IEEE P802.11  
Wireless LANs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| “TGme Resolution to CIDs on Annex G” | | | | |
| Date: 2021-12 | | | | |
| Author(s): | | | | |
| Name | Affiliation | Address | Phone | email |
| Graham SMITH | SR Technology | Sunrise, FL, USA. | 916 799 9563 | gsmith@srtrl.com |
| Mark HAMILTON | Ruckus/Commscope | Sunnyvale, CA 94089 | +1-303-818-8472 | Mark.hamilton2152@gmail.com |

Abstract

Contains changes required for removing references to ANNEX G

Satisfying CIDS 81 and 109

Rev 1 – edits

Rev 2 – Addition of Clause 29 changes 11ba.

Rev 3 – Changes from Mark R

Rev 4 – removal of “transmission” of a frame exchange sequence

Rev 5 – Mark R found another correction needed in PIFS clause

Rev 6 – needed a small edit

**CID 81**

“Delete Annex G.

"frame exchange sequence: A sequence of frames specified by Annex G"

If not in Annex G then by definition it is not a valid sequence? That's dangerous. There is much doubt that Annex G is accurate and up to date.”

**CID 109**

“Annex G is incomplete as it should include all frame exchange sequences in the specification. The annex should be updated or the information in the Annex should be moved else where in the specification and Annex G should be deprecated or removed.”

**BACKGROUND**

A deep investigation into ANNEX G has been carried out in the 802.11 ARC SC.

The “problem” is that a “frame exchange sequence” is presently defined as:

***frame exchange sequence***: A sequence of frames specified by Annex G

It was agreed that ANNEX G is not complete as well as being very “unfriendly”. It was also determined that the term “frame exchange sequence” was not being correctly used in the text in many places.

After much discussion, an approach was agreed upon:

1. Define anew “frame exchange sequence”
   * Determine and agree what its characteristics are
2. Check uses of “frame exchange(s)” in text and edit as required to make sure correct terminology used (i.e., if the “frame exchange” or “frame sequence” really an “frame exchange sequence”, or a “frame exchange”)

Then

1. Make decision on what to do with Annex G
   1. Leave it as is
   2. Re-define use, i.e. make “informative” with possibly a note to the effect that it is historical. (Note: this is base upon the assumption that no-one would volunteer to check it and correct it.)
   3. Make “informative” but re-write in more friendly manner
   4. Delete

21/1143 lists the occurances of “frame exchange sequence(s)” in D0.0.

Each instance was looked at by the ARC SC and the following “rules/features” for “frame exchange sequence” were determined from different sections and references:

* Within a frame exchange sequence, packets separated by SIFS/PIFS
* Multiple frame exchange sequences allowed within a TXOP.
  + Limited to TXOP duration
  + frame exchange sequences within a polled TXOP, or HC TXOP, or EDCA TXOP separated by SIFS,
  + CMMG STA waits PIFS between frame exchange sequences.
* MU TXOP FIG.10-13 and 10-14 is one frame exchange sequence.
  + Not restricted to 2 specific STAs (as first assumed)
  + Exchange desires to keep control of the WM
* End of frame exchange sequencewhen RA or TA changes from first packet. (Need to accommodate MU TXOP case)
* The shared state (e.g., power save) shall not change during a frame exchange sequence.
* Assumed that Beam forming and Beam tracking uses frame exchange sequences
  + Hence calling them frame exchange sequences is correct.
* ASEL is not frame exchange sequence but are “frame exchanges”
  + Needs editing
* GAS frame exchanges are not frame exchange sequences.
  + Needs changing to “frame exchanges”

Attempts for a definition that encompassed all the features/rules proved very elusive, exceptions were apparent.

The one characteristic that defines the frame exchange sequence is that it maintains control of the wireless medium:

***Proposed definition:***

***frame exchange sequence***: a sequence of frames that maintains control of the wireless medium.

This “simple” description seems to work and describes the main feature in that a frame exchange sequence maintains control of the wireless medium, e.g., a 4–way handshake is a frame exchange consisting of 4 frame exchange sequences.

A “frame exchange sequence” is a sequence of frames exchanged between STAs that the STAs do not want to be interrupted.

At first sight a series of frame exchanges within a TXOP may also appear to meet this description,

***transmission opportunity (TXOP):*** *An interval of time during which a particular quality-of-service (QoS)station (STA) has the right to initiate frame exchange sequences onto the wireless medium (WM)*

Note however that TXOP is a time interval, and the frame exchanges within it are frame exchange sequences.

It is proposed to add a note to the definition:

NOTE—Control of the wireless medium might be maintained across multiple frame exchange sequences through other mechanisms, see, for example, 10.23.2.8 (Transmission of frame exchange sequences in an EDCA TXOP)

Section 10.23.2.3 concerns “**multiple frame transmissions**” within a TXOP. In particular, there is a sentence

*Multiple frame transmission within the TXOP occurs when an EDCAF retains the right to access the medium following the completion of a frame exchange sequence, such as on receipt of an Ack frame.*

“multiple frame transmission” needs to be addressed as it is somewhat confusing as we know that multiple frame exchange sequences take place within a TXOP and “multiple frame transmissions” should be the same concept and this is not clear.

There are 35 instances of “multiple frame transmissions” but many refer to Clause 10.23.2.8. which we need to first edit.

The Section starts with a detailed list of frame exchanges which is dangerous, as new frames are introduced in new Amendments. What it seems to be trying to say is that frame exchange sequences are transmitted in an EDCA TXOP (as per the definition). Are these special cases? Can’t be, as any frame requiring an immediate ack is covered, i.e., a frame exchange sequence.

The definition of TXOP is clear “

*transmission opportunity (TXOP*): An interval of time during which a particular quality-of-service (QoS)station (STA) has the right to initiate frame exchange sequences onto the wireless medium (WM).

The question is, “Do we need this “other” concept of ‘multiple frame transmission’ Assumed no.

**PROPOSAL BASIS**

1. Change definition to:

***frame exchange sequence***: a sequence of frames that maintains control of the wireless medium.

NOTE—Control of the wireless medium might be maintained across multiple frame exchange sequences through other mechanisms, see, for example, 10.23.2.8 (Multiple frame transmission in an EDCA TXOP).

1. List the edits in the text to
   1. remove references to ANNEX G
   2. correct wrong references to “frame exchange”
      1. correct “frame exchange” to “frame exchange sequence” where sequence controls the WM
      2. correct “frame exchange sequence(s)” to “frame exchange(s)” where frame exchange(s)” do not control the WM.
      3. Correct other variations such as “frame sequences”
2. Propose changes related to “multiple frame exchanges”

Note: in D0.3 388 instances of “frame exchange” (22 in Contents, Figures, and Tables)

**ANNEX G. Proposal for now is to leave as is but make it ‘informative”. Maybe add some words as intro explaining historical aspect.**

Note: TG may decide to delete Annex G. As Annex G contains no unique features or procedures, it need not go through a “deprecated/obsolete’ route.

**RESOLUTION for CIDs 81, 109**

**REVISED**

Make following changes (reference D 0.3):

At 191.20

Change

***frame exchange sequence*:** A sequence of frames specified by Annex G.

To

***frame exchange sequence***: a sequence of frames that maintains control of the wireless medium.

NOTE—Control of the wireless medium might be maintained across multiple frame exchange sequences through other mechanisms, see, for example, 10.23.2.8 (Multiple frame transmission in an EDCA TXOP)

“Annex G” deletions

9.2.4.1.7, P878.49

Delete “(see Annex G)”

10.3.2.9, P2047.50

Delete “(see Annex G)

10.3.2.11, P2052.61

Delete “(see Annex G)

10.3.3., P2072.19

Delete “as described in Annex G”

10.3.4.4, P2076.47

Delete “(described in Annex G)”

10.23.2.2, P2152.50

Delete “(see Annex G)”

10.23.2.8, P2163.39

Delete “(see Annex G)”

10.3.2.11, P2052.61

Delete “(see Annex G)”

10.3.3, P2072.19

Delete “, as described in Annex G”

10.3.4.4 P2076.47

Delete “(described in Annex G)”

10.23.2.2, P2152.50

Delete “(described in Annex G)”

10.23.2.8, P2163.39

Delete “(see Annex G)”

10.23.2.10, P2168.11

Delete “(using the terminology of Annex G)”

10.45.2.4.4, P2517.2

Delete “, as described in Annex G and”

11.2.3.1, P2632.41

Delete “, as described in Annex G”

11.2.3.2, P2634.61

Delete “(decribed in Annex G)”

11.2.7.1, P2670.39, 44

Delete “as described in Annex G”

11.2.7.2.2, P2671

Delete “(as described in Annex G)”

11.2.7.3.2, P2675.26

Delete “(as described in Annex G)”

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

“Frame exchange(s)” corrections

4.3.22.5.5, P287.22

Change “frame exchanges” to “frame exchange sequences”

9.2.5.3, P928.42

Change “frame exchanges” to “frame exchange sequences”

9.3.1.3 P932.25

Change “frame exchange” to “frame exchange sequence”.

9.3.1.13, P951.15

Change “frame exchange” to “frame exchange sequence”.

9.4.1.14, P1059.30

Change “frame exchanges” to “frame exchange sequences”

9.4.2.199, P1581.4

Change “frame exchanges” to “frame exchange sequences”

9.2.4.255.2, P1681.55, 56

Change “frame exchanges” to “frame exchange sequences”

9.2.4.255.3, P1682.34, 35

Change “frame exchanges” to “frame exchange sequences”

9.2.4.255.4, P1683.32, 33

Change “frame exchanges” to “frame exchange sequences”

10.3.2.2., P2033.20, 23

Change “frame exchange” to “frame exchange sequence”.

10.3.2.6, P2045.6

Change “frame exchange” to “frame exchange sequence”.

10.3.4.3, P2075.51

Change “frame exchange” to “frame exchange sequence”.

10.3.4.3, P2076.27

Change “frame exchange” to “frame exchange sequence”.

10.3.4.3, P2076.33

Change in two places, “frame exchange” to “frame exchange sequence”

10.3.4.3, P2076.34

Change “frame exchange” to “frame exchange sequence”

10.3.5, P2079.5

Change “frame exchanges” to “frame exchange sequences”

10.3.5, P2079.14

Change “frame exchange” to “frame exchange sequence”

10.6.6.2, P2092.43

Change “frame exchange” to “frame exchange sequence”

10.23.2.7, P2160.58

Change “frame exchange” to “frame exchange sequence”

10.23.2.8, P2161.51

Change “frame exchange” to “frame exchange sequence”

10.23.2.8, P2164.16, 25

Change “frame exchange” to “frame exchange sequence”

10.25.8.4, P2233.10

Change “frame exchanges” to “frame exchange sequences”

10.25.8.4, P2233.52

Change “frame exchange” to “frame exchange sequence”

10.25.8.4, P2233.60

Change “frame exchange” to “frame exchange sequence”

(Note to Editor, “Figure ()” needs correcting)

10.25.8.4, P2234.22

Change title Figure 10-45 “frame exchange” to “frame exchange sequence”

10.25.8.4, P2234.54

Change title Figure 10-46 “frame exchange” to “frame exchange sequence”

10.25.8.4, P2234.60

Change “frame exchanges” to “frame exchange sequences”

10.27.1, P2241.58, 59

Change “frame exchanges” to “frame exchange sequences”

10.27.6, P2250.6

Change “frame exchange” to “frame exchange sequence”

10.34.2.3, P2282.27

Change “frame exchange” to “frame exchange sequence”

10.34.2.4.2, P2284.33

Change “frame exchange” to “frame exchange sequence”

10.24.2.4.3, P2285.59, 61

Change “frame exchange” to “frame exchange sequence”

10.24.2.4.3, P2287.42, 45

Change “frame exchange” to “frame exchange sequence”

10.35.2, P2296.15, 29

Delete “sequence”

10.35.2, P2298.22

Delete “sequence”

10.39.2, P2319.42, 45

Change “frame exchanges” to “frame exchange sequences”

10.39.3, P2321.37, 41

Change “frame exchanges” to “frame exchange sequences”

10.39.3, P2322.37, 63

Change “frame exchanges” to “frame exchange sequences”

10.39.4, P2323.11

Change “frame exchange” to “frame exchange sequence”

10.39.4, P2323.22, 47

Change “frame exchange” to “frame exchange sequence”

10.39.5, P2324.7

Change “frame exchange” to “frame exchange sequence”

10.39.6.2.1, P2327.13, 23

Change “frame exchange” to “frame exchange sequence”

10.39.6.2.1, P2327.46, 56

Change “frame exchange” to “frame exchange sequence”

10.39.6.6.3, P2339.54

Change “frame exchange” to “frame exchange sequence”

10.39.8.1, P2347.22

Change “frame exchange” to “frame exchange sequence”

10.39.8.1, P2348.1

Change “frame exchange” to “frame exchange sequence”

10.39.8.1, P2348.3

Change “frame exchange” to “frame exchange sequence”

10.39.12.4.3, P2360.29

Change “frame exchange” to “frame exchange sequence”

10.39.12.4.4, P2364.62

Change “frame exchange” to “frame exchange sequence”

10.42.6.2, P2420.33

Change “frame exchange” to “frame exchange sequence”

10.42.10.2.4.6, P2468.32

Change “frame exchange” to “frame exchange sequence”

10.42.10.2.4.6, P2468.46

Change in Title Figure 10-121 “frame exchange” to “frame exchange sequence”

10.42.10.2.4.6, P2470.23

Change “frame exchange” to “frame exchange sequence”

10.42.10.2.4.6, P2470.34

Change in Title Figure 10-123 “frame exchange” to “frame exchange sequence”

10.42.10.2.4.6, P2471.1

Change “frame exchange” to “frame exchange sequence”

10.42.10.2.4.6, P2471.20

Change in Title Figure 10-124 “frame exchange” to “frame exchange sequence”

10.42.10.3.1, P2471, 43

Change “frame exchanges” to “frame exchange sequences”

10.42.11.3, P2497.27, 55

Change “frame exchanges” to “frame exchange sequences”

10.42.11.5, P2503.18

Change “frame exchanges” to “frame exchange sequences”

10.49, P2540.31, 32, 33,

Change “frame exchanges” to “frame exchange sequences”

10.50.1, P2541.49

Change “frame exchanges” to “frame exchange sequences”

10.47.1, P2525.29

Change “frame exchange” to “frame exchange sequence”

10.53.4, P2553.32

Change “frame exchange” to “frame exchange sequence”

10.53.4, P2554.31

Change “frame exchanges” to “frame exchange sequences”

10.53.4, P2554.7, 25, 27, 29, 31(x2), 42, 44

Change “frame exchange” to “frame exchange sequence”

10.54.4, P2554.48, 54

Change “frame exchange” to “frame exchange sequence”

10.54.4, P2555.27, 32, 63

Change “frame exchange” to “frame exchange sequence”

10.54.4, P2558.2, 13,

Change “frame exchange” to “frame exchange sequence”

10.53.5.2, P2559.24

Change “frame exchange” to “frame exchange sequence”

10.54.5.4, P2569.22

Change “frame exchanges” to “frame exchange sequences”

11.2.3.1, P2632.40

Change “frame exchange” to “frame exchange sequence”

11.2.3.2, P2634.60, 61

Change “frame exchange” to “frame exchange sequence”

11.2.3.2, P2635.62, 6, 20, 23,

Change “frame exchange” to “frame exchange sequence”

11.2.3.2, P2635.9,

Change “frame exchanges” to “frame exchange sequences”

11.2.3.12, P2649.59

Change “frame exchange” to “frame exchange sequence”

11.2.6, P2666.43

Change “frame exchange” to “frame exchange sequence”

11.2.7.1, P2670.39, 44

Change “frame exchange” to “frame exchange sequence”

11.2.7.2.2, P2671.46

Change “frame exchange” to “frame exchange sequence”

11.2.7.2.2, P2671.51, 52

Change “frame exchange” to “frame exchange sequence”

11.2.7.2.3, P2674.9

Change “frame exchange” to “frame exchange sequence”

11.2.7.3.2, P2675.25

Change “frame exchange” to “frame exchange sequence”

11.2.7.3.2, P2675.30, 31

Change “frame exchange” to “frame exchange sequence”

11.2.8, P2682.18

Change “frame exchanges” to “frame exchange sequences”

11.20.6.1, P2812.41

Change “frame exchange” to “frame exchange sequence”

11.22.3.2.1, P2872.37, 42, 49, 54

Delete “sequence”

11.22.3.2.1, P2875.1, 22, 27, 32,

Delete “sequence”

11.22.3.2.1, P2876.43,

Delete “sequence”

11.22.3.2.1, P2877.36,

Delete “sequence”

11.22.3.2.6, P2883.34, 40, 52

Delete “sequence”

11.27.1.1, P2923.35

Change “frame exchange” to “frame exchange sequence”

Figure 11-55 P2942.20

Change “frame exchange” to “frame exchange sequence”

11.46, P3010.25

Change “frame exchanges” to “frame exchange sequences”

14.14.7, P3343.18

Change “frame exchanges” to “frame exchange sequences”

14.14.8.2, P3343.61

Change “frame exchanges” to “frame exchange sequences”

14.14.9.1, P3345.25

Change “frame exchanges” to “frame exchange sequences”

23.3.12.2.1, P3887.31, 32

Change “frame exchange” to “frame exchange sequence”

23.3.12.2.1.2, P3888,12, 13

Change “frame exchange” to “frame exchange sequence”

26., P4057.14

Change “frame exchange” to “frame exchange sequence”

26.2.6, P4062.26, 31

Change “frame exchange” to “frame exchange sequence”

26.2.61, P4062.32

Change “frame exchanges” to “frame exchange sequences”

26.2.8, P4067.26

Change “frame exchanges” to “frame exchange sequences”

26.5.1.1, P4085.21, 25

Change “frame exchange” to “frame exchange sequence”

26.5.1.1, P4085.19, 23

Change “frame exchanges” to “frame exchange sequences”

26.5.2.2.4, P4095.46, 50

Change “frame exchange” to “frame exchange sequence”

26.8.1, P4134.10

Change “frame exchanges” to “frame exchange sequences”

B.4.17.1, P4913.53

Change “frame exchange” to “frame exchange sequence”

B.4.17.1, P4914.6, 17, 27,

Change “frame exchange” to “frame exchange sequence”

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

“frame sequence(s)” corrections

10.23.5.6, P2191.23

Delete “sequence”

10.35.2, P2297.59, 62

Change “frame sequence” to “frame exchange”

10.35.2, P2298.2, 4, 6,

Change “frame sequence” to “frame exchange”

10.54.5.3, P2568.44, 45, 52, 53

Change “frame sequence” to “frame exchange sequence”

11.22.3.2.1, P2872.20, 21, 22, 36, 41, 48

Change “frame sequence” to “frame exchange”

Figure 11-41, P2873.22

Change “GAS frame sequence” to “GAS frame exchange”

Figure 11-42, P2873.62

Change “GAS frame sequence” to “GAS frame exchange”

Figure 11-43, P2874.37

Change “GAS frame sequence” to “GAS frame exchange”

Figure 11-44, P2874.61

Change “Group addressed GAS Query Request exchange sequence” to “Group addressed GAS frame exchange with a response drop”

Figure 11-45, P2875.22

Change “Group addressed GAS Query Response exchange sequence” to “Group addressed GAS frame exchange with a timer”

Figure 11-46, P2875.22

Change “Group addressed GAS Query Request for a specific fragment fragment exchange sequence” to “Group addressed GAS frame exchange for a specific fragment”.

Figure 11-47, P2877.36

Change “GAS frame exchange sequence” to “GAS frame exchange”

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*“exchange sequence(s)” corrections*

Table 9-21, P900.26

Change “sounding exchange sequence”, to “sounding frame exchange sequence”

10.29.2, P2254.42

Change “Reverse direction (RD) exchange sequence” to “Reverse direction (RD) frame exchange sequence”

10.29.2, P2254.45, 49, 51, 58

Change “exchange sequence” to “frame exchange sequence”

10.29.2, P2255.2, 17

Change “exchange sequence” to “frame exchange sequence” in two places

10.29.2, P2255.1

Change “exchange sequences” to “frame exchange sequences”

10.34.2.4.3, P2284.48

Change “sounding PPDU exchange sequence” to “sounding frame exchange sequence”

10.34.2.4.3, P2286.55

Change “sounding PPDU exchange sequence” to “sounding frame exchange sequence”

10.50.2, P2543.38

Figure 10-147, in three places change “Exchange Sequence” to frame exchange sequence”

Change title of Figure 10-147 to “Example of BDT frame exchange sequences”

11.21.6.4, 2837.2,

Change “measurement exchange sequence” to measurement frame exchange”

11.21.6.4, P2837.48, Figure 11-39 title,

Change “measurement exchange sequence” to measurement frame exchange”

11.21.6.4, P2838.3,

Change “measurement exchange sequence” to measurement frame exchange”

11.21.6.4, P2838.57. Figure 11-39 title,

Change “measurement exchange sequence” to measurement frame exchange”

11.21.6.4, P2839.1, 65

Change “measurement exchange sequence” to measurement frame exchange”

11.21.6.4, P2839.57. Figure 11-40 title,

Change “measurement exchange sequence” to measurement frame exchange”

O.3, P5970.1

Change “exchange sequence” to “frame exchanges”

Line 39, Figure O-2 Title, change “exchange sequence” to “frame exchanges”

*“multiple frame transmission” changes*

Make changes as indicated below (reference D0.3)

P2036.10 10.3.2.3.4

A TXOP holder transmitting an RTS with a bandwidth signaling TA within ~~a~~ multiple frame

~~transmission~~ exchange sequences, as specified in 10.23.2.8 (Multiple frame transmission in an EDCA TXOP)

P2154.22

**10.23.2.3. EDCA TXOPs**

There are three modes of EDCA TXOP defined: initiation of an EDCA TXOP, sharing an EDCA TXOP, and multiple ~~frame transmission~~ frame exchange sequence(s) within an EDCA TXOP. Initiation of the TXOP occurs when the EDCA rules permit access to the medium. Sharing of the EDCA TXOP occurs when an EDCAF within an AP that supports DL-MU-MIMO has obtained access to the medium, making the corresponding AC the primary AC, and includes traffic from queues associated with other ACs in VHT(11ay), EDMG, or S1G MU PPDUs transmitted during the TXOP. Multiple ~~frame transmission~~ frame exchange sequence(s) within the TXOP occur~~s~~ when an EDCAF retains the right to access the medium ~~following the completion of a frame exchange sequence, such as on receipt of an Ack frame.~~

P2154.52 10.23.2.4

An EDCA TXOP is granted to an EDCAF when the EDCAF determines that it shall initiate ~~the transmission of~~ a frame exchange sequence~~. Transmission initiation shall be determined~~ according to the following rules:

P2155.52 and .62 10.23.2.4 (2 places)

Initiation of a ~~transmission~~ frame exchange sequence is not allowed to

P2324.31 10.39.5

A STA shall not extend a ~~transmission~~ frame exchange sequence that started during a CBAP

P2328.36 10.39.6.2

In no case shall the source or destination DMG STA extend a ~~transmission~~ frame exchange sequence

**P2155.39**

Initiate ~~the transmission of~~ a frame exchange sequence.

**P2155.48**

each EDCAF shall initiate a ~~transmission~~ frame exchange sequence if

P2161.49

**10.23.2.8 Multiple ~~frame transmission~~ frame exchange sequences in an EDCA TXOP**

~~A frame exchange, in the context of multiple frame transmission in an EDCA TXOP, may be one of the following:~~

~~— A frame not requiring immediate acknowledgment (such as a group addressed frame or a frame transmitted with an ack policy that does not require immediate acknowledgment) or an A-MPDU containing only such frames.~~

~~— A frame requiring immediate acknowledgment (such as an individually addressed frame transmitted with an ack policy that requires immediate acknowledgment) or an A-MPDU containing at least one such frame, followed after SIFS by a corresponding acknowledgment frame.~~

~~— A triggering frame or an A-MPDU containing at least one such frame, followed after SIFS by an HE~~

~~TB PPDU where the HE TB PPDU is optionally followed after SIFS by an acknowledgment.(11ax)~~

~~— One of the following:(11ax)~~

~~— A VHT NDP Announcement frame followed after SIFS by a VHT NDP followed after SIFS by an A-MPDU containing one or more VHT Compressed Beamforming frames.(11ax)~~

~~— A Beamforming Report Poll frame followed after SIFS by an A-MPDU containing one or more VHT Compressed Beamforming frames.~~

~~— An HE NDP Announcement frame followed after SIFS by an HE sounding NDP followed after SIFS by a PPDU containing one or more HE Compressed Beamforming/CQI frames.(11ax)~~

~~— A broadcast HE NDP Announcement frame followed after SIFS by an HE sounding NDP followed after SIFS by a BFRP Trigger frame followed by HE TB PPDUs.(11ax)~~

~~— A BFRP Trigger frame followed after SIFS by an HE TB PPDU containing one or more HE~~

~~Compressed Beamforming/CQI frames.(11ax)~~

~~Multiple frames~~ Frame exchange sequences of the primary AC may be transmitted in an EDCA TXOP that was acquired following the rules in 10.23.2.4 (Obtaining an EDCA TXOP). Frames that are pending in other ACs shall not be transmitted in this EDCA TXOP except when permitted by the rules in 10.23.2.7 (Sharing an EDCA TXOP). If a TXOP holder has in its transmit queue an additional frame exchange sequence of the primary AC (or, where permitted, a secondary AC) and the duration of ~~transmission of~~ that frame exchange sequence ~~plus any expected acknowledgment for that frame~~ is less than the remaining TXNAV timer value and, if dot11MCCAActivated is true, the remaining RAV timer value, then the TXOP holder may commence transmission of that frame exchange sequence a SIFS (or RIFS, if the conditions defined in 10.3.2.3.2 (RIFS) are met, or PIFS, if the frame contains a bandwidth signaling TA) after the completion of the immediately preceding frame exchange sequence, subject to the TXOP limit restriction as described in 10.23.2.9 (TXOP limits). A STA shall not commence the transmission of an RTS with a bandwidth signaling TA until at least a PIFS after the immediately preceding frame exchange sequence. A CMMG STA shall not commence the transmission of an RTS frame until at least PIFS time after the immediately preceding frame exchange sequence. An HT STA that is a TXOP holder may transmit multiple MPDUs of the same AC within an A-MPDU as long as the duration of transmission of the A-MPDU plus any expected BlockAck frame response is less than the remaining TXNAV timer value and, if dot11MCCAActivated is true, the remaining RAV timer value. An S1G STA that is a TXOP holder may transmit multiple MPDUs of the same AC within an A-MPDU as long as the duration of transmission of the A-MPDU plus any expected (NDP) BlockAck frame response is less than the remaining TXNAV timer value.

NOTE 1—PIFS is used by a VHT STA to perform CCA in the secondary 20 MHz, 40 MHz, and 80 MHz channels before receiving RTS (see 10.3.2 (Procedures common to the DCF and EDCAF)).

NOTE 2—An RD responder can transmit multiple MPDUs as described in 10.29.4 (Rules for RD responder).

(11ay)NOTE 3—PIFS is used by an EDMG STA to perform CCA in the secondary, secondary1, and secondary2 channels before receiving RTS (see 10.3.2 (Procedures common to the DCF and EDCAF)).

NOTE 4(11ay)—Within a BDT, STAs can transmit multiple MPDUs as described in 10.50 (Bidirectional TXOP).

NOTE 5(11ay)—A PIFS is required to be present preceding an RTS transmission by a CMMG STA in order to allow a recipient of the RTS to perform CCA in the secondary 540 MHz channels to determine the appropriate response to the RTS.

After a valid response ~~(see Annex G)~~ to the initial frame of a TXOP, if the Duration/ID field is set for multiple frame exchange sequences ~~transmission~~ and there is a subsequent transmission failure, the corresponding channel access function may transmit after the CS mechanism (see 10.3.2.1 (CS mechanism)) indicates that the medium is idle at the TxPIFS slot boundary (see Figure 10-31 (EDCA mechanism timing relationships)) provided that the duration of that transmission plus the duration of any expected acknowledgment and applicable IFS is less than the remaining TXNAV timer value and, if dot11MCCAActivated is true, the RAV timer. At the expiration of the TXNAV timer and if dot11MCCAActivated is true, the RAV timer, if the channel access function has not regained access to the medium, then the EDCAF shall invoke the backoff procedure that is described in 10.23.2.4 (Obtaining an EDCA TXOP). Transmission failure is defined in 10.23.2.12 (Retransmit procedures).

All other channel access functions at the STA shall treat the medium as busy until the expiration of the TXNAV timer.

NOTE 6(11ay)— ~~A multiple f~~Frame ~~transmission~~ exchange sequence(s) ~~is~~ are granted to an EDCAF, not to a STA, so that ~~the~~ multiple frame exchange sequemces ~~is~~ are permitted only for the transmission of ~~a~~ frames of the same AC as the frame that was granted the EDCA TXOP, except as specified in 10.23.2.7 (Sharing an EDCA TXOP).

In the case of PSMP, this AC transmission restriction does not apply to either the AP or the STAs participating in the PSMP sequence, but the specific restrictions on transmission during a PSMP sequence described in 10.30 (PSMP operation) do apply.

If a TXOP is protected by an RTS or CTS frame carried in a non-HT or a non-HT duplicate PPDU, the TXOP holder shall set the TXVECTOR parameter CH\_BANDWIDTH of a PPDU as follows:

— To be the same or narrower than (11ax)the RXVECTOR parameter CH\_BANDWIDTH\_IN\_NON\_HT of the last received CTS frame in the same TXOP, if the RTS

frame with a bandwidth signaling TA and TXVECTOR parameter DYN\_BANDWIDTH\_IN\_NON\_HT set to Dynamic has been sent by the TXOP holder in the last RTS/CTS exchange.

— Otherwise, to be the same or narrower than the TXVECTOR parameter CH\_BANDWIDTH of the RTS frame that has been sent by the TXOP holder in the last RTS/CTS exchange in the same TXOP.

(11ax)If a TXOP is protected by an MU-RTS Trigger frame or CTS frame carried in a non-HT or a non-HT duplicate PPDU, the TXOP holder shall set the TXVECTOR parameter CH\_BANDWIDTH of a PPDU as follows:

— To be the same or narrower than the TXVECTOR parameter CH\_BANDWIDTH of the MU-RTS Trigger frame that has been sent by the TXOP holder in the last MU-RTS Trigger/CTS frame exchange in the same TXOP, if the RU Allocation subfields of the MU-RTS Trigger frame for all intended receivers are equal to a value that corresponds to the channel bandwidth that is indicated in the UL BW subfield in the Common Info field of the MU-RTS Trigger frame.

— Otherwise, to be the same or narrower than the TXVECTOR parameter CH\_BANDWIDTH of the preceding PPDU that it has transmitted in the same TXOP.

If there is no RTS/CTS (11ax)or MU-RTS Trigger/CTS frame exchange in non-HT duplicate format in a TXOP, and the TXOP includes at least one non-HT duplicate frame that does not include a PS-Poll, then the TXOP holder shall set the TXVECTOR parameter CH\_BANDWIDTH of a PPDU sent after the first non-HT duplicate frame that is not a PS-Poll to be the same or narrower than the TXVECTOR parameter CH\_BANDWIDTH of the initial frame in the first non-HT duplicate frame in the same TXOP.

If there is no non-HT duplicate frame in a TXOP, the TXOP holder shall set the TXVECTOR parameter CH\_BANDWIDTH of a non-initial PPDU to be the same or narrower than the TXVECTOR parameter CH\_BANDWIDTH of the preceding PPDU that it has transmitted in the same TXOP, subject to the following constraints:(11ax)

— If the preceding PPDU is a DL HE MU PPDU with preamble puncture, the TXOP holder shall set the TXVECTOR parameter CH\_BANDWIDTH of the non-initial PPDU to a value whose corresponding 20 MHz channels are within a set of 20 MHz channels where pre-HE modulated fields of the preceding PPDU are located.(11ax)

— If the non-initial PPDU is a DL HE MU PPDU with preamble puncture, the TXOP holder shall set the TXVECTOR parameter RU\_ALLOCATION of the non-initial PPDU to a value whose corresponding RU is within a set of 20 MHz channels where pre-HE modulated fields of the preceding PPDU are located.(11ax)

If a TXOP is protected by a CTS-to-self frame carried in a non-HT or non-HT duplicate PPDU, the TXOP holder shall set the TXVECTOR parameter CH\_BANDWIDTH of a PPDU to be the same or narrower than the TXVECTOR parameter CH\_BANDWIDTH of the CTS-to-self frame in the same TXOP.

Note that ~~when transmitting~~ multiple ~~frames~~ frame exchange sequences in a TXOP ~~using~~ that use acknowledgment mechanisms other than immediate acknowledgment, should use a protective mechanism ~~should be used~~ (such as RTS/CTS or the protection mechanism described in 10.27 (Protection mechanisms)). A QoS AP or a mesh STA may send group addressed frames without using any protection mechanism. In a QoS IBSS, group addressed frames shall be sent one at a time, and backoff shall be performed after the transmission of each of the group addressed frames. In an MBSS, a mesh STA may send multiple group addressed frames in a TXOP, bounded by the TXOP limit, without performing backoff after the TXOP is obtained.

An S1G STA that intends to transmit an 8 MHz or 16 MHz PPDU invoking a backoff procedure in the primary 2 MHz channel using the channel busy conditions defined in 23.3.18.5.4.2 (CCA sensitivity for devices in type 2 channels implementing intended 8 or 16 MHz transmit channel width channel access procedure) shall not set the Dynamic Indication field to 1 in any RTS frame that is scheduled for transmission at the expiration of this backoff.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Looking at all other instances of “multiple frame transmission”

10.3.2.3.4, P2036.11

*The PIFS is used to gain priority access to the medium.*

*The PIFS may be used as described in the following list and shall not be used otherwise:*

* A TXOP holder transmitting an RTS with a bandwidth signaling TA within a ~~multiple~~ frame exchange ~~transmission~~ sequence, as specified in 10.23.2.8 (Multiple frame transmission in an EDCA TXOP)

10.23.3.2.3, P2175.27

This subclause describes recovery from the absence of an expected reception in a CAP. Note that the recovery rules from the absence of an expected reception are different from EDCA because in this case the NAVs of all of the STAs in the BSS have already been set up by the transmissions by the HC. The recovery rules for multiple frame ~~transmission of~~ exchange sequences in an EDCA TXOP are different because a STA may always be hidden and may have not set its NAV due to the transmission by another STA. Finally, since an HC is collocated with the AP, the AP may recover using the rules described in this subclause even if the recovery is from the absence of an expected reception.

10.36.5.1, P2306.34

NOTE 4—Recovery in the case of a missing response to a VHT NDP Announcement or Beamforming Report Poll frame follows the rules for multiple ~~frame transmission~~ frame exchange sequences in an EDCA TXOP (see 10.23.2.8 (Multiple frame transmission in an EDCA TXOP)).

P4067.9

26.2.8 Multiple frame ~~transmission~~ exchange sequences in an EDCA TXOP in the 6 GHz band

B.4.13, P4893.53

QD3Multiple frame ~~transmission~~ exchange sequences in an EDCA TXOP support

ANNEX G, P5678.4

Delete “(normative)” and replace with “(informative)”

***Following are changes referenced to D0.4 Clause 29***

*Note: The following “frame exchanges” are deemed to be “frame exchange sequences” as the exchange referred to is a frame/ACK.*

29.8.2 P4851.64

After a WUR non-AP STA has negotiated WUR power management service with a WUR AP, the WUR non-AP STA may switch from WUR mode to WUR mode suspend by initiating and completing a successful frame exchange sequence, which includes a WUR Mode Setup frame with Action Type field of the carrying WUR Mode element equal to “Enter WUR Mode Suspend” from the WUR non-AP STA and an Ack frame from the WUR AP as described in Table 29-2 (WUR Mode Setup frame or WUR Mode Teardown frame transmission (11ba)).

29.8.2 P4852.8

After a WUR non-AP STA has negotiated WUR power management service with a WUR AP, the WUR non-AP STA may switch from WUR mode suspend to WUR mode by initiating and completing a successful frame exchange sequence, which includes a WUR Mode Setup frame with Action Type field of the carrying WUR Mode element equal to “Enter WUR Mode” from the WUR non-AP STA and an Ack frame from the WUR AP as described in Table 29-2 (WUR Mode Setup frame or WUR Mode Teardown frame transmission(11ba)).

The Action Type field in the WUR Mode element of the WUR Mode Setup frame sent by the WUR non-AP STA in this frame exchange sequence indicates the status that the WUR non-AP STA shall adopt upon successful completion of the frame exchange sequence.

P4852.45

After a WUR non-AP STA has negotiated WUR power management service with a WUR AP, the WUR AP may update the WUR parameters with the WUR non-AP STA in WUR mode by initiating and completing a successful frame exchange sequence, which includes an unsolicited WUR Mode Setup frame with the Action Type in WUR Mode element equal to “Enter WUR Mode Response” from the WUR AP and an Ack frame from the WUR non-AP STA as described in Table 29-2 (WUR Mode Setup frame or WUR Mode Teardown frame transmission(11ba)).

After a WUR non-AP STA has negotiated WUR power management service with a WUR AP, the WUR AP may update the WUR parameters with the WUR non-AP STA in WUR mode suspend by initiating and completing a successful frame exchange sequence, which includes an unsolicited WUR Mode Setup frame with the Action Type in WUR Mode element equal to “Enter WUR Mode Suspend Response” from the WUR AP and an Ack frame from the WUR non-AP STA as described in Table 29-2 (WUR Mode Setup frame or WUR Mode Teardown frame transmission(11ba)).

P4853.6

After a WUR non-AP STA negotiates WUR power management service with a WUR AP, the WUR non-AP STA may tear down WUR power management service by initiating and completing a successful frame exchange sequence, which includes a WUR Mode Teardown frame from the WUR non-AP STA and an Ack frame from the WUR AP as described in Table 29-2 (WUR Mode Setup frame or WUR Mode Teardown frame transmission(11ba)).

After a WUR non-AP STA negotiates WUR power management service with a WUR AP, the WUR AP may tear down WUR power management service by initiating and completing a successful frame exchange sequence, which includes a WUR Mode Teardown frame from the WUR AP and an Ack frame from the WUR non-AP STA as described in Table 29-2 (WUR Mode Setup frame or WUR Mode Teardown frame transmission(11ba)).

29.8.4 P4854.52

The WUR power state of the WUR non-AP STA may be in the WUR doze state after the WUR non-AP STA completes a successful frame exchange sequence with the WUR AP, and the frame exchange sequence informs the WUR AP that the WUR non-AP STA is in the awake state (see 11.2.1 (General)).