 1177 1178 1434 1700 1701 2100 2101 2194 2209 2711 2980 3033 3034 3035 3036 3140 3146 3147 3389 3390 3391 3428

These CIDs are related to the subject of NSTR operation

Revisions:

* R0: Initial version of the document.
* R1:
  + Modify resolution of CID 2980 – clarify rationale for REJECT and add another rationale for the REJECT
  + 35.3.13.3 changes – change “receiving MLD” to “intended recipient MLD”
  + 35.3.13.3 changes – change “did not transmit” to “does not initiate transmission” – the use of “initiate” more clearly ties the action here to the conditional action in the previous sentence so as to allow a less ambiguous determination of which STA is the subject STA
  + Add “affiliated with a different MLD” to ensure that it is clear that the new intended recipient STA is not of the same MLD (it seems logically impossible that it is not the same MLD, but just in case)
  + Add link references so that it is clear that the required actions are occurring only on the link where the intended transmission was not initiated
  + Add “AC” as needed to clarify that only the non initiated frame’s AC is involved
* R2:
  + CIDI 2711 –slight modification to wording of the resolution, without changing the nature of the resolution
  + 35.3.13.3 - paragraph relating to should not transmit to a STA that is transmitting on another link - slight wording change to make the non-bullet wording more closely match the wording of the first subbullet phrasing so that it is clear that the subbullet is not introducing a new access mechanism or rule, but simply stating that, provided that the existing EDCA rules are met, any frame in the winning AC queue may be transmitted
  + 35.3.13.3 – first subbullet of the paragraph relating to should not transmit to a STA that is transmitting on another link - remove “affiliated with a different MLD”, as this is too restrictive and redundant
* R3:
  + CID 2100 – revert change of “STA” back to “AP” in the first “should” paragraph of 35.3.13.3
  + CID 1700 – moved reference to clause 36 receiver requirements into 35.3.13.4
    - Doc 11-21-0530 contains the NSTR definition which had a reference to 35.3.13.3 which is now adjusted, see that doc for details
  + CID 2101 – add discussion material
* R4:
  + CID 1700 – moved changes for 35.3.13.4 to definition of NSTR in doc 11-21-0530
  + CID 1700 – removed proposed changes to 35.3.13.2
  + CID 1701 – change NSTR and STR to STR and NSTR where STR is being defined. I.e. a STA can signal the pairs which are NSTR, which then determines which pairs are STR, and not the other way around.
* R5:
  + Add a bullet itme c) to allow no backoff invocation under some circumstances
* R6:
  + Add instructions regarding item c) backoff window (CW)
* R7:
  + In item c), change the part about transmission proceeding immediately to a NOTE, as this is described in the referenced subclause
  + In item c), change the wording slightly regarding keeping the CW unchanged
  + Add similar backoff CW rules/options for a non-AP STA that has deferred a transmission on a link due to NSTR activity
  + Add similar backoff CW rules/options for an AP that has deferred a transmission on a link due to group addressed RX activity
* R8:
  + An AP or STA cannot always definitively determine when a STA is transmitting on a link. Added language to adjust for this. (AP or STA “has determined that”)
  + Change “circumstances” to “conditions” to be consistent
  + Delete the editor’s note
  + Add editing for 10.23.2.2 EDCA backoff procedure, to account for the new reasons to invoke backoff
  + Remove phrase indicating that CW is to be left unchanged, as the condition a) in 10.23.2.2 already includes this
  + Changed an incorrect subclause reference value
  + Included “item a)” reference for the 10.23.2.2 reference
* R9:
  + Add PIFS to the transition to non-empty event for the STA deferral case to cover the possibility that a new reception begins after a response transmission which follows the reception of the frame that had prevented a transmission on the other NSTR link, such that this PIFS causes enough delay to force the deferred link to the BUSY condition before it has a chance to initiate the deferred transmission and instead, for this case, will then invoke backoff to avoid transmitting on top of the new reception of the continuing TXOP on the other link
  + For the virtual empty queue case, add yet another reference, to 10.23.2.4, to cover the medium IDLE case
  + Change the 10.23.2.2 item f) to e) in order to fit inside of the “shall invoke backoff” section instead of the “may invoke backoff”
  + Change the invoke backoff item wording to a reference to the newly created item e) of 10.23.2.2 and call this condition NSTR deferral for proper referencing
  + Change “shall be followed” to “is followed”, because the text points to a reference which is already normative (i.e. removing a double shall)

***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.***

**CIDs**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CID** | **Commenter** | **Clause** | **Page** | **Comment** | **Proposed Change** | **Resolution (Proposed)** |
| 1176 | Arik Klein | 35.3.13.3 | 142.08 | In case of NSTR link pair, a non-AP STA that transmits MPDU on one link which is member of this NSTR link pair at the same time while it receives MPDU on the other link that is the other member of this NSTR link pair might fail with the reception (due to the interference from the link which initiates the transmission and since the receiver does not meet the requirements specified in Clause 36 on the relevant link, as the condition for NSTR is defined in the preceding sentence on the same section). Therefore, why the sentence use "should" verb and not "shall" verb as follows: " An AP that is affiliated with an MLD \*should\* not transmit to a STA affiliated with a non-AP MLD, a frame on a link of an NSTR link pair..." | Consider replacing the "should" with "shall" in this sentenece. | Reject – the receive requirements are very simple and do not cover all of the possible cases that could occur. It might happen that there is enough SINR in the receiving link to allow the reception to withstand the transmission in the other link, because the reception in the receiving link is not the same as the reception described in the reception requirements of clause 36. |
| 1177 | Arik Klein | 35.3.13.3 | 142.13 | In case of NSTR link pair, a non-AP STA that transmits MPDU on one link which is member of this NSTR link pair at the same time while it receives MPDU on the other link that is the other member of this NSTR link pair might fail with the reception (due to the interference from the link which initiates the transmission and since the receiver does not meet the requirements specified in Clause 36 on the relevant link, as the condition for NSTR is defined in the preceding sentence on the same section). Therefore, why the sentence use "should" verb and not "shall" verb as follows: " A STA that is affiliated with a non-AP MLD \*should\* not transmit a frame on a link of one of its NSTR link pairs at the same time that another STA..." | Consider replacing the "should" with "shall" in this sentenece. | Reject – the receive requirements are very simple and do not cover all of the possible cases that could occur. It might happen that there is enough SINR in the receiving link to allow the reception to withstand the transmission in the other link, because the reception in the receiving link is not the same as the reception described in the reception requirements of clause 36.  Additionally, even if the transmission might cause an error in the reception, the use of should gives the transmitter the ability to decide whether the benefit of performing the transmission will outweigh the cost of the receive failure as well might be the case. An example of when this would probably be true is if the reception is a long AMPDU and the transmission is a short BA. The short BA will prevent a retransmission on an entire AMPDU on the other link at the cost of the loss of one or two MPDUs on the receiving link. This is a reasonable net gain tradeoff and should be a possible option for a STA. |
| 1178 | Arik Klein | 35.3.13.3 | 142.18 | In case of NSTR link pair, a non-AP STA that transmits MPDU on one link which is member of this NSTR link pair at the same time while it receives MPDU on the other link that is the other member of this NSTR link pair might fail with the reception (due to the interference from the link which initiates the transmission and since the receiver does not meet the requirements specified in Clause 36 on the relevant link, as the condition for NSTR is defined in the preceding sentence on the same section). Therefore, why the sentence use "should" verb and not "shall" verb as follows: " An AP MLD \*should\* not transmit a frame that solicits an immediate response to a STA that is affiliated with a non-AP MLD on a link ..." | Consider replacing the "should" with "shall" in this sentenece. | Reject – the receive requirements are very simple and do not cover all of the possible cases that could occur. It might happen that there is enough SINR in the receiving link to allow the reception to withstand the transmission in the other link, because the reception in the receiving link is not the same as the reception described in the reception requirements of clause 36.  Additionally, even if the transmission might cause an error in the reception, the use of should gives the transmitter the ability to decide whether the benefit of performing the transmission will outweigh the cost of the receive failure as well might be the case.  In this particular case, it is already known that group addressed frames have an unknown delivery outcome even without an interfering local transmission. Since any group frame can be lost at any time without the transmitter knowing of the loss, it is fair to presume that an induced loss is not creating much of a new problem. |
| 1434 | Chien-Fang Hsu | 35.3.13.3 | 142.13 | "a frame" here means any frames including management and control frames? | Clarify it | Reject – when not qualified, frame means any MAC MPDU or MMPDU. |
| 1700 | GEORGE CHERIAN | 35.3.13.3 | 142.01 | "An MLD may indicate a pair of links as STR by setting the TBD field in the TBD elements that it transmits if the receiver requirements specified in Clause 36 (Extremely high throughput (EHT) PHY specification) on one link are met whenever it is transmitting on the other link."  This is duplicate of lines in pp-141LL34/35.3.13.2. Remove this sentence | As in the comment | Revise – TGbe editor to delete the cited sentence and slightly modify the wording of the subsequent sentence that relates STR pairs and NSTR pairs as shown in the changes labeled CID 1700 within 11-21/0558r9 |
| 1701 | GEORGE CHERIAN | 35.3.13.3 | 142.06 | "A pair of links that is not indicated as STR shall be indicated as NSTR"  Rephrease as follows:  "An AP MLD shall consider all the link-pairs that are not indicated by the Non-AP MLD as STR capable to be NSTR link-pair(s)" | As in the comment | Revise – TGbe editor to modify the cited sentence as shown in the changes labeled CID 1701 within 11-21/0558r9, which generally agrees with the sentiment of the commenter, but uses different wording. |
| 2100 | kaiying Lu | 35.13.3 | 142.08 | An AP that is affiliated with an MLD should not transmit to a STA affiliated with a non-AP MLD, a frame on a link of an NSTR link pair of the non-AP MLD at the same time that the non-AP MLD is a TXOP holder on the other link of the NSTR link pair | change "transmitting a frame" to " a TXOP holder" | Revise – TGbe editor to modify the cited sentence as shown in the changes labeled CID 2100 within 11-21/0558r9, which, rather than replacing the existing condition, adds to it, as TXOP holder does not capture the possibility of the NSTR limited STA transmitting a response frame. |
| 2101 | kaiying Lu | 35.13.3 | 142.13 | A STA that is affiliated with a non-AP MLD should not transmit a frame on a link of one of its NSTR link pairs at the same time that another STA that is affiliated with the same non-AP MLD is a TXOP responder on the other link of the NSTR link pair. | change "receiving a frame addressed to that receiving STA" to " a TXOP responder" | Revise – TGbe editor to modify the cited sentence as shown in the changes labeled CID 2101 within 11-21/0558r9, which, rather than replacing the existing condition, adds to it, as TXOP holder does not capture the possibility of the NSTR limited STA transmitting a response frame. |
| 2194 | Li-Hsiang Sun | 35.3.13.3 | 142.22 | "and the non-AP MLD is expected to be receiving those group addressed MPDUs." But how does AP MLD know the non-AP MLD will use "another link" to receive group addressed frames? | remove "and the non-AP MLD is expected to be receiving those group addressed MPDUs." | Reject – the rules for MLD reception of group addressed frames have not been finalized at this time, so the possibility of the AP having an expectation of a STA of a non-AP MLD receiving group addressed frames is theoretically possible. |
| 2209 | Liwen Chu | 35.3.13.3 | 142.08 | Here the avoidance of simultaneous Tx and Rx at NSTR non-AP MLS is not mandatory requrement. However the same ending time requirement at AP MLD to NSTR non-AP MLD is mandatory requirement. | Harmonize them, e.g. rmove the mandatory requirement | Reject – the commenter is asking for the removal of some mandatory behavior, but there is no mandatory behavior described in the cited text, or in the entire cited subclause. |
| 2711 | Ryuichi Hirata | 35.3.13.3 | 142.01 | The ability to perform STR depends on some parameters (BW, Tx Power, etc.). But current spec does not consider this and this may reduce spectrum efficiency. | Solve this issue. This could be solved by indicating additional parameters about the ability to perform STR (cross link interference, etc.) and enable MLD to change STR/NSTR operation dynamically. | Reject – The group has examined and debated proposals to include additional parameteric information regarding the details of the NSTR condition and has failed to reach a consensus to include a mechanism to communicate such information, for example, see 11-20-0527 and 11-20-0226. The commenter is welcomed to bring an alternative to the group for further discussion. |
| 2980 | Tomoko Adachi | 35.3.13.3 | 0.00 | For the transmitter to easly confirm that the NSTR MLD as the recipient is transmitting in one of the links, it is better to set a constraint on NSTR transmission. The AP MLD sets an anchor link for the NSTR transmission and notifies through Beacon and Probe Response frames. The NSTR MLDs need to at least acquire TXOP at the anchor link to start transmission. Transmission on other links if any needs to fit within the TXOP at the anchor link. Then the other MLDs only need to monitor the anchor link to judge if the recipient NSTR MLD is transmitting or not. If the recipient NSTR MLD is transmitting at the anchor link, the MLD defers the transmission to it until the exchange ends at the anchor link. If the recipient NSTR MLD is not transmitting on the anchor link, an STR MLD can transmit to it on any links between them. No restriction required for STR MLD to STR MLD transmission. | As in comment. | Reject – While it is true that a larger number of NSTR link pairs will create an increasing burden of cross-pair monitoring, that burden is rathe minimal. One only needs a value of “who is the TXOP owner” per link. Any device that needs to check the value does not have a much larger problem if there are two values to check instead of one.  Additionally:  The behavior is not mandatory, but recommended, as indicated by the use of the verb “should” – i.e. if the complexity is overwhelming, the choice can be made to not implement it.  And:  Removing the ability of a non-AP STA to be able to use the first available link reduces some of the gain of ML operation for an NSTR non-AP STA, which is reduced latency  Even if an anchor link were created, knowing who the TXOP holder (UL transmitter in this case) is, is not enough, as the AP might be performing DL to STAx on the non-anchor link, then for the anchor link, the AP might want to know if there is any BA transmission pending on the non-anchor link. I.e. the AP still needs to check something other than the anchor link. I.e. a reduction in cross link monitoring is not achieved – note that one could ignore short response frames, but there is still the possibility of Triggered UL PPDUs on the non-anchor link which are potentially very long. So again, creating an anchor link does not remove the requirement to check the activity on the other links. |
| 3033 | Xiaofei Wang | 35.3.13.3 | 142.08 | why "should", if the pair of links are NSTR, isn't "shall" more appropriate? |  | Reject – changing to a mandatory requirement adds burden to the transmitting device which might be excessive for some implementers. Maintaining the verb should encourages implementers to include the necessary additional complexity to achieve the objective. Additionally, even in the presence of excellent cross link communication, there is the possibility that a net-gain position can be realized by transmitting despite the NSTR limitation. For example, transmitting a BA after a long PPDU reception will validate the use of >5000 usec of medium time, while potentially causing the failure of one or two MPDUs during 200 usec of medium time. |
| 3034 | Xiaofei Wang | 35.3.13.3 | 142.13 | why "should", if the pair of links are NSTR, isn't "shall" more appropriate? |  | Reject – changing to a mandatory requirement adds burden to the transmitting device which might be excessive for some implementers. Maintaining the verb should encourages implementers to include the necessary additional complexity to achieve the objective. Additionally, even in the presence of excellent cross link communication, there is the possibility that a net-gain position can be realized by transmitting despite the NSTR limitation. For example, transmitting a BA after a long PPDU reception will validate the use of >5000 usec of medium time, while potentially causing the failure of one or two MPDUs during 200 usec of medium time. |
| 3035 | Xiaofei Wang | 35.3.13.3 | 142.16 | How about when the other link is receving a broadcast frames, such as beacons? Those can be ignored? |  | Reject – a beacon is group addressed and therefore is included in the set of frames that the transmitter should avoid potentially causing to fail by transmitting. |
| 3036 | Xiaofei Wang | 35.3.13.3 | 142.18 | why "should", if the pair of links are NSTR, isn't "shall" more appropriate? |  | Reject – changing to a mandatory requirement adds burden to the transmitting device which might be excessive for some implementers. Maintaining the verb should encourages implementers to include the necessary additional complexity to achieve the objective. Additionally, even in the presence of excellent cross link communication, there is the possibility that a net-gain position can be realized by transmitting despite the NSTR limitation. For example, transmitting a BA after a long PPDU reception will validate the use of >5000 usec of medium time, while potentially causing the failure of one or two MPDUs during 200 usec of medium time. |
| 3140 | Yong Liu | 35.3.13.3 | 142.06 | If an MLD shares a radio between a pair of links, should these links be indicated as STR or NSTR? | Clarify | Reject – at other locations in the draft amendment, the criteria for determining whether to indicate a pair of links as NSTR is provided. The question asked by the commenter is easily resolved by examining those criteria, specifically: [for each pair of links, if the pair] supports transmission on one link concurrent with reception on the other link |
| 3146 | Yongho Kim | 35.3.13.3 | 142.08 | "should" needs to be changed to "shall" because it is obvious to make interference if an AP transmits a frame to a STA while the STA is transmitting a frame on the other link of the NSTR link pair. | As in the comment. | Reject – changing to a mandatory requirement adds burden to the transmitting device which might be excessive for some implementers. Maintaining the verb should encourages implementers to include the necessary additional complexity to achieve the objective. Additionally, even in the presence of excellent cross link communication, there is the possibility that a net-gain position can be realized by transmitting despite the NSTR limitation. For example, transmitting a BA after a long PPDU reception will validate the use of >5000 usec of medium time, while potentially causing the failure of one or two MPDUs during 200 usec of medium time. |
| 3147 | Yongho Kim | 35.3.13.3 | 142.08 | When a frame is defered to transmit according to the description, in order to defer and transmit the frame as soon as the other link's STA's transmission finises, the rules defined in 35.3.13.6 can be used. If an AP follows the rule "When the backoff counter of the STA reaches zero, it may choose not to transmit and keep its backoff counter at zero.", the AP can perform a backoff procedure in one link while waiting for the other link's STA's transmssion and wait and transmit a frame as soon as the other link's transmission finishes. It is necessary to define the procedure when an AP decides to defer a frame transmission. | As in the comment. | Revise – TGbe editor to modify the cited sentence as shown in the changes labeled CID 3147 within 11-21/0558r9, which generally agrees with the sentiment of the commenter, but includes additional conditions because the situation described in 35.3.13.6 is a bit different |
| 3389 | Zhou Lan | 35.3.13.3 | 142.08 | "...affiliated with an MLD should not transmit to...". Please clarify it is a SHOULD or SHALL requirment here. | As stated in the comment | Reject – changing to a mandatory requirement adds burden to the transmitting device which might be excessive for some implementers. Maintaining the verb should encourages implementers to include the necessary additional complexity to achieve the objective. Additionally, even in the presence of excellent cross link communication, there is the possibility that a net-gain position can be realized by transmitting despite the NSTR limitation. For example, transmitting a BA after a long PPDU reception will validate the use of >5000 usec of medium time, while potentially causing the failure of one or two MPDUs during 200 usec of medium time. |
| 3390 | Zhou Lan | 35.3.13.3 | 142.13 | "...affiliated with an MLD should not transmit to...". Please clarify it is a SHOULD or SHALL requirment here. | As stated in the comment | Reject – changing to a mandatory requirement adds burden to the transmitting device which might be excessive for some implementers. Maintaining the verb should encourages implementers to include the necessary additional complexity to achieve the objective. Additionally, even in the presence of excellent cross link communication, there is the possibility that a net-gain position can be realized by transmitting despite the NSTR limitation. For example, transmitting a BA after a long PPDU reception will validate the use of >5000 usec of medium time, while potentially causing the failure of one or two MPDUs during 200 usec of medium time. |
| 3391 | Zhou Lan | 35.3.13.3 | 142.18 | "...affiliated with an MLD should not transmit to...". Please clarify it is a SHOULD or SHALL requirment here. | As stated in the comment | Reject – changing to a mandatory requirement adds burden to the transmitting device which might be excessive for some implementers. Maintaining the verb should encourages implementers to include the necessary additional complexity to achieve the objective. Additionally, even in the presence of excellent cross link communication, there is the possibility that a net-gain position can be realized by transmitting despite the NSTR limitation. For example, transmitting a BA after a long PPDU reception will validate the use of >5000 usec of medium time, while potentially causing the failure of one or two MPDUs during 200 usec of medium time. |
| 3428 | Yonggang Fang | 35.3.13.3 | 141.60 | NSTR operation should include ML EDCA (or CCA), ML transmission, and/or link switch. ML EDCA (or CCA) and link switch parts are missing. Suggest to add those clauses under 35.3.13.3 NSTR operation. | as suggested in comment. | Reject – ML modifications to EDCA rules are described elsewhere with appropriate sublcauses including special consideration for NSTR link pair access. Link switch operations are independent of NSTR and any NSTR changes resulting from link switching can be signaled dynamically. Of the other subclauses that address EDCA issues, 35.3.13.6 Start time sync PPDUs medium access is common to NSTR and STR and therefore cannot be brought into an NSTR-only subclause. Subclauses 35.3.13.4 Capability signaling and 35.3.13.7 Medium synch recovery could both be merged into the NSTR operation subclause. |

**Discussion**

**CID 3147**

The CID calls attention to a deficiency in the following text:

An AP that is affiliated with an MLD should not transmit to a STA affiliated with a non-AP MLD, a frame on a link of an NSTR link pair of the non-AP MLD at the same time that the non-AP MLD is transmitting a frame or is a TXOP holder on the other link of the NSTR link pair. **(#2100)**

The problem here is that if the AP does DEFER a TX, then what is the rule for continuing EDCA/TX operations at that AP after that deferral occurs?

Currently, we have specified such text for the case of a STA operating on an NSTR link pair, where the rules are intended to attempt to create synchronous transmissions, and in the case when the attempt to gain access to both links fails, there are rules to determine what to do with the EDCA function at the non-transmitting links.

The commenter points to those rules as a possible choice of what the AP could do in the cited text.

However:

1. The cited text refers to an AP, and the suggested rules of reference specifically refer to a non-AP
2. The cited text should be broadened to cover any STA transmitting on any NSTR link of any other STA, the type of STA performing the transmission is immaterial, only the NSTRness of the target STA matters
3. The cited rules for non-AP STA behaviour do NOT cover the case indicated

See the proposed changes.

**CID 3428**

The CID asks for NSTR ML EDCA and NSTR link switch behaviour to be included in the NSTR operation subclause

The ML EDCA modifications are applicable to EDCA operations on NSTR links and STR links, and therefore, must stand separately.

Link switch operations are not affected by the NSTR/STR nature of the links. The link switch operation might cause a subsequent change in NSTR designation, but at most, this would appear as a note in the NSTR capability signalling subclause.

One might move the following into the NSTR operation subclause:

The NSTR capability signalling subclause (35.3.13.4)

The Medium Synchronization recovery procedure (35.3.13.7)

There are currently no propsed changes relating to this CID.

**CID 2101**

A question arises:

Are the rules described in **35.3.13.5** **PPDU end time alignment** already sufficient regarding NSTR non-AP MLD TX operations so that the addition of “or is a TXOP holder” is not needed in the paragraph that begins with “A STA that is affiliated with a non-AP MLD should not transmit”?

The answer is “no”.

I.e. the modification is needed to the paragraph because the rules in 35.3.13.5 are written specifically to cover AP initiated PPDU end time alignment. This means that it is possible that some non-AP STA might be transmitting to this MLD or to some other STA and this STA either wins a round of contention or is scheduled to transmit a response frame. Such cases are not covered by the PPDU end time alignment rules. Note that these cases are not restricted to cases where a peer is communicating with the STA in question, meaning that even if the group adopts a restriction against MLD operation between peers, the addition of “is a TXOP holder” is still needed.

**Proposed changes**

***TGbe editor: Within TGbe Draft D0.4, add the following subclause heading and editing instruction as shown:***

**10.23.2.2 EDCA backoff procedure**

***Change the fourth through seventh paragraphs as shown:***

The backoff procedure shall be invoked by an EDCAF when any of the following events occurs:

a) An MA-UNITDATA.request primitive is received or the transmit queues associated with that AC have become non-empty due to the conditions in 35.3.13.3 (Nonsimultaneous transmit and receive (NSTR) operation), either of which causes an MPDU corresponding to the EDCAF’s AC to be queued for transmission such that all of the following are true:

1) One of the transmit queues associated with that AC has now become non-empty

2) Any other transmit queues associated with that AC are empty

3) The backoff counter has a value of 0 for that AC

4) The medium is busy on the primary channel as indicated by any of the following:

— Physical CS

— Virtual CS

— A nonzero TXNAV timer value

— For a mesh STA that has dot11MCCAActivated true, a nonzero RAV timer value

b) For the EDCAF that is the TXOP holder, the transmission of the final PPDU transmitted by the TXOP holder during the TXOP has completed and the TXNAV timer has expired.

c) For the EDCAF that is the TXOP holder, the transmission of an MPDU in the initial PPDU of a TXOP fails, as defined in this subclause.

d) A transmission attempt by the EDCAF collides internally with another EDCAF of an AC that has higher priority, that is, two or more EDCAFs in the same STA are granted a TXOP at the same time.

e) An NSTR deferral is performed due to one of the conditions described in 35.3.13.3 (Nonsimultaneous transmit and receive (NSTR) operation).

In addition, the backoff procedure may be invoked by an EDCAF when:

f) For the EDCAF that is the TXOP holder, the transmission by the TXOP holder of an MPDU in a non-initial PPDU of a TXOP fails, as defined in this subclause.

NOTE 1—If the transmission by the TXOP holder of an MPDU in a non-initial PPDU of a TXOP failed, the STA can

perform either a PIFS recovery, as described in 10.23.2.8 (Multiple frame transmission in an EDCA TXOP), perform a

backoff as described in item f) above, or wait for the TXNAV timer to expire and invoke the backoff procedure per item

b) above. How it chooses among these options is implementation dependent.

A STA that performs a backoff within its existing TXOP per item f) above shall not extend the TXNAV timer value (see 10.23.2.8 (Multiple frame transmission in an EDCA TXOP)).

NOTE 2—In other words, the backoff is a continuation of the TXOP, not the start of a new TXOP.

If the backoff procedure is invoked for reason a) or e) above, CW[AC] and QSRC[AC] shall be left unchanged.

***TGbe editor: Within TGbe Draft D0.4, change the text within subclause 35.3.13.3 Nonsimultaneous transmit and receive (NSTR) operation, as shown:***

35.3.13.3 Nonsimultaneous transmit and receive (NSTR) operation

**(#1700, #1701)**

**(#1700)**A pair of links that is not indicated as an NSTR pair is an STR pair. **(#1700, #1701)**

An AP that is affiliated with an MLD should not initiate the transmission of a frame on one link of an NSTR link pair of the intended recipient MLD at the same time that the AP has determined that a STA of the intended recipient MLD is transmitting a frame or is a TXOP holder on the other link of the NSTR link pair. An AP of an MLD that has gained the right to initiate transmission of a frame of an AC on a link through the rules for EDCA backoff in 10.23.2.4 (Obtaining an EDCA TXOP) but which does not initiate the transmission of a frame on that link due to either of these conditions shall perform exactly one of the following actions:

1. Initiate transmission on that link, of a different frame of the same AC to a different STA
2. Perform an NSTR deferral for the EDCAF associated with that AC by invoking backoff per item e) of 10.23.2.2 (EDCA backoff procedure)
3. If no frame to a different STA is in the TX queue for that AC, consider the TX queue for that AC to be empty until either a frame to a different STA appears in the queue or the conditions described above no longer exist, at which time, the queue is considered non-empty and the procedure described in item a) of 10.23.2.2 (EDCA backoff procedure) is followed if the medium is busy as described in item a), otherwise, transmission proceeds immediately as per 10.23.2.4 (Obtaining an EDCA TXOP) **(#2100, #3147)**

NOTE – If a transmission is initiated per item a) above, then transmission by the EDCAF is not deferred for the purposes of determining the correct behavior in 10.23.2.2 (EDCA backoff procedure).

NOTE – In item c) above, when the queue is considered non-empty, if the backoff procedure is not invoked per the conditions described in 10.23.2.2 (EDCA backoff procedure), then transmission proceeds immediately. **(#2100, #3147)**

A STA that is affiliated with a non-AP MLD should not transmit a frame on a link of one of its NSTR link pairs at the same time that the STA has determined that another STA that is affiliated with the same non-AP MLD is either a TXOP holder or is receiving a frame addressed to that receiving STA on the other link of the NSTR link pair. A STA that is affiliated with a non-AP MLD that has gained the right to initiate transmission of a frame of an AC on a link through the rules for EDCA backoff in 10.23.2.4 (Obtaining an EDCA TXOP) but which does not initiate the transmission of a frame on that link due to either of these conditions shall perform exactly one of the following actions:

1. Perform an NSTR deferral for the EDCAF associated with that AC by invoking backoff per item e) of 10.23.2.2 (EDCA backoff procedure)
2. Consider the TX queue for that AC to be empty until PIFS after the condition described above no longer exists, at which time, the queue is considered non-empty and the procedure described in item a) of 10.23.2.2 (EDCA backoff procedure) is followed if the medium is busy as described in item a), otherwise, transmission proceeds immediately as per 10.23.2.4 (Obtaining an EDCA TXOP) **(#2101, #2100, #3144)**

NOTE – In item b) above, when the queue is considered non-empty, if the backoff procedure is not invoked per the conditions described in 10.23.2.2 (EDCA backoff procedure), then transmission proceeds immediately. **(#2100, #3147)**

An AP MLD should not transmit a frame that solicits an immediate response to a STA that is affiliated with a non-AP MLD on a link that is a member of one or more NSTR link pairs for that non-AP MLD, if the immediate response is expected to overlap in time with group addressed MPDUs scheduled in another link of any of those NSTR link pairs and the non-AP MLD is expected to be receiving those group addressed MPDUs. An AP of an MLD that has gained the right to initiate transmission of a frame of an AC on a link through the rules for EDCA backoff in 10.23.2.4 (Obtaining an EDCA TXOP) but which does not initiate the transmission of a frame on that link due to this condition shall perform exactly one of the following actions:

1. Initiate transmission on that link, of a different frame of the same AC to a different STA
2. Perform an NSTR deferral for the EDCAF associated with that AC by invoking backoff per item e) of 10.23.2.2 (EDCA backoff procedure)
3. If no frame to a different STA is in the TX queue for that AC, consider the TX queue for that AC to be empty until either a frame to a different STA appears in the queue or the condition described above no longer exists, at which time, the queue is considered non-empty and the procedure described in item a) of 10.23.2.2 (EDCA backoff procedure) is followed if the medium is busy as described in item a), otherwise, transmission proceeds immediately as per 10.23.2.4 (Obtaining an EDCA TXOP) **(#2100, #3147)**

NOTE – If a transmission is initiated per item a) above, then transmission by the EDCAF is not deferred for the purposes of determining the correct behavior in 10.23.2.2 (EDCA backoff procedure).

NOTE – In item c) above, when the queue is considered non-empty, if the backoff procedure is not invoked per the conditions described in 10.23.2.2 (EDCA backoff procedure), then transmission proceeds immediately. **(#2100, #3147)**

If a STA that is affiliated with a non-AP MLD successfully obtains a TXOP on one link of one of its NSTR link pairs before the TBTT of the other link of the NSTR link pair, then it should end its TXOP before the TBTT of the other link if it intends to receive Beacon frames on the other link.

NOTE—The STA may not do so if it is not aware of the TSF of the other link.