IEEE P802.11  
Wireless LANs

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| “Annex G (part 2)” | | | | |
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Abstract

Look at defining Frame Exchange Sequence that does not reference ANNEX G

Rev 1 – Added results of discussion on June 3

Rev 2 – Based on Discussions June 21,

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| At first look, it may seem obvious that we must keep Annex G as it meticulously defines all the packet exchanges and is normative, but there are consequences.  “***frame exchange sequence*:** A sequence of frames specified by Annex G”  Hence, any sequence of frames not in Annex G is not, on the face of it, a valid sequence.  In Draft D0.0  “frame exchange” 309 instances, of which “frame exchange sequence” 128  “valid response” 4 instances  “frame sequence” 23 instances  “see Annex G” 5 instances  “in Annex G” 9 instances  If we can remove “Annex G” from the definition, then it all gets easier. We could keep Annex G, or remove it, but let’s first see if we can agree on a correct definition for “frame exchange sequence”.  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  What exactdISCUSSION ON June 3ly is a “frame exchange sequence”?  In G.2. Basic Sequences,  “Except where modified by the *pifs* attribute, frames are separated by a SIFS or RIFS.”  Hence, “frame exchange sequences” appear to be a sequence of frames separated by an IFS.  Note the definition of “successful transmission”  ***successful transmission***: A transmission and the reception of its expected immediate response or a transmission for which no immediate response is expected  The only thing missing is “sequence”. For example, consider a TXOP where we can have a succession of data/ACK exchanges, all seperated by SIFS.  Is this a series of “successful transmissions” rather than one successful transmission? I think it is.  So *frame exchange sequence =* several *successful transmissions*  **Consider the 4-way handshake**.  This is a *frame sequence,* i.e., a sequence of 8 or more frames, that consists of 4 *frame sequence exchanges* OR four *successful transmissions*.  IS THAT RIGHT? Can we agree on the use of the terms?  In this case, *successful transmission = frame exchange sequence*  In case of TXOP, that is not true.  What is a frame sequence? (Note these are not formal definitions, I am just trying to see if we all understand their usage)  ***Frame sequence***: a sequence of frames sent to make something happen, e.g. 4 way handshake, umpteen figures with “frame exchange” in the title. A succession of frames in some order, BUT although each frame may have an immediate response frame (e.g., ACK), each ‘request’ frame may come after a back off.  What is a “**Frame exchange sequence**” **?**  It needs to get across the concept of “immediate response”, where “Immediate response” means RIFS, SIFS, PIFS or DIFS between frames/packets, including, for example, TXOPs (EDCA and HCCA), and RTS/CTS exchange before data packets  Suggested definitions:  Explicit definition as proposed by Robert:  ***frame exchange sequence***: A frame that is not an immediate response and that does not solicit an immediate response or a sequence of frames exchanged between two STAs where each frame in the sequence is addressed to the other STA and either solicits an immediate response from the other STA or is the response to a frame from the other STA that solicits an immediate reponse  My only problem with this is “immediate response” and “response to previous frame. In a TXOP is the next data frame a response to the preceeding data/ACK?  Simple (builds upon the *successful transmission* definition)  ***frame exchange sequence –*** A successful transmission or a sequence of exchanged frames, each frame seperated from the previous frame by an IFS***.***  It is accurate but DIFS can occur even with back-off.  ***frame exchange sequence –*** A successful transmission or a sequence of exchanged frames that ends when a backoff procedure is required.  I think this is getting close. *Successful transmission* covers the single frame and request / immediate response and frame exchange sequence ends when a backoff procedure takes place.  MAYBE,  ***frame exchange sequence***: A successful transmission or a sequence of frames exchanged between two STAs which ends when a backoff procedure takes place.  Before continuing, I suggest we get agreement on a new definition for “frame exchange sequence”  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |  |  |  |  |  |
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**Proposals considered and discussed at ARC meeting 6/3/2021**

***frame exchange sequence***: A successful transmission or a sequence of frames exchanged between two STAs which ends when a backoff procedure takes place.

***frame exchange sequence***: A successful transmission or a sequence of frames exchanged between two specific STAs which is protected by a Duration field.

Note: *A TXOP is a frame exchange sequence or a number of parallel frame exchange sequences in the case of MU transmissions.*

***frame exchange sequence***: A successful transmission or a sequence of frames that are protected by a Duration field.

Note: *A TXOP is a frame exchange sequence or a number of parallel frame exchange sequences*

Note:

***successful transmission***: A transmission and the reception of its expected immediate response or a transmission for which no immediate response is expected

**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—A TXOP is defined by a starting time and a maximum duration.

**transmission opportunity (TXOP):** An interval of time during which a particular quality-of-service (QoS)

station (STA) has the right to initiate a frame exchange sequence or a number of parallel frame exchange sequences onto the wireless medium (WM).

NOTE—A TXOP is defined by a starting time and a maximum duration.

DISCUSSION June 3, 2021

**How closely linked are “frame exchange sequence” and TXOP?**

Points:

1. A “standard” TXOP between two unique STAs, is a frame exchange sequence.
2. TXOP MU
   1. Is the TXOP duration protected?
   2. Is it a number of frame exchange sequences in parallel?
   3. Is it a series of frame exchange sequences?
   4. Is it a series of frame excahange sequences in parallel?
   5. Does it matter which way we define it?

**What is the purpose of defining “frame exchange sequence”?**

1. **Power save**:

We have the rule that the Power Save status cannot be changed during a frame exchange sequence.

Pretty sure MU TXOP is not in Annex G, so nothing in Spec to say if power save status can change during such a TXOP.

Specifying that an MU TXOP is a number of frame exchange sequences in parallel would clearly say no STA should change power save status during a TXOP or an MU TXOP. Does that break anything?

* + Does not work for a Sequence of fragmented packets of a single packet (BUT is this actually covered in ANNEX G?)

( [**CTS**] (**Management** +*broadcast* | **Data** +*group*) ) |

( [**CTS** | **RTS CTS** | **PS-Poll**] {frag-frame **Ack**} last-frame **Ack** ) |

(**PS-Poll Ack**) |

hcf-sequence |

mcf-sequence |

s1g-sequence;

1. **A sequence of frames that are not to be interrupted by a third STA**

A sequence of frames protected by a Duration field.

* + Works for a data/ACK, data/BA,
  + Works for RTS/CTS/data/ACK – duration field counts down
  + Works for a TXOP – duration field counts down.
  + In a way works for a single packet as duration is set to zero

1. **Any other reason?**

“Valid” exchanges?

**Maybe combine all the thoughts:**

PROPOSAL

***frame exchange sequence***: A successful transmission, a sequence of frames exchanged between two specific STAs which ends when a backoff procedure takes place, or a sequence of frames exchanged between two specific STAs which is protected by a Duration field value.

Note: *A TXOP is a frame exchange sequence or, in the case of MU transmissions, a number of parallel frame exchange sequences.*

*And*

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

NOTE—A TXOP is defined by a starting time and a maximum duration.

Discussions June 21, 2021

The frame exchange sequence definition was not liked as it was a series of “or” and exceptions to each of the categories could be stated.

A lot of discussion on “Fragmentation”, points were:

* Fragmentation packets are same as any data packet, individually ACK’d with back off, or
* Contained in a TXOP

Some felt that fragmented sequence is a frame exchange sequence as power save condition should not be changed.

So what distinguishes a “frame exchange sequence” and why do we need it?

What is a frame exchange sequence?

1. Shared state between two STAs, (state cannot change, eg. Power save)
2. Control of the medium. (e.g. TXOP)

Some attempts at definitions:

**Attempt A**

***frame exchange sequence:*** A sequence of frames (typically NAV protected and separated by a SIFS or RIFS, except when modified by the *pifs* attribute), exchanged between two specific STAs during which their shared state is not changed, or a sequence of fragmented packets of a single packet.

Then modify the power save changing sentence to read “power save state is not changed during a frame exchange sequence”, rather than “shall not be changed…”

*Comments:*

Turned the definition around by defining iot as the state not changing, rather than don’t change state during the sequence. Added a sentence to cover fragmentation because felt that fragmentation sequence is included.

*My view:*

Fragmentation is not a special case and should not be considered so. For example, one would not expect the power save setting to change during a 4-way handshake, but this is definitely not a “frame exchange sequence”. I like the “NAV” protection as this agrees very much with what ANNEX G states up front.

An allowable frame exchange sequence is defined by the rule frame-exchange-sequence. Except where

modified by the *pifs* attribute, frames are separated by a SIFS or RIFS.

(\* This rule defines all of the allowable frame exchange sequences \*)

frame-exchange-sequence =

( [**CTS**] (**Management** +*broadcast* | **Data** +*group*) ) |

( [**CTS** | **RTS CTS** | **PS-Poll**] {frag-frame **Ack**} last-frame **Ack** ) |

(**PS-Poll Ack**) |

hcf-sequence |

mcf-sequence |

s1g-sequence;

(\* A frag-frame is a nonfinal part of an individually addressed MSDU or MMPDU \*)

frag-frame = (**Data** | **Management**) +*individual* +*frag*;

(\* This is the last (or only) part of a an individually addressed MSDU or MMPDU \*)

last-frame = (**Data** | **Management**) +*individual* +*last*;

**Attempt B**

***frame exchange sequence:*** A sequence of frames between two specific STAs, during which the STAs share unchanging state information about their common link, such as power save state, channel and band, etc.,

*Comment:*

Again, basing the sequence on the non-changing of state.

*My view:*

This does not work at all. Again take the case of 4-way exchange, the state will not change, but it is not a “packet exchange sequence”. Also, example of a voice call, STAs will not change state, but the complete call is not one sequence.

***Soo…***

1. ***Like it or not, we should not change the definition from what it is now, i.e. what is ANNEX G Definition?*** 
   1. ***It clearly states SIFS and “NAV-protected” which cover the 2 points as above.***
2. ***The non-changing state is not a definition of a packet exchange sequence***
3. ***Fragmentation is not a special case it should be treated as intended, i.e., a series of data packets.***
4. ***There are many cases where a STA is ill advised to change state, but during a packet exchange sequence is simply one case where it should not.***

**Attempt C**

*Based upon Robert’s original suggestion*

***frame exchange sequence***: A frame that is not an immediate response and that does not solicit an immediate response or a sequence of frames exchanged between two specific STAs where each frame in the sequence is separated by a SIFS or RIFS, except when modified by the *pifs* attribute.

Note: Do we delete RIFS?

“**10.3.2.3.2 RIFS** The use of RIFS for a non-DMG STA is obsolete…”

So presumeably, DMG still uses it.

So, leave it in.

*Comments:*

* Covers the two cases, Power Save and control of medium
* Is effectively same as the basic sequences as per ANNEX G, so potentially no new behaviour.
* Is straightforward and not ambiguous.