IEEE P802.11
Wireless LANs

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| LB275 CR for CID 19876 NSTR Operation |
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Abstract

This submission proposes resolutions of comments received from TGbe comment collection LB275 based on TGbe D4.0.

19876 (1 CID)

Revisions:

* Rev 0: Initial version of the document.
* Rev 1: Added discussion and editorial changes.
* Rev 2: Date updated.
* Rev 3: Added brief review in discussion
1. **Introduction**

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. The introduction and the explanation of the proposed changes are 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 802.11be 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** |
| 19876 | 35.3.16.4 | 556.01 | non-AP MLD may be awake on both links of an NSTR link pair when it is receiving on one link, even though the AP MLD may not send a PPDU on the other link. This is not good for STA power save. | Allow a non-AP MLD to inform the AP MLD that when the non-AP MLD is communivating on one link, the STA on another link of an NSTR link pair will in power save status, so the AP MLD will not send PPDU on the another link to this non-AP MLD. | Revised-Agree with the comment in principle. An indication for power save on the other NSTR link is added.Apply the changes marked as #19876 in this document. |

**Discussion:**

For the two links in a NSTR link pair, the case where one link is transimitting when the other link is receiving is prohibited. The links have to do PPDU end time alignment as per 35.3.16.5 (PPDU end time alignment on an NSTR link pair). The following figure is a brief illustration.



This limitation obviously adds complexity on the transmitter. As a result, an MLD may choose not to transmit on both links in practice. Generally, there are multiple reasons why an MLD does not use both links:

1. One link is sufficient to deliver traffic, especially in low-rate scenarios;
2. To reduce complexity.

As per the current draft standard, the receiver does not know whether the transmitter is going to use both links or not. The receiver has to stay awake/active during the receiption on the other link, although the transmitter does not send anything on the link during the time. (As shown in the following figure.)



The proposed change is to allow the link not being used to transition from awake state to doze state automatically and let both the transmitter and the receiver be aware of that transition. The main purpose is to save power at the non-AP MLD side (and the AP side if it wants to).



**Motivation:**For some reasons, AP MLD may use only one link of the NSTR link pair to do frame exchange.

As per the current draft, the link in the NSTR link pair which is not used has to stay awake. That is a waste of power.

This proposal introduces **a new PS mode** for the link which is not used to do power save automatically.

(Transmitting on both links with start times aligned is allowed by the current draft. We use “may” in the proposed text.)

**How the new mode works:**

1. AP MLD need to announce whether it supports the mechanism using the newly added **capability** bit **“NSTR Power Save”** in the MLD Capabilities and Operations field. Only when the bit is set to 1, non-AP MLDs could exchange Request/Response frames with the AP MLD.
2. Non-AP MLD initiates Request/Response frame exchange to enter the NSTR Power Save mode. (The Request frame and Response frame are **new action frames**. To enter the mode, the newly added **enablement/disablement** bit **“NSTR Power Save Mode”** in the Request frame is set to 1.)
3. Under the mode, if AP MLD intends to use both links of a NSTR pair of the non-AP MLD, it has to do start time alignment. Otherwise, the AP MLD can only use one link and the other link can enter the doze state. (In this case, all links belonging to NSTR link pairs with the transmitting link won’t be used by the AP MLD.)
4. If the non-AP MLD wants to exit this mode, it shall initiate Request/Response frame exchange with NSTR Power Save Mode bit in the Request frame set to 0.

**Benefit:**

1. To save power.
2. Overhead & Efficiency: **The only overhead is the Request/Response frame exchange for entering/exiting the mode.** As long as the non-AP MLD enters the mode, the unused link will do conditional power save **automatically**, no additional signaling.

**Comparison with other methods:**

1. With **EMLSR/EMLMR**:

To enter EMLSR/EMLMR mode, Request/Response frame exchange is needed. What’s more, **an initial frame** is required for each frame exchange. **Transition delay padding** is needed for switching RF chains.

To enter NSTR PS mode, Request/Response frame exchange is needed. Then, PS is done **automatically**. It is almost **instantaneous** for the unused link to do PS.

However, EMLSR/EMLMR and NSTR PS are not competitors. They can be both implemented. EMLSR/EMLMR is used for PS in **high-data-rate scenarios at the cost of additional signaling** overhead. NSTR PS is used for PS in **low-data-rate scenarios**.

1. **Traditional PS**:

According to traditional PS mechanism, the non-AP MLD needs to signal AP MLD which link is going to be doze.

However, “which link is to be used” and “when the one link is sufficient to deliver traffic”, those kinds of information is at the AP MLD side. Non-AP MLD does not know when and which link should do power save.

Thus, traditional PS and NSTR PS can be both implemented and

**Traditional PS** is used when the non-AP MLD does PS **actively**,

while the **NSTR PS** is used when the non-AP MLD does PS **passively**.

**Proposed spec text**

***TGbe editor: Please insert the following paragraphs at the end of subclause 35.3.16.4 (Nonsimultaneous transmit and receive (NSTR) operation): (#19876)***

An AP that is affiliated with an AP MLD shall set the NSTR Power Save subfield in the MLD Capabilities And Operations subfield in a frame that it transmits to 1 if its dot11NSTRPowerSaveImplemented is true. Otherwise, the AP shall set the NSTR Power Save subfield to 0.

A non-AP MLD may notify the updated NSTR power save mode to its associated AP MLD, from which the NSTR Power Save subfield in the MLD Capabilities And Operations subfield set to 1 is received by transmitting an NSTR Power Save Request frame through one of its enabled links. Otherwise, the non-AP MLD shall not send an NSTR Power Save Request frame.

An AP affiliated with an AP MLD shall not transmit an NSTR Power Save Request frame.

An AP MLD that reveived an NSTR Power Save Request frame shall respond with an NSTR Power Save Response frame. The Status Code subfield of the NSTR Power Save Response frame shall be set to 0 (SUCCESS).

The non-AP MLD shall not update its NSTR power save mode indicated in NSTR Power Save Control field of the corresponding NSTR Power Save Request frame until the NSTR Power Save Response frame is reveived.

An AP MLD with the NSTR Power Save subfield in the MLD Capabilities And Operations subfield equal to 1 shall not simultaneously perform frame exchanges with an associated non-AP MLD in NSTR power save mode on any NSTR link pair that belongs to that non-AP MLD. When an AP affiliated with the AP MLD initiates frame exchanges with a non-AP STA affiliated with the non-AP MLD in NSTR power save mode on one link of an NSTR link pair for the non-AP MLD, the non-AP STA affiliated with the same non-AP MLD on another link of that NSTR link pair, if it is in awake state, may enter doze state and shall transition to awake state at the end of frame exchange sequence as described in 35.3.18 (Enhanced multi-link multi-radio operation).

***TGbe editor: Please make the following changes in subclause 9.4.2.312.2.3 (Common Info field of the Basic Multi-Link element): (#19876)***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | B0 B3 | B4 | B5 B6 | B7 B11 |
|  | Maximum Number of Simultaneous Links | SRS Support | TID-To-Link Mapping Negotiation Supported | Frequency Separation For STR/AP MLD Type Indication |
| Bits: | 4 | 1 | 2 | 5 |
|  |  |  |  |  |
|  | B12 | B13 | B14 | B15 |
|  | AAR Support | Link Reconfiguration Operation Support | Aligned TWT Support | NSTR Power Save |
| Bits: | 1 | 1 | 1 | 1 |

**Figure 9-1001k—MLD Capabilities And Operations subfield format**

**Table 9-404j—Subfields of the MLD Capabilities And Operations subfield**

|  |  |  |
| --- | --- | --- |
| **Subfield** | **Definition** | **Encoding** |
| **…** |  |  |
| Aligned TWT Support | Indicates support for an alignement or nonalignment of the TWTs across more than one link | For an MLD:Set to 1 to indicate that an MLD with which the STA is affiliated is capable of receiving a TWT setup frame that requests an alignment or nonalignment of the TWTs acress more than one link. Set to 0 otherwise. |
| NSTR Power Save | An AP MLD indicates support for NSTR power save mode on NSTR link pairs that belong to the associated non-AP MLDs. | For AP MLD:Set to 1 if the AP MLD supports NSTR power save mode.Set to 0 otherwise.Reserved for a non-AP MLD.See 35.3.16.4 (Nonsimultaneous transmit and receive (NSTR) operation). |
| NOTE—Indicating support for TTLM negotiation by setting the TID-To-Link Mapping Negotiation Support subfield to a nonzero value also indicates support for negotiations applicable to all smaller values. Also see 35.3.7.2.1 (General) for rules related to performing ML (re)setup with an AP MLD that has the subfield set to a nonzero value. |

***TGbe editor: Please make the following changes in subclause 9.6.35.1 (Protected EHT Action field): (#19876)***

**Table 9-628c—Protected EHT Action field values**

|  |  |  |
| --- | --- | --- |
| **Value** | **Meaning** | **Time Priority** |
| 0 | TID-To-Link Mapping Request | No |
| 1 | TID-To-Link Mapping Response | No |
| 2 | TID-To-Link Mapping Teardown | No |
| 3 | EPCS Priority Access Enable Request | No |
| 4 | EPCS Priority Access Enable Response | No |
| 5 | EPCS Priority Access Enable Teardown | No |
| 6 | EML Operating Mode Notification | No |
| 7 | Link Recommendation | No |
| 8 | Multi-Link Operation Update Request | No |
| 9 | Multi-Link Operation Update Response | No |
| 10 | Link Reconfiguration Notify | No |
| 11 | Link Reconfiguration Request | No |
| 12 | Link Reconfiguration Response | No |
| 13 | NSTR Power Save Request | No |
| 14 | NSTR Power Save Response | No |
| 15-255 |  |  |

***TGbe editor: Please insert following subclauses after subclause 9.6.35.14 (Link Reconfiguration Response frame format): (#19876)***

**9.6.35.15 NSTR Power Save Request frame format**

The NSTR Power Save Request frame is sent by a non-AP STA affiliated with a non-AP MLD to request to update its NSTR Power Save mode specified in the NSTR Power Save Control field. The Action field of the NSTR Power Save Request frame contains the information shown in Table 9-628q (NSTR Power Save Request frame Action field format).

**Table 9-628q—NSTR Power Save Request frame Action field format**

|  |  |
| --- | --- |
| **Order** | **Information** |
| 1 | Category |
| 2 | Protected EHT Action |
| 3 | Dialog Token |
| 4 | NSTR Power Save Control (see 9.4.1.77(NSTR Power Save Control field)) |

The Category field is defined in 9.4.1.11 (Action field).

The Protected EHT Action field is defined in 9.6.35.1 (Protected EHT Action field).

The Dialog Token field is defined in 9.4.1.12 (Dialog Token field) and set by the requesting MLD.

NSTR Power Save Control field is defined in 9.4.1.73 (NSTR Power Save Control field) to indicate the updated status of NSTR power save mode.

**9.6.35.16 NSTR Power Save Response frame format**

The NSTR Power Save Response frame is sent by an AP affiliated with an AP MLD in response to a NSTR Power Save Request frame to accept the request of NSTR power save status update in the NSTR Power Save Request frame. The Action field of the NSTR Power Save Response frame contains the information shown in Table 9-628r (NSTR Power Save Response frame Action field format).

**Table 9-628r—NSTR Power Save Response frame Action field format**

|  |  |
| --- | --- |
| **Order** | **Information** |
| 1 | Category |
| 2 | Protected EHT Action |
| 3 | Dialog Token |
| 4 | Status Code |

The Category field is defined in 9.4.1.11 (Action field).

The Protected EHT Action field is defined in 9.6.35.1 (Protected EHT Action field).

The Dialog Token field value is copied from the Dialog Token field in the corresponding NSTR Power Save Request frame.

The Status Code is defined in 9.4.1.9 (Status Code field).

***TGbe editor: Please insert following subclause after subclause 9.4.1.72 (EMLSR Parameter Update field): (#19876)***

**9.4.1.73 NSTR Power Save Control field**

The NSTR Power Save field is defined in Figure 9-189g (NSTR Power Save Control field format).

|  |  |  |
| --- | --- | --- |
|  | B0 | B1 B7 |
|  | NSTR Power Save Mode | Reserved |
| Bits: | 1 | 7 |

**Figure 9-189g—NSTR Power Save Control field format**

A non-AP MLD sets the NSTR Power Save Mode subfield to 1 to indicate that the NSTR power save mode is enabled for the non-AP MLD and to 0 to indicate that the NSTR power save mode is disabled for the non-AP MLD.