IEEE P802.11
Wireless LANs

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| Proposed Spec TextMulti-link Channel Access: General-Non-STR |
| Date: 2020-09-16 |
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Abstract

This submission proposes spec text for multi-link channel access general-Non-STR to be incorporated into 801.11be D0.1

Revisions:

* Rev 0: Initial version of the document.
* R1:
	+ Change NSTR CLS to NSTR link set (i.e. remove “constrained”)
	+ Change “constrained” to “limited” in the behavioural section
	+ Editorial “.” Added to the definition
* R2:
	+ Change CTS response to a choice on the part of the NSTR limited STA
* R3:
	+ 33.x.y.3 – add another “should not transmit” case for the STR AP – i.e. to not transmit to the NSTR non-AP MLD if the NSTR non-AP MLD is transmitting to ANY STA on any link of the NSTR link set (e.g. the non-AP MLD might be transmitting to a P2P peer) – it is possible that the AP is unable to detect such an event, but when it is able to detect a transmission by the non-AP MLD, then it definitely should not transmit to the non-AP MLD – this is just adding coverage per the first motion i.e. STR AP MLD with non-STR non-AP MLD
* R4:
	+ 33.x.y.3 – removed the first paragraph, as it is a subset of the second paragraph
* R5:
	+ 10.3.2.9 CTS – modify the condition to make the meaning more clear, yielding: except for the condition ‘the STA is not NSTR limited’
* R6:
	+ Cave in on the STR link set v STR link pair style issue
* R7:
	+ 3.1 definitions: Add mention of what a member is in the definition.
	+ 10.3.2.9 CTS – remove S1G changes, remove CMMG changes, as it is suggested that an MLD cannot be S1G or CMMG
	+ 10.3.2.9 – reword the definition of STA is not NSTR limited
	+ 33.x.y.3 modest clarifying wording changes without changing the technical content
	+ 33.x.y.3 – add another recommendation for the NSTR non-AP MLD
* R8:
	+ Added a note in the abstract beneath the motions regarding the question of whether there is overlap in the description of rules for the alignment of PPDUs between this document and 11-20-1271, the note asserts that there is no overlap because 1271 addresses only the AP case and this document addresses only the non-AP case
	+ 3.1 - Slight mod to definition – add NSTR in front of link pair for the member sentence
	+ 33.x.y.3 – modified wording to remove the terms NSTR MLD, keeping NSTR as an adjective only for link pairs
	+ 33.x.y.3 – split the PPDU alignment into a separate paragraph, as it can equally apply to the case when the non-AP MLD STA transmits while receiving to itself on the other link of an NSTR link pair (i.e. as opposed to only the case when the reception is for someone else)
* R9:
	+ 3.1 definition – change from “inability” to “impaired ability”
	+ 10.3.2.9 CTS – made definition of “NSTR limited” more accurate and broke the definition into a list of bullets to make it more readable
	+ 33.x.y.3 – rename, transmission and receiption v transmit and receive
* R10:
	+ 3.1 definitions – NSTR – radical change from a nebulous implementation dependent definition of impairment of ability to receive back to inability to receive under a defined full set of specific parameters including receiver sensitivity signal level specified in the PHY via reference
	+ 10.3.2.9 CTS – added “that has NSTR link pairs” which is a bit redundant but more explicit as the next condition could not possibly be met if there were no NSTR link pairs at the MLD and added “that is a member of” to the second condition
	+ 33.x.y.3 – 3rd paragraph, changed the sense from “receiving a frame not addressed to” -> “not receiving a frame addressed to” – this resolves the issue of the unknown case, although it does leave a time-window when Schroedinger’s cat is still hidden inside of the box (i.e. between the start of the LSTF and the receipt and decode of addressing information)
	+ 33.x.y.3 – 4th paragraph, add “earlier than”

The text is based on the following motions:

802.11be supports the following cases in R1:

* STR AP MLD with STR non-AP MLD
* STR AP MLD with non-STR non-AP MLD
* Note: All the other cases are TBD.

[Motion 111, #SP0611-30, [13] and [145]]

802.11be supports the following constrained multi-link operation:

* When a STA in a non-STR MLD receives an RTS addressed to itself, if the NAV of the STA indicates idle but another STA in the same MLD is either a TXOP holder or a TXOP responder, the STA may not respond with a CTS frame.

[Motion 111, #SP0611-32, [13] and [146]]

Note that while there is another document 11-20-1271 which addresses PPDU alignment, that document only addresses PPDU alignment as performed by an AP MLD. The alignment indicated in this document (i.e. 11-20-1395) address alignment by a non-AP MLD.

***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: Add a new definition in an appropriate location within subclause 3.1 Definitions, as follows:***

3.1 Definitions

***Insert the following definition maintaining alphabetical order:***

**Non-simultaneous transmit and receive (NSTR) link pair**: A pair of links of a multi link device (MLD) for which the transmission by a STA of the MLD on one of the links of a PPDU using the maximum allowed transmission power on the primary 20 MHz channel of the BSS using any PPDU bandwidth permitted within the BSS that the STA is capable of transmitting causes the inability of the STA of the MLD on the other link to meet the minimum receive sensitivity requirement defined in 34.w.x..y (Receiver minimum input sensitivity). Each link of such a pair is a member of the NSTR link pair.

**Receiver minimum input**

***TGbe editor: Add new abbreviations in an appropriate location within subclause 3.4 Abbreviations and acronyms, as follows:***

3.4 Abbreviations and acronyms

***Insert the following acronym definitions (maintaining alphabetical order):***

NSTR non-simultaneous transmit and receive

***TGbe editor: Add the following subclause and editing instructions at an appropriate location within the TGbe draft:***

**10.3.2.9 CTS and DMG CTS procedure**

***Change the text as shown:***

A STA that receives an RTS frame addressed to it considers the NAV and NSTR limits in determining whether to respond with CTS, unless the NAV was set by a frame originating from the STA sending the RTS frame (see 10.23.2.2 (EDCA backoff procedure)). In this subclause for a non-S1G STA, “NAV indicates idle” means that the NAV count is 0 or that the NAV count is nonzero but the nonbandwidth signaling TA obtained from the TA field of the RTS frame matches the saved TXOP holder address. In an S1G STA, “NAV indicates idle” means that both NAV and RID counters are 0 or that either NAV or RID counter is nonzero but the TA field of the RTS frame matches the saved TXOP holder address.

In this subclause, a STA is NSTR limited if all of the following conditions are true:

* the STA is affiliated with an MLD that has NSTR link pairs
* the STA has received the RTS on a link that is a member of one or more of the MLD’s NSTR link pairs
* a STA of the MLD is a TXOP holder or TXOP responder on one of the other links that is a member of at least one of the NSTR link pairs of which the RTS link is a member

If at least one of the above conditions is not ture, then the STA is not NSTR limited.

A VHT STA that is addressed by an RTS frame in a non-HT or non-HT duplicate PPDU that has a bandwidth signaling TA and that has the RXVECTOR parameter DYN\_BANDWIDTH\_IN\_NON\_HT equal to Static behaves as follows:

— If the NAV indicates idle, the STA is not NSTR limited and CCA has been idle for all secondary channels (secondary 20 MHz channel, secondary 40 MHz channel, and secondary 80 MHz channel) in the channel width indicated by the RTS frame’s RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT for a PIFS prior to the start of the RTS frame, then the STA shall respond with a CTS frame carried in a non-HT or non-HT duplicate PPDU after a SIFS. The CTS frame’s TXVECTOR parameters CH\_BANDWIDTH and CH\_BANDWIDTH\_IN\_NON\_HT shall be set to the same value as the RTS frame’s RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT.

* If all of the conditions in the previous paragraph are met, except for the condition ‘the STA is not NSTR limited’, then the STA may respond with the CTS frame as described in that paragraph.

— Otherwise, the STA shall not respond with a CTS frame.

A VHT STA that is addressed by an RTS frame in a non-HT or non-HT duplicate PPDU that has a bandwidth signaling TA and that has the RXVECTOR parameter DYN\_BANDWIDTH\_IN\_NON\_HT equal to Dynamic behaves as follows:

— If the NAV indicates idle, the STA is not NSTR limited, then the STA shall respond with a CTS frame in a non-HT or non-HT duplicate PPDU after a SIFS. The CTS frame’s TXVECTOR parameters CH\_BANDWIDTH and CH\_BANDWIDTH\_IN\_NON\_HT shall be set to any channel width for which CCA on all secondary channels has been idle for a PIFS prior to the start of the RTS frame and that is less than or equal to the channel width indicated in the RTS frame’s RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT.

* If all of the conditions in the previous paragraph are met, except for the condition ‘the STA is not NSTR limited’, then the STA may respond with the CTS frame as described in that paragraph.

— Otherwise, the STA shall not respond with a CTS frame.

An S1G STA that is addressed by an RTS frame that has the Dynamic Indication field in the Frame Control field equal to 0 (Static) behaves as follows:

— If the NAV indicates idle and the CCA has been idle for all secondary channels within the channel width indicated in the Bandwidth Indication field of the Frame Control field of the RTS frame for a PIFS period prior to the start of the RTS frame, then the STA shall respond with an (NDP) CTS frame after a SIFS. The STA shall set the TXVECTOR parameter CH\_BANDWIDTH to a value that is equivalent to the value of the Bandwidth Indication field of the Frame Control field in the received RTS frame. The (NDP\_2M) CTS frame shall have the Bandwidth Indication field set to the value of the Bandwidth Indication field of the received RTS frame.

— Otherwise the STA shall not respond with an (NDP) CTS frame.

An S1G STA that is addressed by an RTS carried in a 2 MHz duplicate frame that has the Dynamic Indication field in the Frame Control field equal to 1 (Dynamic) behaves as follows:

— If the NAV indicates idle, then the STA shall respond with an (NDP\_2M) CTS frame after a SIFS. The (NDP) CTS frame’s TXVECTOR parameter CH\_BANDWIDTH may be set to any channel width for which the CCA on all secondary channels has been idle for a PIFS prior to the start of the RTS frame and that is equal to or less than the channel width indicated in the Bandwidth Indication field of the Frame Control field of the RTS frame. The (NDP\_2M) CTS frame shall have the Bandwidth Indication field set to a value that is equivalent to the value of the TXVECTOR parameter’s CH\_BANDWIDTH.

— Otherwise the STA shall not respond with an (NDP) CTS frame.

NOTE—The NDP\_1M CTS frame is not used for dynamic bandwidth indication.

A non-VHT and non-S1G STA that is addressed by an RTS frame or a VHT STA that is addressed by an RTS frame carried in a non-HT or non-HT duplicate PPDU that has a nonbandwidth signaling TA or a VHT STA that is addressed by an RTS frame in a format other than non-HT or non-HT duplicate behaves as follows:

— If the NAV indicates idle, the STA is not NSTR limited, the STA shall respond with a CTS frame after a SIFS.

* If all of the conditions in the previous paragraph are met, except for the condition ‘the STA is not NSTR limited’, then the STA may respond with the CTS frame as described in that paragraph.

— Otherwise, the STA shall not respond with a CTS frame.

The RA field of the CTS frame shall be set to the nonbandwidth signaling TA obtained from the TA field of the RTS frame to which this CTS frame is a response. The Duration field in the CTS frame shall be the duration field from the received RTS frame, adjusted by subtraction of aSIFSTime and the number of microseconds required to transmit the CTS frame at a data rate determined by the rules in 10.6 (Multirate support).

After transmitting an RTS frame, the STA shall wait for a CTSTimeout interval with a value of aSIFSTime + aSlotTime + aRxPHYStartDelay. This interval begins when the MAC receives a PHY-TXEND.confirm primitive. If a PHY-RXSTART.indication primitive does not occur during the CTSTimeout interval, the STA shall conclude that the transmission of the RTS frame has failed, and this STA shall invoke its backoff procedure upon expiration of the CTSTimeout interval. If a PHY-RXSTART.indication primitive does occur during the CTSTimeout interval, the STA shall wait for the corresponding PHY-RXEND.indication primitive to determine whether the RTS frame transmission was successful. The recognition of a valid CTS frame sent by the recipient of the RTS frame, corresponding to this PHY-RXEND.indication primitive, shall be interpreted as successful response, permitting the frame exchange sequence to continue (see Annex G). The recognition of anything else, including any other valid frame, shall be interpreted as failure of the RTS frame transmission. In this instance, the STA shall invoke its backoff procedure at the PHY-RXEND.indication primitive and may process the received frame.

A DMG STA follows the procedure defined in this subclause, except that it uses a DMG CTS frame instead of a CTS frame. A non-DMG STA does not transmit DMG CTS frames.

An S1G STA shall transmit NDP CTS frames instead of CTS frames with the following exception: transmission of an CTS frame is required if the link adaptation procedure is negotiated as described in 10.32 (Link adaptation).

The RA/Partial BSSID field of the NDP CTS shall be generated as described in 23.3.12.2.1 (NDP CTS). The Duration field in the NDP CTS frame shall be set to the same value as the Duration field from the received RTS frame, adjusted by subtracting the value of aSIFSTime and the NDPTxTime required to transmit the NDP CTS frame, where NDPTxTime is calculated according to 10.3.2.5.2 (RID update).

An S1G STA that receives an NDP CTS frame should disregard the value of the Duration field of the NDP CTS frame if any of the following conditions are satisfied:

— The Address Indicator field is equal to 1, and the Early Sector Indicator field is equal to 0, and the RA/PBSSID field is equal to the PBSSID of the AP with which the non-AP STA is associated (see 10.53.4 (TXOP-based sectorization operation)).

— The Address Indicator field is equal to 0, and the RA/PBSSID indicates that the STA is the intended receiver of this frame, and the frame is received during the intervals of time negotiated with the UL-Sync capable AP (see 10.49 (Sync frame operation(#1072)(#1071)(11ah)(M101))).

A CMMG STA that receives an RTS frame in a CMMG or CMMG duplicate PPDU that has the RXVECTOR parameter DYN\_BANDWIDTH equal to Static behaves as follows:

— If the NAV indicates idle and CCA has been idle for the secondary channel (secondary 540 MHz channel) in the channel width indicated by the RTS frame’s RXVECTOR parameter CH\_BANDWIDTH for a PIFS period prior to the start of the RTS frame, then the STA shall respond with a CTS frame carried in a CMMG or CMMG duplicate PPDU after a SIFS. The CTS frame’s TXVECTOR parameters CH\_BANDWIDTH shall be set to the same value as the RTS frame’s RXVECTOR parameter CH\_BANDWIDTH.

— Otherwise, the STA shall not respond with a CTS frame.

A CMMG STA that is addressed by an RTS frame in a CMMG or CMMG duplicate PPDU that has the RXVECTOR parameter DYN\_BANDWIDTH equal to Dynamic behaves as follows:

— If the NAV indicates idle, then the STA shall respond with a CTS frame in a CMMG or CMMG duplicate PPDU after a SIFS. The CTS frame’s TXVECTOR parameters CH\_BANDWIDTH may be set to any channel width for which CCA has been idle for a PIFS prior to the start of the RTS frame and that is equal to or less than the channel width indicated in the RTS frame’s RXVECTOR parameter indicated in the RTS frame’s RXVECTOR parameter CH\_BANDWIDTH.

— Otherwise, the STA shall not respond with a CTS frame.

***TGbe editor: Add new a subclause 33.x.y.3 Non-simultaneous transmission and reception (NSTR) within clause 33 as follows:***

33. Extreme High Throughput (EHT) MAC specification

33.x. Multi-link operation

33.x.y. Multi-link channel access

33.x.y.3. Non-simultaneous transmit and receive (NSTR)

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 on the other link of the NSTR link pair.

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 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 may transmit a frame on a link of one of its NSTR link pairs at the same time that another STA affiliated with the same non-AP MLD is not receiving a frame addressed to that receiving STA on the other link of the NSTR link pair, provided that the transmission meets other restrictions indicated in this subclause.

A STA that is affiliated with a non-AP MLD and that transmits a frame on a link of one of its NSTR link pairs at the same time that another STA affiliated with the same non-AP MLD is receiving a frame on the other link of the NSTR link pair should ensure that the transmitted PPDU ends at the same time or earlier than the PPDU that is being recevied.