IEEE P802.11  
Wireless LANs

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| |  |  |  |  |  | | --- | --- | --- | --- | --- | | Misc PHY and Lower Level CIDs | | | | | | Date: 2022-09-13 | | | | | | Author(s): | | | | | | Name | Affiliation | Address | Phone | email | | Brian Hart | Cisco Systems |  |  | [brianh@cisco.com](mailto:brianh@cisco.com) | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |

Abstract

This submission proposes resolutions for the following comments from comment collection on P802.11me D1.0:

1052, 1054, 1056, 1058, 1059, 2109, 1062, 1065, 2275, 1067, 1072

The baseline used in this document is D1.0.

NOTE – Set the Track Changes Viewing Option in the MS Word to “All Markup” to clearly see the proposed text edits.

**Revision History:**

R0: Initial version.

R1: Inserted Visio files, trivial editorial corrections

R2: Vendor specific corrections from MarkR

R3: Updates to 1052.

R4: More updates to 1052.

R5: For 1065 and 2275, removed PE changes; other notes added via “XXXX”

R6: Updates to VS Trigger Types, and other minor cleanup (including addresseing the XXXXs) after presentation to 11me.

R7: Fixes for LENGTH topic (thanks Xiagang!)

R8: New approach for 1059, descoping of 1052, corrections to 1058

R9: Added CID2109, declined R1056

R10: Streamlined rejection for R1056, aligned POWER\_BOOST\_FACTOR changes with EHT changes in 22/1270r3

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| --- | --- | --- | --- | --- |
| 1052 | 4485.00 | 27.3.22 | Handling of very short 11a/g/ PPDUs is not well addressed. | Also follow the clause 17/19/21 RX procedures If the PPDU is too short to be an HE PPDU. Note related text changes in 21/963 under CID 18 (for VHT PHY) |

# 1052 Discussion

Commenter writes 21/963 but means 21/965.

A 14B CTS or Ack frame sent at 54 Mbps in an 11a/g OFDM format takes just one OFDM symbol, before PHY format discrimination for certain frame format/subformats combinations can complete. This case is always distinguished by a 6 Mbps LSIG and a short Length field. However, the HE RX procedure does not clearly account for this case.

For HE, after the LSIG we have:

* RLSIG is 4us
* HESIGA is 8us
* Minimum HESIGB is 0us
* Minimum HESTF is 4us
* Minimum of:
  + HE sounding NDP (8+0+4=12us)
    - Minimum NSS=1 for CQI so HELTF field is 7.2us aka 8us
    - HE-Data is 0us
    - PE is 4us
  + Otherwise (4+16+0=20us)
    - Minimum HELTF is x1 and 0.8us aka 4us
    - Minimum HE-Data is 13.6us aka 16us
    - Minimum PE is 0us

… for a mimum duration of 4+8+0+4+min(12,20) = 28us or seven 11a/g OFDM symbols, which is indicated by L\_LENGTH as floor(((#symbol-1)\*(6e6\*4e-6)-6-16)/8)+1 = (#symbol)\*3-5 = 16 octets or higher.

However, the introduction to the RX procedure describes the reception of other PHYs in general terms, as follows, this seems to suffice:

“If the detected format indicates a non-HT PPDU, refer to the receive procedure and state machine in Clause 15 (DSSS PHY specification for the 2.4 GHz band designated for ISM applications), Clause 16 (High rate direct sequence spread spectrum (HR/DSSS) PHY specification), Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification), and Clause 18 (Extended Rate PHY (ERP) specification). If the detected format indicates an HT PPDU format, refer to the receive procedure and state machine in Clause 19 (High-throughput (HT) PHY specification). If the detected format indicates a VHT PPDU format, refer to the receive procedure and state machine in Clause 21 (Very high throughput (VHT) PHY specification).”

Instead use this CID to clean up some related VHT text when not receiving a VHT PPDU. Also, LSIG counts OFDM symbols after *itself*, so “the L-SIG field indicates at least seven OFDM symbols after the L-LTF field” reads like a typo.

The calculation is:

* VHTSIGA is 8us
* VHTSTF is 4us
* Either NDP: 2\*4+4+0 = 12us
  + Minimum NSS=2 VHTLTF field is 2\*4us
  + VHTSIGB is 4us
  + VHT-Data is 0us
* Or Data = 1\*4us + 4 + 4 = 12us
  + Minimum NSS=1 VHTLTF field is 1\*4us
  + VHTSIGB is 4us
  + VHT-Data is 1 OFDM symbol or 4us

… for a mimum duration of 8+4+min(12,12) = 24us or six11a/g OFDM symbols after the LSIG. This is indicated by L\_LENGTH as floor(((#symbol-1)\*(6e6\*4e-6)-6-16)/8)+1 = 13 octets or higher.

**Proposed Resolution: CID 1052**

**Revised**.

**Note to Commenter:**

The commenter’s concerns are valid and are substantially addressed in 22/0576R<motionedRevision> under CID 1052.

**Instruction to Editor:**

Implement the proposed text updates listed under CID 1052 in 22/0576R<motionedRevision>

***TGme Editor, make the following changes to D1.0 shown by Word track changes under CID 1052***

21.3.20 PHY receive procedure

After the PHY-CCA.indication(BUSY, channel-list) primitive is issued, the PHY entity shall begin receiving the training symbols and searching for L-SIG in order to set the maximum duration of the data stream. If the check of the L-SIG parity bit is not valid or the RATE field is an undefined value(#18), a PHY-RXSTART.indication primitive is not issued, and instead the PHY shall issue the error condition PHY-RXEND.indication(FormatViolation) primitive. If a valid L-SIG parity bit is indicated,(#18) the RATE field indicates 6 Mbps, the L-SIG field indicates at least six OFDM symbols after the L-SIG field (i.e., the L-SIG LENGTH is at least 13 octets at 6 Mbps), the first two OFDM symbols after the L-LTF field are using BPSK modulation, and the third OFDM symbol after the L-LTF field is using QBPSK modulation, then the VHT PHY shall maintain PHY-CCA.indication(BUSY, channel-list) primitive for the predicted duration of the transmitted PPDU, as defined by RXTIME in Equation (21-105), for all supported modes, unsupported modes, Reserved VHT-SIG-A Indication, invalid VHT-SIG-A CRC and invalid L-SIG Length field value. The L-SIG Length field value of a VHT PPDU is invalid if it is not divisible by 3. Reserved VHT-SIG-A Indication is defined as a VHT-SIG-A with Reserved bits equal to 0 or MU[u] NSTS fields (u = 0, 1, 2, 3) set to 5-7 or Short GI field set to 0 and Short GI NSYM Disambiguation field set to 1, or a combination of VHT-MCS and N STS not included in 21.5 (Parameters for VHT-MCSs) or any other VHT-SIG-A field bit combinations that do not correspond to modes of PHY operation defined in Clause 21 (Very high throughput (VHT) PHY specification). If the VHT-SIG-A indicates an unsupported mode, the PHY shall issue a PHY-RXEND.indication(UnsupportedRate) primitive. If the VHT-SIG-A indicates an invalid CRC or Reserved VHT-SIG-A Indication or if the L-SIG Length field is invalid, the PHY shall issue the error condition PHY-RXEND.indication(FormatViolation) primitive.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1054 | 4383.00 | 27.3.11.7.4 | HESIGA for HEER conflates two different concepts: bits and OFDM symbols. There are 26 data bits per OFDM symbol but, due to BCC encoding, some of the first 26 data bits appear in the second OFDM symbol. However, the terms HE-SIG-A1/2 are used both for bits in Table 27-18 and symbols in Fig 27-25 | Use distinct terms for distinct quantities. E.g., following 11beD1.3, use HE-SIG-A-sym-1 and HE-SIG-A-sym-2 in fig 27-25 and associated text. |

# 1054 Discussion (Resolved by r1)

HE-SIG-A1/2 are first defined as the bits:

“27.3.11.7.4 Encoding and modulation

For an HE SU PPDU, HE MU PPDU, and HE TB PPDU, the HE-SIG-A field is composed of two subfields,

HE-SIG-A1 and HE-SIG-A2, each containing 26 data bits. The HE-SIG-A1 subfield is transmitted before

the HE-SIG-A2 subfield.”

… , so let’s keep that definition and modify the definition of the symbols: i.e., closely following what is done in 11be.

**Proposed Resolution: CID 1054**

**Revised**.

**Note to Commenter:**

The commenter’s concerns are valid and are substantially addressed in 22/0576R<motionedRevision> under CID 1054.

**Instruction to Editor:**

Implement the proposed text updates listed under CID 1054 in 22/0576R<motionedRevision>

***TGme Editor, make the following changes to D1.0 shown by Word track changes under CID 1054***

27.3.6.6 Construction of HE-SIG-A field

a) For an HE SU PPDU, HE MU PPDU, and HE TB PPDU, the HE-SIG-A field consists of two subfields, HE-SIG-A1 and HE-SIG-A2 and two OFDM symbols, HE-SIG-A-sym-1 and HE-SIG-A-sym-2, as defined in 27.3.11.7 (HE-SIG-A field), and is constructed as follows:

1) Obtain the HE-SIG-A field values from the TXVECTOR. Add the reserved bits, append the calculated CRC, and then append the N tail tail bits as shown in 27.3.11.7 (HE-SIG-A field). This results in 52 uncoded bits.

…

b) For an HE ER SU PPDU, the HE-SIG-A field consists of two subfields, HE-SIG-A1 and HE-SIG-A2, and four OFDM symbols: HE-SIG-A-sym-1, HE-SIG-A-sym-1-

R, HE-SIG-A-sym-2, and HE-SIG-A-sym-2-R. The HE-SIG-A-sym-1 and HE-SIG-A-sym-1-R OFDM symbols are calculated from one set of coded bits common to both OFDM symbols while the HE-SIG-A2 and HE-SIG-A2-R OFDM symbols are calculated from a second set of coded bits common to both OFDM symbols as defined in 27.3.11.7 (HE-SIG-A field). The HE-SIG-A field is constructed as follows:

1. Obtain the HE-SIG-A fields from the TXVECTOR. Add the reserved bits, append the

calculated CRC, and then append the N tail tail bits as shown in 27.3.11.7 (HE-SIG-A field).

This results in 52 uncoded bits.

2) BCC encoder: Encode the data by a convolutional encoder at the rate R = ½ as described

in 17.3.5.6 (Convolutional encoder).

3) BCC interleaver: Interleave the first and second half of the coded bits of the HE-SIG-A field as described in 27.3.12.8 (BCC interleavers). The coded bits of the HE-SIG-A-sym-1-R and HE-SIG-A-sym-2-R subfields are not interleaved.

4) Constellation mapper: BPSK modulate the BCC interleaver output of the HE-SIG-A-sym-1, HE-SIG-A-sym-2, and HE-SIG-A-sym-2-R OFDM symbols as described in 17.3.5.8 (Subcarrier modulation mapping) to form the first, third, and fourth OFDM symbols of the HE-SIG-A field, respectively. QBPSK modulate the BCC interleaver output of the HE-SIG-A-sym-1-R OFDM symbol to form the second OFDM symbol of the HE-SIG-A field.

…

27.3.11.7.4 Encoding and modulation

For an HE SU PPDU, HE MU PPDU, and HE TB PPDU, the HE-SIG-A field is composed of two subfields,

HE-SIG-A1 and HE-SIG-A2, each containing 26 data bits. These two subfields are sent as two OFDM symbols: HE-SIG-A-sym-1 and HE-SIG-A-sym-2. The HE-SIG-A-sym-1 OFDM symbolis transmitted before the HE-SIG-A-sym-2 OFDM symbol. The data bits of the HE-SIG-A OFDM symbols shall be BCC encoded at rate R = ½, be interleaved, be mapped to a BPSK constellation, and have pilots inserted following the steps described in 17.3.5.6 (Convolutional encoder), 27.3.12.8 (BCC interleavers), 17.3.5.8 (Subcarrier modulation mapping), and 17.3.5.9 (Pilot subcarriers), respectively. The constellation mappings of the HE-SIG-A field in an HE SU PPDU, HE MU PPDU, and HE TB PPDU are shown in Figure 27-25 (Data subcarrier constellation of HE-SIG-A symbols(11ax)). The first half and second half of the stream of 104 complex numbers generated by these steps (before pilot insertion) are divided into two groups of 52 complex numbers, where the first 52 complex numbers form the first OFDM symbol of the HE-SIG-A field, HE-SIG-sym-1, and the second 52 complex numbers form the second OFDM symbol of the HE-SIG-A field, HE-SIG-sym-2, respectively.

…

For an HE ER SU PPDU, the HE-SIG-A field is composed of two subfields, HE-SIG-A1 and HE-SIG-A2, each containing 26 data bits. These two subfields are sent as four OFDM symbols: HE-SIG-A-sym-1, HE-SIG-A-sym-1-R, HE-SIG-A-sym-2, and HE-SIG-A-sym-2-R. These four OFDM symbols are transmitted sequentially from HE-SIG-A-sym-1 to HE-SIG-A-sym-2-R. The data bits of the HE-SIG-A1 and HE-SIG-A2 subfields shall be BCC encoded at rate R = ½, be interleaved, be mapped to a BPSK constellation, and have pilots inserted. The HE-SIG-A-sym-1-R OFDM symbol is calculated from the same encoded bits as the HE-SIG-A-sym-1 subfield, and the encoded bits shall be mapped to a QBPSK constellation without interleaving and have pilots inserted. The constellation mappings of the HE-SIG-A field in an HE ER SU PPDU are shown in Figure 27-25 (Data subcarrier constellation of HE-SIG-A symbols(11ax)). The QBPSK constellation on the HE-SIG-A-sym-1-R OFDM symbol is used to differentiate between an HE ER SU PPDU and an HE MU PPDU when m = 1 in Equation (27-11). The HE-SIG-A-sym-2-R OFDM symbol is calculated using the same encoded bits as the HE-SIG-A-sym-2 OFMD-symbol, and the encoded bits shall be mapped to a BPSK constellation without interleaving and have pilots inserted. BCC encoding, data interleaving, constellation mapping, and pilot insertion follow the steps described in 17.3.5.6, 27.3.12.8 (BCC interleavers), 17.3.5.8 (Subcarrier modulation mapping), and 17.3.5.9 (Pilot subcarriers), respectively.

***Tgme editor, ensure the following further changes are made using the embedded zip of Visio files:***



Figure 27-25—Data subcarrier constellation of HE-SIG-A symbols(11ax)

***In Figures 27-54, 27-56, 27-57, 27-59, 27-61 and 27-62, change:***

* ***HE-SIG-A1 to HE-SIG-A-sym-1***
* ***HE-SIG-A2 to HE-SIG-A-sym-2***

***In Figures 27-55 and 27-60, change:***

* ***HE-SIG-A1 to HE-SIG-A-sym-1***
* ***HE-SIG-A1-R to HE-SIG-A-sym-1-R***
* ***HE-SIG-A2 to HE-SIG-A-sym-2***
* ***HE-SIG-A2-R to HE-SIG-A-sym-2-R***

***In Figure 27-58, change:***

* ***HE-SIG-A1 to HE-SIG-A-sym-1 x3***
* ***HE-SIG-A1-R to HE-SIG-A-sym-1-R x1***
* ***HE-SIG-A2 to HE-SIG-A-sym-2 x3***
* ***HE-SIG-A2-R to HE-SIG-A-sym-2-R x1***

******

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1056 | 988.00 | 9.3.1.22.1 | Pre-standards prototyping is hindered by the absence of a vendor specific trigger type | Define a value (e.g. 15) for vendor specific triggers, where the first 3 octets of the Trigger Dependent Common Info field is an OUI |

# 1056 Discussion

Vendor specific functionality is typically supported via SW yet Trigger frames require hard real time operation that makes such SW functionality more challenging.

**Proposed Resolution: CID 1056**

**Rejected**. Vendor specific functionality is typically supported via SW yet Trigger frames require hard real time operation that makes such SW functionality more challenging.

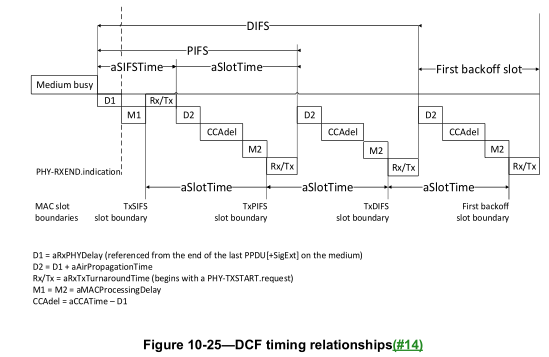
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1058 | 2133.00 | 10.3.7 | MAC timing at end of RX is not internally consistent: consider how the end of a received PPDU is signalled to the MAC. P2133L47 says "All MAC timings are referenced from the PHY-TXEND.confirm, PHY-TXSTART.confirm, PHY-RXSTART.indication, and PHY-RXEND.indication primitives" so we look at PHY-RXEND.indication. P2133L20-33 shows that the start of SIFS = when PHY-RXEND.indication is asserted minus aRxPHYDelay but at P866L9 aRxPHYDelay is defined as "The nominal time (in microseconds) that the PHY uses to deliver the last bit of a received PSDU to the MAC from the end of the PPDU[+SigExt] on the WM to the MAC", so this only works if PHY-RXEND.indication primitives is issued exactly when the PHY delivers the last bit of a received PSDU to the MAC. However at P894L20-23, we see something else "This primitive is generated by the PHY for the local MAC entity to indicate that the receive state machine has completed a reception with or without errors. When a signal extension is present, the primitive is generated at the end of the signal extension." | Either a) redefine aRxPHYDelay so it relates to when RXEND.indication is issued, or b) redefine when RXEND.indication is issued so it relates to aRxPHYDelay, or c) replace aRxPHYDelay with a new parameter that relates to when RXEND.indication is issued. Keep in mind a) the figure in the HE RX procedure which implies RXEND.indication is aligned with end of PPDU (!!??), and b) RX of an 11a/g 54Mbps PPDU containing an Ack/CTS where the header might be decoded only after the PPDU has long since ended. |

# 1058 Discussion

There are actually two distinct problems here:

1) As stated by the commenter, the definition of when PHY-RXEND.indication is issued is not tight enough, and further confusion is created from the PHY figures. Consider the following three bolded items taken, with context, from 802.11meD1.0:

10.3.7 DCF timing relations



All medium timings that are referenced from the end of the transmission are referenced from the end (#14)of the PPDU[+SigExt]. The beginning of transmission refers to the (#14)start of the preamble of the next PPDU. All MAC timings are referenced from the PHY-TXEND.confirm, PHY-TXSTART.confirm, PHY-RXSTART.indication, and **PHY-RXEND.indication** primitives.

6.5.4 PLME-CHARACTERISTICS.confirm

6.5.4.2 Semantics of the service primitive

|  |  |  |
| --- | --- | --- |
| Name | Type | Description |
| aRxPHYDelay | Integer | (#14)The nominal time (in microseconds) that the PHY uses to **deliver the last bit of a received PSDU to the MAC** from the end of the PPDU[+SigExt] on the WM to the MAC. |

8.3.5.14 PHY-RXEND.indication

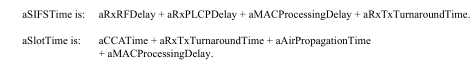
8.3.5.14.3 When generated

This primitive is generated by the PHY for the local MAC entity to indicate **that the receive state machine has completed a reception with or without errors**. When a signal extension is present, the primitive is generated at the end of the signal extension.

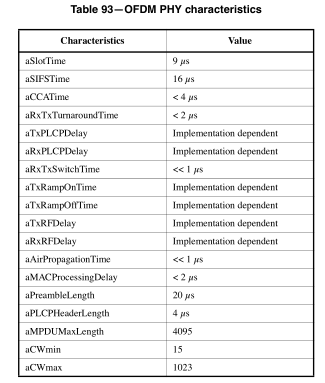
These all need to refer to the same event in the same way, but don’t: “last bit of a received PSDU delivered” is not necessarily the same as “the [PHY’s] receive state machine has completed a reception”. We need to harmonize this language.

2) The DC/EDCF timing relationships slot time have never worked for OFDM(!)

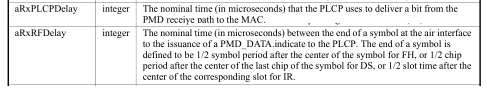
*Background*: From the 1999 version of 802.11 as reaffirmed in 2003



… and - from the aSIFS Time equation and Table 93 from the 802.11a amendment

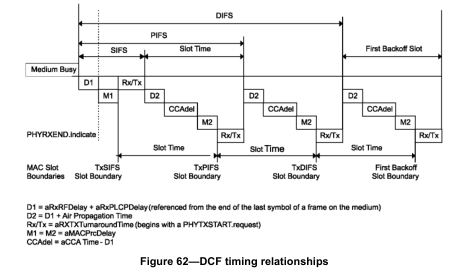


- we infer that aRxRfDelay + aRxPLCPDelay = 16us – <2us - <2us so >12us, where



… aRxRfDelay is the portion of the RX PHY delay from the PMD PHY sublayer and aRxPLCPDelay is the portion of the RX PHY delay from the PLCP PHY sublayer.

However, from the 1999/2003 version of 802.11, we have



… wherein D2 = D1 + Air Propagation Time = aRxRfDelay + aRxPLCPDelay + Air Propagation Time … which is > 12us. Yet this “>12us” is drawn as a small fraction of a 9usec slot time!? Meanwhile CCAdel = aCCATime – D1 = 4us – D1 which is < -8us. We don’t have a grave problem here since we’re both adding and subtracting D1. However it is very confusing / wrong for CCAdel to be negative.

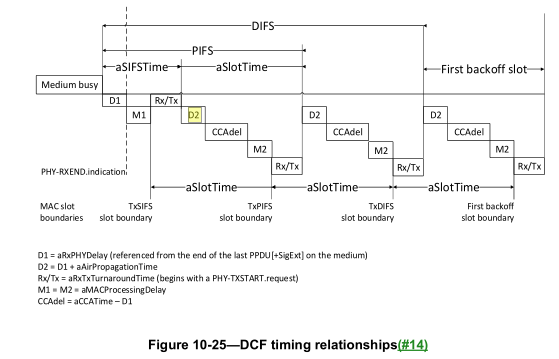
Put another way, during a slot time, the **only things that matter are:**

* aAirPropagationTime
  + Round trip air propagation time
* aCCATime
  + Receive signal delays: group delay from analog filters, ADC conversion delay, group delay from digital filters, and digital pipeline delay
  + Receiving enough of the preamble that CCA can discriminate a preamble from noise and other signals reliably
  + Further group delay from digital filters, and digital pipeline delay from the CCA block
  + PHY-CCA.indication (i.e., transferring the busy/idle information from PHY to MAC)
* aMACProcessingDelay
  + MAC processing delays
  + Deferring PHY-TXSTART.request (i.e., not sending a start request from MAC to PHY when and if the medium is busy
* aRxTxTurnaroundTime
  + Transmit signal delays: group delay from digital filters, digital pipeline delay, DAC conversion delay, and group delay from analog filters
    - Where the filter group delay can be recorded as aTxRampOnTime.
  + RX-to-TX switch time, although this might (partially) occur in parallel with the transmit signal delays

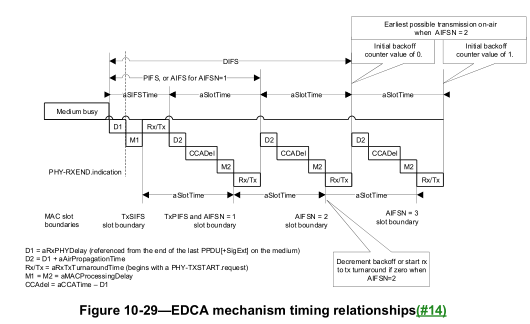
**That is, during the slot time, the PHY is not transferring any PLCP or Data bits from the PLCP sublayer to the MAC, so D1 = aRxRfDelay + aRxPLCPDelay should not be used within the slot time, just SIFS time!**

**D2 should simply equal Air Propagation Time and CCAdel should simply equal aCCATime.**

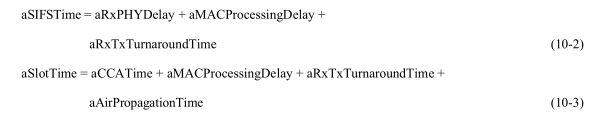
After the PMD interface was removed, we have aRxPHYDelay = aRxRfDelay + aRxPLCPDelay so now aRxPHYDelay > 12us. But the D2 problem remains in 802.11meD1.0, in the DCF and EDCF sections:



… and



… with



**Proposed Resolution: CID 1058**

**Revised**.

**Note to Commenter:**

The commenter’s concerns are valid and are substantially addressed in 22/0576R<motionedRevision> under CID 1058.

**Instruction to Editor:**

Implement the proposed text updates listed under CID 1058 in 22/0576R<motionedRevision>

***TGme Editor, make the following changes to D1.0 shown by Word track changes under CID 1058***

6.5.4 PLME-CHARACTERISTICS.confirm

6.5.4.2 Semantics of the service primitive

|  |  |  |
| --- | --- | --- |
| Name | Type | Description |
| aRxPHYDelay | Integer | (#14)The nominal time (in microseconds) that the PHY takess to generate the PHY-RXEND.indication for a received PPDU to the MAC from the end of the PPDU[+SigExt] on the WM. |

8.3.5.14 PHY-RXEND.indication

8.3.5.14.3 When generated

This primitive is generated by the PHY for the local MAC entity to indicate that the receive state machine has completed a reception with or without errors. When reception is completed without error, the primitive is generated after the PHY has delivered the last bit of the received PSDU to the MAC. When reception of two or more UL MU transmissions completes without error, the primitive is generated at or after the PHY has delivered the last bit of each correctly received PSDU to the MAC. When a signal extension is present, the primitive is generated at or after the end of the signal extension.

***TGme editor: in Figure 10-25, change:***

* ***“D2 = D1 + aAirPropagationTime” to “D2 = aAirPropagationTime”***
* ***“CCAdel = aCCATime – D1” to “CCAdel = aCCATime”***

Diagram, schematic

Description automatically generated

***TGme editor: in Figure 10-29, change:***

* ***“D2 = D1 + aAirPropagationTime” to “D2 = aAirPropagationTime”***
* ***“CCAdel = aCCATime – D1” to “CCAdel = aCCATime”***
* ***Also, in the figure, change “CCADel” to “CCAdel”***

Diagram, schematic

Description automatically generated

10.3.2.1 CS mechanism

At aRxTxTurnaroundTime + aAirPropagationTime + 10% × (aSlotTime –

aAirPropagationTime) after each MAC slot boundary as defined in 10.3.7 (DCF timing relations) and

10.23.2.4 (Obtaining an EDCA TXOP), the MAC shall issue a PHY-CCARESET.request primitive to the

PHY, where aAirPropagationTime determined as described in 10.22.5 (Operation with coverage classes).

***TGme editor: move PHY-RXEND.indication a distinct but small amount past the end of the PPDU in:***

* Figure 16-6—Receive PHY
* Figure 17-19—Receive PHY
* Figure 19-25—PHY receive procedure for HT-mixed format PPDU
* Figure 19-26—PHY receive procedure for HT-greenfield format PPDU
* Figure 20-18—PHY receive procedure
* Figure 27-59—PHY receive procedure for an HE SU PPDU
* Figure 27-60—PHY receive procedure for an HE ER SU PPDU
* Figure 27-61—PHY receive procedure for an HE MU PPDU
* Figure 27-62—PHY receive procedure for an HE TB PPDU

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1059 | 2106.00 | 10.3.2.11 | MAC uses aRxPHYStartDelay to determine when the PPDU containing a response frame should already have been detected by the PHY. At P865L63 aRxPHYStartDelay is defined as a constant for a PHY but P893L17 "This primitive is generated by the local PHY entity to the MAC sublayer when the PHY has successfully validated the PHY header at the start of a new PPDU." so in reality this delay varies by a) PPDU format (11a/b/g/HT/VHT/HE...), b) PPDU subformat (HESU/HEMU/HEER/...), c) number of STSs (e.g., VHTSIGB in VHT MU PPDU), or d) a great many parameters (HE PPDUs especially HE MU PPDUs). This variability is explicit at P2109L43 "The AckTimeout interval is calculated with aRxPHYStartDelay value for ΓëÑ 2 MHz short/long preamble except when the receiving STA has indicated use of 1 MHz control responses as described in 10.6.6.6 (Channel Width selection for Control frames) in which case the AckTimeout interval is calculated with aRxPHYStartDelay value for S1G\_1M preamble." Ditto P3531L28, P3629L40 etc. | 1) Upgrade the definition of aRxPHYStartDelay to be a "structure" with a start delay value per PPDU type/subtype (and the "structure" needs to be iteratively extended since e.g. an HE PHY contains a VHT PHY contains ... a clause 17/18 PHY). 2) Also, for each reference to aRxPHYStartDelay in the MAC sections, either identify how the structure member is selected, or define aRxPHYStartDelay to be the overall maximum among the aRxPHYStartDelay's. We might end up with aRxPHYStartDelayList and keep aRxPHYStartDelay (but now defined as max of aRxPHYStartDelayList). |
| 2109 |  | 10 | aRxPHYSTartDelay needs to be a set of delays indexed by PPDU format. The MAC then needs to use the right delay in the particular context, e.g. if it's expecting an immediate response and that has to be in a 1 Mbps long-preamble CCK PPDU then it should use the value for that, buf if the response has to be a 24 Mbps OFDM PPDU it should use the value for that | In the row defining aRxPHYStartDelay in the middle cell change "Integer" to "Dictionary of integers indexed by PPDU format; the STA chooses the largest value among all those corresponding to the PPDU formats that are valid at the point the PHY start delay is required" |

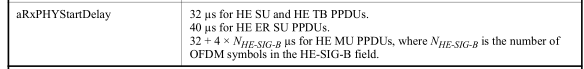
# 1059 & 2019 Discussion

The commenters raise an important topic.

aRxPHYStartDelay is has an abstract definition as a parameter of the PLME-CHARACTERISTICS.confirm via:



Then aRxPHYStartDelay is defined in each PHY clause, such as Table 27-54 (HE PHY characteristics)



From clauses 16-27 (e.g., see above), aRxPHYStartDelay is not a single constant and depends on many TXVECTOR parameters, a MIB variable and a subfield in the the HE Capabilities element, includiing:

* PREMABLE\_TYPE
* FORMAT
* Channel Spacing ~ BANDWIDTH
* NON\_HT\_MODULATION
* MCS
* Max NVHTLTF supported ~ dot11NumberOfSpatialStreamsImplemented
* *NHE-SIG-B* which in turn depends on *many* TXVECTOR parameters and also Longer Than 16 HE-SIG-B OFDM Symbols Support in the HE PHY Capabilities Information field in the HE Capabilities element

We actually have a **second** problem since aRxPHYStartDelay is used widely but imprecisely in the MAC. The exhaustive list of instances is:

1. MAC

* 10.3.2.4 Setting and resetting the NAV
  + P2093: A STA that used information from an RTS frame or MU-RTS Trigger frame as the most recent basis to update its NAV setting is permitted to reset its NAV if no PHY-RXSTART.indication primitive is received from the PHY during a NAVTimeout period starting when the MAC receives a PHY-RXEND.indication primitive corresponding to the detection of the RTS frame or MU-RTS Trigger frame.(11ax)

In non-DMG BSS, NAVTimeout period is equal to (2 × aSIFSTime) + (CTS\_Time) + aRxPHYStartDelay + (2 × aSlotTime). In a non-S1G STA, (11ax)if an RTS frame is used for the most recent NAV update, CTS\_Time shall be calculated using the length of the CTS frame and the data rate at which the RTS frame used for the most recent NAV update was received. (11ax)If an MU-RTS Trigger frame was used for the most recent NAV update, CTS\_Time shall be calculated using the length of the CTS frame and the 6 Mb/s data rate (see 26.2.6 (MU-RTS Trigger/CTS frame exchange sequence procedure(#109))). In an S1G STA, (11ax)CTS\_Time shall be calculated using the time required to transmit an NDP CTS frame that is equal to NDPTxTime, which is specified in 10.3.2.5.2 (RID update).

* + - // This is really an indication of “actively receiving a PPDU within the expected time” or not
  + P2094: In DMG BSS, NAVTimeout period is equal to (2 × aSIFSTime) + TDMG-CTS + StartDelayCompensation + (2 × aSlotTime), where TDMG-CTS is the duration of a DMG CTS frame calculated using the TXVECTOR TRN\_LEN parameter equal to the RXVECTOR TRN\_LEN parameter of the received RTS frame and StartDelayCompensation is equal to aSlotTime

NOTE 4—This value of StartDelayCompensation is a compromise over the possible values of aRxPHYStartDelay, which are dependent on both the implementation and the DMG PHY mode

* + - // This is just a reference in a note, and can be ignored.
* 10.3.2.9 CTS and DMG CTS procedure P2100: 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.
  + // This is really an indication of “actively receiving a PPDU within the expected time” or not, again
* 10.3.2.11 Acknowledgment procedure
  + P2106: After transmitting an MPDU that requires an Ack or BlockAck frame as a response (see Annex G), the STA shall wait for an AckTimeout interval, with a value of aSIFSTime + aSlotTime + aRxPHYStartDelay, starting at the PHY-TXEND.confirm primitive. If a PHY-RXSTART.indication primitive does not occur during the AckTimeout interval, the STA concludes that the transmission of the MPDU has failed, and this STA shall invoke its backoff procedure upon expiration of the AckTimeout interval.
    - // This is really an indication of “actively receiving a PPDU within the expected time” or not, again
  + P2108 (x3): In an S1G BSS, the AckTimeout interval depends on the TXVECTOR parameter PREAMBLE\_TYPE. When the TXVECTOR parameter PREAMBLE\_TYPE is equal to S1G\_SHORT\_PREAMBLE or S1G\_LONG PREAMBLE, the AckTimeout interval is calculated with aRxPHYStartDelay value for ≥ 2 MHz short/long preamble except when the receiving STA has indicated use of 1 MHz control responses as described in 10.6.6.6 (Channel Width selection for Control frames) in which case the AckTimeout interval is calculated with aRxPHYStartDelay value for S1G\_1M preamble. When the TXVECTOR parameter PREAMBLE\_TYPE is equal to S1G\_1M preamble, the AckTimeout interval is calculated with aRxPHYStartDelay value for S1G\_1M preamble.
    - // This is really an indication of “actively receiving a PPDU within the expected time” or not, but now the time varies according to the context (what was transmitted)
* 10.23.2.2 EDCA backoff procedure P2207: The STA shall wait for a timeout interval of duration aSIFSTime + aSlotTime + aRxPHYStartDelay, starting when the MAC receives a PHY-TXEND.confirm primitive. If a PHY-RXSTART.indication primitive does not occur during the timeout interval, the transmission of the MPDU has failed.
  + // This is really an indication of “actively receiving a PPDU within the expected time” or not, again
* 26.2.4 Updating two NAVs P4131: An HE STA that used information from an RTS or MU-RTS Trigger frame as the most recent basis to update its NAV may reset the NAV that is updated by the RTS or MU-RTS Trigger frame if no PHY-RXSTART.indication primitive is received from the PHY during a period with a duration of 2 × aSIFSTime + CTS\_Time + aRxPHYStartDelay + 2 × aSlotTime starting when the MAC receives a PHY-RXEND.indication primitive corresponding to the detection of the RTS or MU-RTS Trigger frame (see 10.3.2.4 (Setting and resetting the NAV) for the definition of CTS\_Time).
  + // This is really an indication of “actively receiving a PPDU within the expected time” or not, again
* 26.2.6.2 MU-RTS Trigger frame transmission P4133: After transmitting an MU-RTS Trigger frame, the AP shall wait for a CTSTimeout interval of aSIFSTime + aSlotTime + aRxPHYStartDelay that begins when the MAC receives the PHY-TXEND.confirm primitive for the transmitted MU-RTS Trigger frame. If the MAC does not receive a PHY-RXSTART.indication primitive during the CTSTimeout interval, the AP shall conclude that the transmission of the MU-RTS Trigger frame has failed, and, if the MU-RTS Trigger frame initiated a TXOP, the AP shall invoke its backoff procedure. If the MAC receives a PHY-RXSTART.indication primitive during the CTSTimeout interval, then the MAC shall wait for the corresponding PHY-RXEND.indication primitive to determine whether the MU-RTS Trigger frame transmission was successful. The receipt of a CTS frame from any non-AP STA addressed by the MU-RTS Trigger frame before the PHY-RXEND.indication primitive shall be interpreted as the successful transmission of the MU-RTS Trigger frame, permitting the frame exchange sequence to continue. The receipt of any other type of frame shall be interpreted as a failure of the MU-RTS Trigger frame transmission. In this instance, the AP may process the received frame and, if the MU-RTS Trigger frame initiated a TXOP, shall invoke its backoff procedure at the PHY-RXEND.indication primitive.
  + // This is really an indication of “actively receiving a PPDU within the expected time” or not, again
* 26.10.3.2 PSR-based spatial reuse initiation P4143: An HE STA that identifies an PSR opportunity may choose to not perform NAV update operations normally executed based on the receipt of the RXVECTOR parameter TXOP\_DURATION and the Trigger frame Duration field. See Figure 26-13 (PSRR PPDU spatial reuse(11ax)). A STA that identifies an PSR opportunity may issue a PHY-CCARESET.request to ignore the associated HE TB PPDU(s) that are triggered by the Trigger frame of the PSRR PPDU and that occur within aSIFSTime + aRxPHYStartDelay + 2 × aSlotTime of the end of the last symbol on the air of the PPDU that contained the Trigger frame, provided that the value of the RXVECTOR parameter BSS\_COLOR of the HE TB PPDU matches the BSS color of the PSRR PPDU. A STA that identifies an PSR opportunity shall not transmit an PSRT PPDU that terminates beyond the PPDU duration of the HE TB PPDU that is triggered by the Trigger frame of the PSRR PPDU.
  + // This is really an indication of “actively receiving a PPDU within the expected time” or not, again

(B) The following apply to DMG and the like, and these PPDUs have a single SIG field

* 10.42.6.2 SLS phase execution P2476: (11ay)An EDMG STA that transmitted an unsolicited RSS shall wait for MBIFSTimeout interval, which has a value of MBIFS + aSlotTime + aRxPHYStartDelay, starting at the PHY-TXEND.confirm primitive of the last SSW frame transmitted as part of the unsolicited RSS. If a PHY-RXSTART.indication primitive does not occur during the MBIFSTimeout interval, the STA concludes that the unsolicited RSS failed and may initiate an ISS to the STA to which the unsolicited RSS was transmitted.
* 10.53.4 TXOP-based sectorization operation
  + P2610: 2) Not observing the subsequent sectorized beam transmission by the AP for aSIFSTime + aSlotTime + aRxPHYStartDelay duration.
  + P2611 (Sectorized beam operation): Note that in the first diagram in Figure 10-151 (SO frame exchange sequence 3), an OBSS non-AP STA or OBSS AP infers its spatial orthogonality with the AP by observing the omnidirectional beam RTS frame and the omnidirectional portion of the long format for the duration of one symbol (D-STF as shown in Figure 23-2 (S1G\_LONG format)) following the omnidirectional portion of the S1G\_LONG format but not the subsequent sectorized beam transmission and with the STA by observing a gap of no transmission between the omnidirectional RTS frame and the omnidirectional preamble of the long preamble. Note that in the second diagram in Figure 10-151 (SO frame exchange sequence 3), an OBSS non-AP STA or OBSS AP infers its spatial orthogonality with the AP by observing the transmission of the omnidirectional beam RTS frame and the omnidirectional beam PPDU of the short format but not observing the subsequent sectorized beam transmission for aSIFSTime + aSlotTime + aRxPHYStartDelay duration and with the STA by observing a gap of no transmission between the omnidirectional RTS frame and the omnidirectional beam PPDU of the short format by the AP.

(C) There are also values defined for aRxPHYStartDelay in each PHY clause.

Now consider an HE STA for example, that might receive a clause 15/16/17/HT/VHT/HE PPDU, with very different values for aRxPHYStartDelay for each PPDU format, and even multiple values for each PPDU format. Which value should the MAC use in the equations above? It seems to be case-by-case, since for

“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.”

… we’d expect the CTS to be sent in a clause 15/16/17 format in 2.4 GHz according to the format of the RTS, and a clause 17 format in 5/6 GHz. Meanwhile for

“In non-DMG BSS, NAVTimeout period is equal to (2 × aSIFSTime) + (CTS\_Time) + aRxPHYStartDelay + (2 × aSlotTime).”

… we’d expect it to be the maximum aRxPHYStartDelay across all possible supported PPDUs.

In several cases the MAC needs to do some filtering of all these aRxPHYStartDelay’s, but nothing is mentioned except one time in regard to S1G.

Rough notes from previous discussion: “aRxPHYStartDelay only matters for RTS/CTS/Ack transmissions … which then simplifies it since they are *almost* always carried in 11a/b/g PPDU formats only. If set delay to LSIG + 1 symbol then either LSIG or HT SIG, so know a packet is coming in. Then might not need a second primitive. BUT Ack in VHT is allowed because of FTM. And RTS/CTS is allowed in VHT PPDUs. Then need to create an new early-warning primitive.”

Given that discussion, when we review the (exhaustive) list of usages of aRxPHYStartDelay, we see that, almost always, the MAC is using aRxPHYStartDelay to make a decision based on whether the PHY has positively started to receive a PPDU or not, and the MAC really wants this information with lowest latency – i.e., after the successful reception of the first SIG field (or, in the case of HT-MF, then after the successful reception of the HT SIG field).

This suggests that, due to the potentially long or delayed VHTSIGB or HESIGB fields, that PHY-RXSTART.ind is coming very late, and some new primitive is required earlier, to signal to the MAC that the PHY is positively receiving a PPDU.

This leads to the following set of changes, which we attempt to limit to clause 6 as much as possible:

**Proposed Resolution: CID 1059**

**Revised**.

**Note to Commenter:**

The commenter’s concerns are valid and are substantially addressed in 22/0576R<motionedRevision> under CID 1059.

**Instruction to Editor:**

Implement the proposed text updates listed under CID 1059 in 22/0576R<motionedRevision>

***TGme Editor, make the following changes to D1.0 shown by Word track changes under CID 1059***

6.5.4.2 Semantics of the service primitive

|  |  |  |
| --- | --- | --- |
| Name | Type | Description |
| aRxPHYStartDelayKeyValueList | A list of (key, value) pairs | The list concatenates the aRxPHYStartDelayKeyValueSublist for each supported PHY clause, where the aRxPHYStartDelayKeyValueSublist is a list of (key, value) pairs where the key identifies the characteristics of a PPDU format or set of PPDU formats and the value is the delay, in microseconds, from the start of the PPDU at the receiver’s antenna to the issuance of the earlier of the PHY-RXFIRSTSIG.indication if sent or the PHY-RXSTART.indication primitive.  NOTE – The key incorporates clause-dependent parameters such as the TXVECTOR parameter FORMAT and the TXVECTOR parameter PREAMBLE\_TYPE. |

6.5.4.4 Effect of receipt

The receipt of this primitive provides the operational characteristics of the PHY entity. The MAC determines aRxPHYStartDelay by excluding the (key, value) pairs in the aRxPHYStartDelayKeyValueList parameter that are not allowed in the current context, then setting aRxPHYStartDelay to the maximum of the remaining values.

Table 8-2—PHY SAP inter-(sub)layer service primitives

|  |  |  |  |
| --- | --- | --- | --- |
| Primitive | Request | Indication | Confirm |
| … |  |  |  |
| PHY-CCA |  | X |  |
| PHY-RXEARLYSIG |  | X |  |
| PHY-RXSTART |  | X |  |
| … |  |  |  |

8.3.5.12a PHY-RXEARLYSIG.indication

8.3.5.12a.1 Function

This primitive is an early indication by the PHY to the local MAC entity that the PHY has received a valid start of a PPDU.

NOTE—This primitive might be generated before the PHY has narrowed down the PPDU format to a single possibility, such as either of non-HT or VHT.

8.3.5.12a.2 Semantics of the service primitive

The primitive does not include any parameters:

PHY-RXEARLYSIG.indication(

)

8.3.5.12a.3 When generated

This primitive is generated by the local PHY entity to the MAC sublayer when the PHY has successfully validated an early SIG field in the PHY and the validation of the SIG field does not cause the issuance of the PHY-RXSTART.indication. The early SIG field is the first SIG field in the PPDU except:

* If the HTSIG field is present, then the HTSIG field is validated instead of the L-SIG field (and so the PHY-RXEARLYSIG.indication is not issued)
* If the RL-SIG field is present, then the pair of L-SIG and RL-SIG fields is validated instead of the L-SIG field

After generating a PHY-RXEARLYSIG.indication primitive, the PHY is expected to maintain physical medium busy status (not generating a PHY-CCA.indication(IDLE) primitive) until the issuance of the next PHY-RXSTART.indication or PHY-RXEND.indication.

8.3.5.12a.4 Effect of receipt

The receipt of this primitive by the MAC entity causes the MAC to determine that there is no NAV, CTS, Ack or similar timeout (see 10.3.2.4 (Setting and resetting the NAV), 10.3.2.9 (CTS and DMG CTS procedure), 10.3.2.11 (Acknowledgment procedure), 26.2.4 (Updating two NAVs), and 26.2.6.2 (MU-RTS Trigger frame transmission)).

10.3.2.4 Setting and resetting the NAV P2093:

A STA that used information from an RTS frame or MU-RTS Trigger frame as the most recent basis to update its NAV setting is permitted to reset its NAV if no PHY-RXEARLYSIG.indication or PHY-RXSTART.indication primitive is received from the PHY during a NAVTimeout period starting when the MAC receives a PHY-RXEND.indication primitive corresponding to the detection of the RTS frame or MU-RTS Trigger frame.(11ax)

In non-DMG BSS, NAVTimeout period is equal to (2 × aSIFSTime) + (CTS\_Time) + aRxPHYStartDelay + (2 × aSlotTime). In a non-S1G STA, (11ax)if an RTS frame is used for the most recent NAV update, CTS\_Time shall be calculated using the length of the CTS frame and the data rate at which the RTS frame used for the most recent NAV update was received. (11ax)If an MU-RTS Trigger frame was used for the most recent NAV update, CTS\_Time shall be calculated using the length of the CTS frame and the 6 Mb/s data rate (see 26.2.6 (MU-RTS Trigger/CTS frame exchange sequence procedure(#109))). In an S1G STA, (11ax)CTS\_Time shall be calculated using the time required to transmit an NDP CTS frame that is equal to NDPTxTime, which is specified in 10.3.2.5.2 (RID update).

10.3.2.9 CTS and DMG CTS procedure P2100:

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-RXEARLYSIG.indication or 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-RXEARLYSIG.indication or 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.

10.3.2.10.1 Dual CTS protection procedure P2104

NOTE 2—When an HT STA sends an RTS frame to the AP that is a non-STBC frame, the AP returns a CTS frame that is a non-STBC frame to the STA and then immediately transmits a CTS frame that is an STBC frame. The original non-AP STA is now free to transmit. But a non-HT STA that has set its NAV based on the original RTS frame might reset its NAV and then decrement its backoff counter, given that a SIFS + the duration of CTS2 is longer than a DIFS (i.e., the STA does not detect a PHY-RXEARLYSIG.indication or PHY-RXSTART.indication primitive within the period specified in 10.3.2.4 (Setting and resetting the NAV)). Thus, without sending a CTS-to-AP, the NAV reservation might not always work.

10.3.2.11 Acknowledgment procedure P2106:

After transmitting an MPDU that requires an Ack or BlockAck frame as a response (see Annex G), the STA shall wait for an AckTimeout interval, with a value of aSIFSTime + aSlotTime + aRxPHYStartDelay, starting at the PHY-TXEND.confirm primitive. If a PHY-RXEARLYSIG.indication or PHY-RXSTART.indication primitive does not occur during the AckTimeout interval, the STA concludes that the transmission of the MPDU has failed, and this STA shall invoke its backoff procedure upon expiration of the AckTimeout interval.

If a PHY-RXEARLYSIG.indication or PHY-RXSTART.indication primitive does occur during the AckTimeout interval, the STA shall wait for the corresponding PHY-RXEND.indication primitive to determine whether the MPDU transmission was successful. If the STA recognizes a valid Ack frame addressed to the STA and corresponding to this PHY-RXEND.indication primitive, this recognition shall be interpreted as successful acknowledgment.

10.3.2.11 Acknowledgment procedure, P2107

a) …

- A PHY-RXEARLYSIG.indication or PHY-RXSTART.indication primitive that corresponds to the received PPDU is detected within the AckTimeout interval that started as a result of the previously transmitted MPDU.

b) …

- A PHY-RXEARLYSIG.indication or PHY-RXSTART.indication primitive that corresponds to the received PPDU is detected within the AckTimeout interval that started as a result of the previously transmitted MPDU.

10.3.2.11 Acknowledgment procedure¸ P2108 (x3):

In an S1G BSS, the AckTimeout interval depends on the TXVECTOR parameter PREAMBLE\_TYPE. When the TXVECTOR parameter PREAMBLE\_TYPE is equal to S1G\_SHORT\_PREAMBLE or S1G\_LONG PREAMBLE, the AckTimeout interval is calculated with aRxPHYStartDelay value for ≥ 2 MHz short/long preamble except when the receiving STA has indicated use of 1 MHz control responses as described in 10.6.6.6 (Channel Width selection for Control frames) in which case the AckTimeout interval is calculated with aRxPHYStartDelay value for S1G\_1M preamble. When the TXVECTOR parameter PREAMBLE\_TYPE is equal to S1G\_1M preamble, the AckTimeout interval is calculated with aRxPHYStartDelay value for S1G\_1M preamble.

10.23.2.2 EDCA backoff procedure P2207:

- The STA shall wait for a timeout interval of duration aSIFSTime + aSlotTime + aRxPHYStartDelay, starting when the MAC receives a PHY-TXEND.confirm primitive. If a PHY-RXEARLYSIG.indication or PHY-RXSTART.indication primitive does not occur during the timeout interval, the transmission of the MPDU has failed.

- If a PHY-RXEARLYSIG.indication or PHY-RXSTART.indication primitive does occur during the timeout interval, the STA shall wait for the corresponding PHY-RXEND.indication primitive to recognize a valid response MPDU(#109) that either does not have a TA field or is sent by the recipient of the MPDU requiring a response. If anything else, including any other valid frame, is recognized, the transmission of the MPDU has failed.

10.39.10 Updating multiple NAVs P2408

A STA that has updated a NAV as a result of the reception of an RTS may reset its NAV(s) as follows. After the NAV update for a duration of NAVTimeout period (10.3.2.4 (Setting and resetting the NAV)), the STA shall monitor the channel to determine if a PHY-RXEARLYSIG.indication or PHY-RXSTART.indication primitive is received from the PHY. If such an event has not occurred during this time period, then the STA may reset to 0 any NAV whose NAV\_RTSCANCELABLE value is true.

10.42.6.2 SLS phase execution P2476

(11ay)An EDMG STA that transmitted an unsolicited RSS shall wait for MBIFSTimeout interval, which has a value of MBIFS + aSlotTime + aRxPHYStartDelay, starting at the PHY-TXEND.confirm primitive of the last SSW frame transmitted as part of the unsolicited RSS. If a PHY-RXEARLYSIG.indication or PHY-RXSTART.indication primitive does not occur during the MBIFSTimeout interval, the STA concludes that the unsolicited RSS failed and may initiate an ISS to the STA to which the unsolicited RSS was transmitted.

10.49 Sync frame operation, P2596

(#468)After transmitting the sync frame, the AP shall wait for an AckTimeout interval (as defined in 10.3.2.11 (Acknowledgment procedure)), starting at the PHY-TXEND.confirm primitive. If a PHY-RXEARLYSIG.indication or PHY-RXSTART.indication primitive does not occur during the AckTimeout interval, the AP may transmit a CF-End frame or an NDP CF-End frame to reset the NAV provided that the remaining duration is long enough to transmit this frame.

10.53.4 TXOP-based sectorization operation, P2610:

2) Not observing the subsequent sectorized beam transmission by the AP for aSIFSTime + aSlotTime + aRxPHYStartDelay duration.

10.53.4 TXOP-based sectorization operation, P2611:

Note that in the first diagram in Figure 10-151 (SO frame exchange sequence 3), an OBSS non-AP STA or OBSS AP infers its spatial orthogonality with the AP by observing the omnidirectional beam RTS frame and the omnidirectional portion of the long format for the duration of one symbol (D-STF as shown in Figure 23-2 (S1G\_LONG format)) following the omnidirectional portion of the S1G\_LONG format but not the subsequent sectorized beam transmission and with the STA by observing a gap of no transmission between the omnidirectional RTS frame and the omnidirectional preamble of the long preamble. Note that in the second diagram in Figure 10-151 (SO frame exchange sequence 3), an OBSS non-AP STA or OBSS AP infers its spatial orthogonality with the AP by observing the transmission of the omnidirectional beam RTS frame and the omnidirectional beam PPDU of the short format but not observing the subsequent sectorized beam transmission for aSIFSTime + aSlotTime + aRxPHYStartDelay duration and with the STA by observing a gap of no transmission between the omnidirectional RTS frame and the omnidirectional beam PPDU of the short format by the AP.

26.2.4 Updating two NAVs P4131:

An HE STA that used information from an RTS or MU-RTS Trigger frame as the most recent basis to update its NAV may reset the NAV that is updated by the RTS or MU-RTS Trigger frame if no PHY-RXEARLYSIG.indication or PHY-RXSTART.indication primitive is received from the PHY during a period with a duration of 2 × aSIFSTime + CTS\_Time + aRxPHYStartDelay + 2 × aSlotTime starting when the MAC receives a PHY-RXEND.indication primitive corresponding to the detection of the RTS or MU-RTS Trigger frame (see 10.3.2.4 (Setting and resetting the NAV) for the definition of CTS\_Time).

26.2.6.2 MU-RTS Trigger frame transmission P4133:

After transmitting an MU-RTS Trigger frame, the AP shall wait for a CTSTimeout interval of aSIFSTime + aSlotTime + aRxPHYStartDelay that begins when the MAC receives the PHY-TXEND.confirm primitive for the transmitted MU-RTS Trigger frame. If the MAC does not receive a PHY-RXEARLYSIG.indication or PHY-RXSTART.indication primitive during the CTSTimeout interval, the AP shall conclude that the transmission of the MU-RTS Trigger frame has failed, and, if the MU-RTS Trigger frame initiated a TXOP, the AP shall invoke its backoff procedure. If the MAC receives a PHY-RXEARLYSIG.indication or PHY-RXSTART.indication primitive during the CTSTimeout interval, then the MAC shall wait for the corresponding PHY-RXEND.indication primitive to determine whether the MU-RTS Trigger frame transmission was successful. The receipt of a CTS frame from any non-AP STA addressed by the MU-RTS Trigger frame before the PHY-RXEND.indication primitive shall be interpreted as the successful transmission of the MU-RTS Trigger frame, permitting the frame exchange sequence to continue. The receipt of any other type of frame shall be interpreted as a failure of the MU-RTS Trigger frame transmission. In this instance, the AP may process the received frame and, if the MU-RTS Trigger frame initiated a TXOP, shall invoke its backoff procedure at the PHY-RXEND.indication primitive.

26.10.2.2 General operation with non-SRG OBSS PD level, P4234

If the PHY of a STA issues a PHY-CCA.indication(BUSY) followed by a PHY-RXEARLYSIG.indication or PHY-RXSTART.indication due to a PPDU reception, then the STA’s MAC sublayer(#1119):

a) May issue a PHY-CCARESET.request primitive before the end of the PPDU and not update its basic NAV timer based on the PPDU, or …

26.10.2.3 General operation with SRG OBSS PD level, P4235

If the PHY of a STA issues a PHY-CCA.indication(BUSY) followed by a PHY-RXEARLYSIG.indication or PHY-RXSTART.indication due to a PPDU reception, then the STA’s MAC sublayer

a) May issue a PHY-CCARESET.request primitive before the end of the PPDU and not update its basic NAV timer based on the PPDU, or …

26.10.3.2 PSR-based spatial reuse initiation P4243:

An HE STA that identifies an PSR opportunity may choose to not perform NAV update operations normally executed based on the receipt of the RXVECTOR parameter TXOP\_DURATION and the Trigger frame Duration field. See Figure 26-13 (PSRR PPDU spatial reuse(11ax)). A STA that identifies an PSR opportunity may issue a PHY-CCARESET.request to ignore the associated HE TB PPDU(s) that are triggered by the Trigger frame of the PSRR PPDU and that occur within aSIFSTime + aRxPHYStartDelay + 2 × aSlotTime of the end of the last symbol on the air of the PPDU that contained the Trigger frame, provided that the value of the RXVECTOR parameter BSS\_COLOR of the HE TB PPDU matches the BSS color of the PSRR PPDU. A STA that identifies an PSR opportunity shall not transmit an PSRT PPDU that terminates beyond the PPDU duration of the HE TB PPDU that is triggered by the Trigger frame of the PSRR PPDU.

26.10.3.2 PSR-based spatial reuse initiation

An HE STA identifies an PSR opportunity if the following two conditions are met:

a) The STA receives a PHY-RXEARLYSIG.indication or PHY-RXSTART.indication corresponding to the reception of a PSRR PPDU that is identified as an inter-BSS PPDU (see 26.2.2 (Intra-BSS and inter-BSS PPDU classification)).

Table 15-5—DSSS PHY characteristics

|  |  |
| --- | --- |
| Characteristic | Value |
| aRxPHYStartDelayKeyValueSublist | (key = DSSS, value = 192 us) |

Table 16-4—HR/DSSS PHY characteristics

|  |  |
| --- | --- |
| Characteristic | Value |
| aRxPHYStartDelayKeyValueSublist | (key = HR\_DSSS\_LONG\_PREAMBLE, value = 192 us)  (key = HR\_DSSS\_SHORT\_PREAMBLE, value = 96us) |

Table 17-21—OFDM PHY characteristics

|  |  |  |  |
| --- | --- | --- | --- |
| Characteristics | Value (20 MHz channel spacing) | Value (10 MHz channel spacing) | Value (5 MHz channel spacing) |
| aRxPHYStartDelayKeyValueSublist | (key = OFDM, value = 20 us) | (key = OFDM\_10MHz, value = 40 us) | (key = OFDM\_5MHz, value = 80 us) |

Table 18-5—ERP characteristics

|  |  |
| --- | --- |
| Characteristic | Value |
| aRxPHYStartDelayKeyValueSublist | (key = ERP\_OFDM, value = 20 µs),  (key = ERP\_DSSS\_CCK\_LONG\_PREAMBLE, value = 192 µs),  (key = ERP\_DSSS\_CCK\_SHORT\_PREAMBLE , value = 96 µs) |

Table 19-25—HT PHY characteristics

|  |  |
| --- | --- |
| Characteristics | Value |
| aRxPHYStartDelayKeyValueSublist | (key = HT\_MIXED\_FORMAT, value = 28 µs),  (key = HT\_GREENFIELD\_FORMAT, value = 24 µs) |

Table 20-30—DMG PHY characteristics

|  |  |
| --- | --- |
| PHY parameter | Value |
| aRxPHYStartDelayKeyValueSublist | (key = DMG\_CONTROL\_MODE, value = 10 µs),  (key = DMG\_SC\_AND\_SC\_LOW\_POWER, value = 3.6 µs) |

***TGme editor:***

* Figure 21-36—PHY receive procedure for SU transmission: add a new arrow labeled as PHY-RXEARLYSIG.indimmediatelyafter L-SIG
* Figure 21-37—PHY receive state machine: add “Issue PHY-RXEARLYSIG.ind” at the end of “Not HT-SIG”

21.3.20 PHY receive procedure

After the PHY-CCA.indication(BUSY, channel-list) primitive is issued, the PHY entity shall begin receiving the training symbols and searching for L-SIG in order to set the maximum duration of the data stream. If the check of the L-SIG parity bit is not valid or the RATE field is an undefined value(#18), neither a PHY-RXEARLYSIG.indication nor a PHY-RXSTART.indication primitive is issued, and instead the PHY shall issue the error condition PHY-RXEND.indication(FormatViolation) primitive.

If a valid L-SIG parity bit is indicated,(#18) the RATE field indicates 6 Mbps, the L-SIG field indicates at least six OFDM symbols after the L-SIG field, and the first two OFDM symbols after the L-LTF field are using BPSK modulation, then the PHY entity shall issue a PHY-RXEARLYSIG.indication primitive.

If a valid L-SIG parity bit is indicated,(#18) the RATE field indicates 6 Mbps, the L-SIG field indicates at least seven OFDM symbols after the L-LTF field, the first two OFDM symbols after the L-LTF field are using BPSK modulation, and the third OFDM symbol after the L-LTF field is using QBPSK modulation, then the VHT PHY shall maintain PHY-CCA.indication(BUSY, channel-list) primitive for the predicted duration of the transmitted PPDU, as defined by RXTIME in Equation (21-105), for all supported modes, unsupported modes, Reserved VHT-SIG-A Indication, invalid VHT-SIG-A CRC and invalid L-SIG Length field value. The L-SIG Length field value of a VHT PPDU is invalid if it is not divisible by 3. Reserved VHT-SIG-A Indication is defined as a VHT-SIG-A with Reserved bits equal to 0 or MU[u] NSTS fields (u = 0, 1, 2, 3) set to 5-7 or Short GI field set to 0 and Short GI NSYM Disambiguation field set to 1, or a combination of VHT-MCS and NSTS not included in 21.5 (Parameters for VHT-MCSs) or any other VHT-SIG-A field bit combinations that do not correspond to modes of PHY operation defined in Clause 21 (Very high throughput (VHT) PHY specification). If the VHT-SIG-A indicates an unsupported mode, the PHY shall issue a PHY-RXEND.indication(UnsupportedRate) primitive. If the VHT-SIG-A indicates an invalid CRC or Reserved VHT-SIG-A Indication or if the L-SIG Length field is invalid, the PHY shall issue the error condition PHY-RXEND.indication(FormatViolation) primitive.

After receiving a valid L-SIG and VHT-SIG-A indicating a supported mode, the PHY entity shall begin receiving the VHT-STF, VHT-LTFs and VHT-SIG-B. If the received group ID in VHT-SIG-A has a value indicating a VHT SU PPDU (see 10.19 (Group ID and partial AID in VHT and CMMG PPDUs)), the PHY entity may choose not to decode VHT-SIG-B. If VHT-SIG-B is not decoded, subsequent to an indication of a valid VHT-SIG-A CRC, a PHY-RXSTART.indication(RXVECTOR) primitive shall be issued

Table 21-28—VHT PHY characteristics

|  |  |
| --- | --- |
| Characteristics | Value |
| aRxPHYStartDelayKeyValueSublist | (key = VHT, value = 24  (see NOTE 2) |

NOTE 2—This value arises from the time to the end of when the HT\_MF PPDU format is excluded which is at the end of first OFDM symbol after the L-SIG field (see Figure 21-4 (VHT PPDU format)).

Table 22-25—TVHT PHY characteristics

|  |  |
| --- | --- |
| Characteristics | Value |
| aRxPHYStartDelayKeyValueSublist | (key = TVHT, value = 20 ×  7.5 (6 and 7 MHz channels) or 5.625 (8 MHz channels)) (see NOTE 2) |

NOTE 2—This value arises from the time to the end of the L-SIG field (see Figure 22-1 (VHT PPDU format in TVWS bands)).

***Note to reader, not for inclusion in the draft: In Figure 23-52—PHY receive procedure for an SU transmission, S1G\_LONG procedure: no need to add a new arrow labeled as PHY-RXEARLYSIG.ind immediately after SIG-A Sym 2 since this is a SU transmission and it is reasonable to assume that SIG-B will not be decoded (and the figure, by having no space for SIG-B in the middle layer, seems to reinforce that)***

***TGme editor:***

* Figure 23-53—PHY receive state machine: add: “. If SIG-B to be decoded, issue PHY-RXEARLYSIG.ind” at the end of “CRC OK”

23.3.20 PHY receive procedure

After the PHY-CCA.indication(BUSY, channel-list) is issued, the PHY entity shall begin receiving the training symbols and searching for SIG or SIG-A in order to set the maximum duration of the data stream and get other PHY parameters such as the demodulation type, code type, and the decoding rate. If the check of the SIG or SIG-A CRC is not valid, no RXEARLYSIG.indication or PHY-RXSTART.indication primitive is issued, and instead the PHY shall issue the error condition PHY-RXEND.indication(FormatViolation) primitive, and set PHY\_CCA.indication(IDLE) when receive level drops below threshold (minimum modulation and coding rate sensitivity + 20 dB). If a valid SIG or SIG-A CRC is indicated, and the Uplink Indication bit is 1 and the ID field value matches the PBSSID of the BSS of which the STA is a member or the Uplink Indication bit is 0 and the COLOR field value matches the COLOR indicated by the AP to which the STA is associated, then the S1G PHY shall maintain PHY-CCA.indication(BUSY, channel-list) for the predicted duration of the transmitted PPDU, as defined by RXTIME in Equation (23-69) or Equation (23-70), for all supported modes, unsupported modes, and Reserved SIG or SIG-A Indication. If a valid SIG or SIG-A CRC is indicated, and the Uplink Indication bit is 1 and the ID field value does not match the PBSSID of the BSS of which the STA is a member or the Uplink Indication bit is 0 and the COLOR field value does not match the COLOR indicated by the AP to which the STA is associated, then the S1G PHY shall maintain PHY-CCA.indication(BUSY, channel-list) for the predicted duration of the transmitted PPDU, as defined by RXTIME in Equation (23-69) or Equation (23-70), for all supported modes, unsupported modes, and Reserved SIG-A Indication if the reception meets the minimum CCA sensitivity level specified in 23.3.18.5.4 (CCA sensitivity for signals occupying the primary 2 MHz and/or primary 1 MHz channel). Reserved SIG or SIG-A Indication is defined as an SIG or SIG-A with Reserved bits equal to 0 or a combination not valid as defined in 23.3.8.2.2.5 (SIG definition), 23.3.8.2.3.2.5 (SIG-A definition), or 23.3.8.3.5 (SIG definition), or a combination of S1G-MCS and NSTS not included in 23.5 (Parameters for S1G-MCSs) or any other SIG or SIG-A field bit combinations that do not correspond to modes of PHY operation defined in Clause 23 (Sub 1 GHz (S1G) PHY specification).

(#455)NOTE 1—From Figure 23-53 (PHY receive state machine(#342)), Reserved SIG or SIG-A Indication does not apply to the Reserved fields in NDP CMAC PPDUs since NDP CMAC PPDUs do not use S1G\_LONG format. Subsequently, if dot11TimingMsmtActivated is true, a PHY-RXSTART.indication (RXVECTOR) shall be issued and RX\_START\_OF\_FRAME\_OFFSET parameter within the RXVECTOR shall be forwarded (see 23.2.2 (TXVECTOR and RXVECTOR parameters)).

NOTE 2—The RX\_START\_OF\_FRAME\_OFFSET value is used as described in 6.3.55 in order to estimate when the start of the preamble for the incoming (#14)PPDU was detected on the medium at the receive antenna connector.

If the SIG or SIG-A indicates an unsupported mode, the PHY shall issue PHY-RXEND.indication(UnsupportedRate). If the SIG or SIG-A indicates an invalid CRC or Reserved SIG

or SIG-A Indication, the PHY shall issue the error condition PHY-RXEND.indication(FormatViolation).

If the PHY preamble reception is successful and a valid SIG or SIG-A CRC is indicated:

—

Upon reception of an S1G\_LONG format preamble, after receiving a valid SIG-A indicating a

supported mode, the PHY entity shall begin receiving the rest of S1G training symbols and SIG-B. If the received MU/SU subfield in SIG-A has a value indicating SU PPDU (see 23.3.8.2.3.2.5 (SIG-A definition)), the PHY entity does not need to decode SIG-B since in this case SIG-B does not carry any information bit (see 23.3.8.2.3.3.5 (SIG-B definition)). Subsequent to an indication of a valid SIG-A, if the SIG-B is not to be decoded, then a PHY-RXSTART.indication (RXVECTOR) primitive shall be issued, and otherwise a PHY-RXEARLYSIG.indication primitive shall be issued.

Table 23-40—S1G PHY characteristics

|  |  |
| --- | --- |
| Characteristics | Value |
| aRxPHYStartDelayKeyValueSublist | (key = S1G\_1M\_PREAMBLE, value = 600 µs),  (key = S1G\_SHORT\_OR\_LONG\_PREAMBLE, value = 280 µs) |

Table 25-37—CMMG PHY characteristics

|  |  |
| --- | --- |
| PHY parameter | Value |
| aRxPHYStartDelayKeyValueSublist | (key = CMMG, value = 11 µs) |

***TGme editor:***

* Figure 27-59—PHY receive procedure for an HE SU PPDU(11ax), Figure 27-60—PHY receive procedure for an HE ER SU PPDU(11ax), Figure 27-61—PHY receive procedure for an HE MU PPDU(11ax), Figure 27-62—PHY receive procedure for an HE TB PPDU(11ax): add a new arrow labeled as PHY-RXEARLYSIG.indimmediatelyafter RL-SIG
* Figure 27-63—PHY receive state machine if midambles are not present(11ax): add “Issue PHY-RXEARLYSIG.ind” at the end of “LENGTH mod 3 = 1” and at the end of at the end of “LENGTH mod 3 = 2”

27.3.22 HE receive procedure

The PHY shall not issue a PHY-RXEARLYSIG.indication nor a PHY-RXSTART.indication primitive in response to a PPDU that does not overlap the primary channel, unless the PHY at an AP receives the HE TB PPDU solicited by the AP. For the HE TB PPDU solicited by the AP, the PHY shall issue both a PHY-RXEARLYSIG.indication primitive and a PHY-RXSTART.indication primitive for a PPDU received in the primary or at the secondary 20 MHz channel, the secondary 40 MHz channel, or the secondary 80 MHz channel.

The PHY includes the measured RSSI and RSSI\_LEGACY value in the PHY-RXSTART.indication(RXVECTOR) primitive issued to the MAC.

After the PHY-CCA.indication(BUSY, channel-list) primitive is issued, the PHY entity shall begin receiving the training symbols and searching for the preambles for non-HT, HT, VHT, and HE PPDUs, respectively. If the constellation used in the first symbol after the first long training field is QBPSK, the PHY entity shall continue to detect the received signal using the receive procedure for HT-GF depicted in Clause 19 (High-throughput (HT) PHY specification). Otherwise, for detecting the HE preamble, the PHY entity shall search for L-SIG and RL-SIG fields in order to set the maximum duration of the data stream. If an RL-SIG field is detected, the PHY entity should check the parity bit and RATE fields in the L-SIG and RL-SIG fields. If either the check of the parity bit is invalid or the RATE field is not set to 6 Mb/s in non- HT, no PHY-RXEARLYSIG.indication or PHY-RXSTART.indication primitive is issued. If the check of the parity bit is valid and the RATE field indicates 6 Mb/s in non-HT but the LENGTH field value in the L-SIG field is a multiple of 3, no PHY-RXEARLYSIG.indication or PHY- RXSTART.indication primitive is issued. In both cases, the PHY should continue to detect the received signal using non-HT, HT, and VHT receive procedure in Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification), Clause 19 (High-throughput (HT) PHY specification), and Clause 21 (Very high throughput (VHT) PHY specification), respectively.

If a valid parity bit and the RATE with 6 Mb/s in non-HT are indicated in the L-SIG and RL-SIG fields and the LENGTH field value in the L-SIG and RL-SIG fields meets the condition that the remainder is 1 after LENGTH divided by 3, the PHY entity shall issue a PHY-RXEARLYSIG.indication primitive and should begin receiving the sequence of HE-SIG-A, HE-STF, and HE-LTF fields for the HE SU PPDU and HE TB PPDU as shown in Figure 27-59 (PHY receive procedure for an HE SU PPDU(11ax)) and Figure 27-62 (PHY receive procedure for an HE TB PPDU(11ax)), respectively. After the RL-SIG field, the PHY entity shall receive two symbols of the HE-SIG-A field immediately followed by HE-STF.

Table 27-54—HE PHY characteristics(11ax)

|  |  |
| --- | --- |
| Characteristic | Value |
| aRxPHYStartDelayKeyValueSublist | (key = HE, value = 24 µs) |

Table 30-13—WUR PPDU Time and Length Characteristics(11ba)

|  |  |
| --- | --- |
| Characteristics | Value |
| aRxPHYStartDelayKeyValueSublist | (key = WUR, value = 92 µs) (see NOTE 2) |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1062 | 3618.00 | 19.3.21 | An HT RX procedure invokes the 11a/g RX procedure when the received PPDU format is determined to be 11a/g. Ditto the VHT RX procedure invokes the HT/11a/g RX procedures etc. These could be like function calls, but they are \*partway\* into the called receive procedure since the preamble has already been partly processed, and then these calls are much more like GOTOs. However, the called RX procedures do not have "labels" which is the destination of the GOTO at the relevant point of the called RX procedure. | In the 11a/g/HT/VHT receive procedures insert something along the lines of "In a HT/VHT/HE STA, once a received PPDU has been determined to be a PPDU following Clause [17 | 18 | 19 | 21], then the receive prcoedure resumes here. Existing state, including knowledge of the LSIG Parity and RATE checks, is retained." |

# 1062 Discussion

The commenter raises an important topic, and their resolution seems workable.

**Proposed Resolution: CID 1062**

**Revised**.

**Note to Commenter:**

The commenter’s concerns are valid and are substantially addressed in 22/0576R<motionedRevision> under CID 1062.

**Instruction to Editor:**

Implement the proposed text updates listed under CID 1062 in 22/0576R<motionedRevision>

***TGme Editor, make the following changes to D1.0 shown by Word track changes under CID 1062***

17.3.12 Receive PHY

Upon receiving the transmitted PHY preamble, the PHY measures the received signal strength level. This

indicates activity to the MAC via PHY-CCA.indication primitive. A PHY-CCA.indication(BUSY) primitive

shall be issued for reception of a signal prior to correct reception of the PPDU. The RSSI parameter reported

to the MAC in the RXVECTOR.

After a PHY-CCA.indication primitive is issued, the PHY entity shall begin receiving the training symbols

and searching for the SIGNAL in order to set the length of the data stream, the demodulation type, and the

decoding rate.

For an HT STA that determines it is receiving a Clause 17 PPDU, the STA’s receive procedure shall resume here. Existing state, including knowledge of the L-SIG Parity and RATE checks, is retained.

If dot11TimingMsmtActivated is false, if the PHY header reception is successful (and the SIGNAL field is completely recognizable and supported), a PHY-RXSTART.indication(RXVECTOR) primitive shall be issued.

If dot11TimingMsmtActivated is true, the PHY shall do the following:

— Complete receiving the PHY header and verify the validity of the PHY Header.

— If the PHY header reception is successful (and the SIGNAL field is completely recognizable

and supported), a PHY-RXSTART.indication(RXVECTOR) primitive shall be issued and

RX\_START\_OF\_FRAME\_OFFSET parameter within the RXVECTOR shall be forwarded

(see 17.2.3 (RXVECTOR parameters)).

19.3.21 PHY receive procedure

Upon receiving the transmitted PHY preamble, the PHY measures a receive signal strength. This indicates

activity to the MAC via the PHY-CCA.indication primitive. A PHY-CCA.indication(BUSY, channel-list)

primitive shall also be issued as an initial indication of reception of a signal. The channel-list parameter of

the PHY-CCA.indication primitive is set as follows:

— It is absent when the operating channel width is 20 MHz.

— It is set to {primary} when the operating channel width is 40 MHz and the signal is present only in

the primary channel.

— It is set to {secondary} when the operating channel width is 40 MHz and the signal is present only in

the secondary channel.

— It is set to {primary, secondary} when the operating channel width is 40 MHz and the signal is

present in both the primary and secondary channels.

The RSSI parameter is reported to the MAC in the RXVECTOR.

After the PHY-CCA.indication(BUSY, channel-list) primitive is issued, the PHY entity shall begin receiving

the training symbols and searching for SIGNAL and HT-SIG in order to set the length of the data stream, the

demodulation type, code type, and the decoding rate.

For a VHT STA, or an HE STA operating in the 2.4 GHz band, that determines it is receiving an HT PPDU, the STA’s receive procedure shall resume here. Existing state, including knowledge of the L-SIG Parity and RATE checks, is retained.

If signal loss occurs before validating L-SIG and/or HT-SIG, the HT PHY shall not generate a PHY-CCA.indication(IDLE) primitive until the received level drops below the CCA sensitivity level (for a missed preamble) specified in 19.3.19.5 (CCA sensitivity). If the check of the HT-SIG CRC is not valid, a PHY-RXSTART.indication primitive is not issued. The PHY shall indicate the error condition by issuing a PHY-RXEND.indication(FormatViolation) primitive. The HT PHY shall not generate a PHY-CCA.indication(IDLE) primitive until the received level drops below the CCA sensitivity level (for a missed preamble) specified in 19.3.19.5 (CCA sensitivity).

If the PHY preamble reception is successful and a valid HT-SIG CRC is indicated:

— Upon reception of an HT-mixed format preamble, the HT PHY shall not generate a

PHY-CCA.indication(IDLE) primitive for the predicted duration of the (#14)PPDU, as defined by

TXTIME in 19.4.3 (TXTIME calculation), for all supported and unsupported modes except

Reserved HT-SIG Indication. Reserved HT-SIG Indication is defined in the fourth item below.

— Upon reception of a GF preamble by an HT STA that does not support GF, the HT PHY shall not

generate a PHY-CCA.indication(IDLE) primitive until either the predicted duration of the

(#14)PPDU from the contents of the HT-SIG field, as defined by TXTIME in 19.4.3 (TXTIME

calculation), except Reserved HT-SIG Indication, elapses or until the received level drops below the

receiver minimum sensitivity level of BPSK, R=1/2 in Table 19-23 (Receiver minimum input level

sensitivity) + 10 dB (–72 dBm for 20 MHz, –69 dBm for 40 MHz). Reserved HT-SIG Indication is

defined in the fourth item below.

— Upon reception of a GF preamble by an HT STA that supports GF, the HT PHY shall not generate a

PHY-CCA.indication(IDLE) primitive for the predicted duration of the (#14)PPDU, as defined by

TXTIME in 19.4.3 (TXTIME calculation), for all supported and unsupported modes except

Reserved HT-SIG Indication. Reserved HT-SIG Indication is defined in the fourth item below.

— If the HT-SIG indicates a Reserved HT-SIG Indication, the HT PHY shall not generate a PHY-

CCA.indication(IDLE) primitive until the received level drops below the CCA sensitivity level

(minimum modulation and coding rate sensitivity + 20 dB) specified in 19.3.19.5 (CCA sensitivity).

Reserved HT-SIG Indication is defined as an HT-SIG with MCS field in the range 77–127 or

Reserved field = 0 or STBC field = 3 and any other HT-SIG field bit combinations that do not

correspond to modes of PHY operation defined in Clause 19 (High-throughput (HT) PHY

specification).

Subsequent to an indication of a valid HT-SIG CRC, a PHY-RXSTART.indication(RXVECTOR) primitive

shall be issued. If dot11TimingMsmtActivated is true, the PHY shall do the following:

— Complete receiving the PHY header and verify the validity of the PHY Header.

— If the PHY header reception is successful (and the SIGNAL field is completely recognizable and

supported), a PHY-RXSTART.indication(RXVECTOR) primitive shall be issued

and RX\_START\_OF\_FRAME\_OFFSET parameter within the RXVECTOR shall be forwarded

(see 19.2.2 (TXVECTOR and RXVECTOR parameters)).

21.3.20 PHY receive procedure

Upon receiving the transmitted PHY preamble overlapping the primary 20 MHz channel, the PHY measures

a receive signal strength. The PHY indicates this activity to the MAC by issuing a PHY-CCA.indication

primitive. A PHY-CCA.indication(BUSY, channel-list) primitive is also issued as an initial indication of

reception of a signal as specified in 21.3.18.5 (CCA sensitivity). The channel-list parameter of the PHY-

CCA.indication primitive is absent when the operating channel width is 20 MHz. The channel-list parameter

is present and includes the entry primary when the operating channel width is 40 MHz, 80 MHz, 160 MHz,

or 80+80 MHz.

The PHY shall not issue a PHY-RXSTART.indication primitive in response to a PPDU that does not

overlap the primary 20 MHz channel.

The PHY includes the most recently measured RSSI value in the PHY-RXSTART.indication(RXVECTOR)

primitive issued to the MAC.

After the PHY-CCA.indication(BUSY, channel-list) primitive is issued, the PHY entity shall begin

receiving the training symbols and searching for L-SIG in order to set the maximum duration of the data

stream.

For an HE STA that determines it is receiving a VHT PPDU, the STA’s receive procedure shall resume here. Existing state, including knowledge of the L-SIG Parity and RATE checks, is retained.

If the check of the L-SIG parity bit is not valid or the RATE field is an undefined value(#18), a

PHY-RXSTART.indication primitive is not issued, and instead the PHY shall issue the error condition

PHY-RXEND.indication(FormatViolation) primitive. If a valid L-SIG parity bit is indicated,(#18) the

RATE field indicates 6 Mbps, the L-SIG field indicates at least seven OFDM symbols after the L-LTF field,

the first two OFDM symbols after the L-LTF field are using BPSK modulation, and the third OFDM symbol

after the L-LTF field is using QBPSK modulation, then the VHT PHY shall maintain

PHY-CCA.indication(BUSY, channel-list) primitive for the predicted duration of the transmitted PPDU, as

defined by RXTIME in Equation (21-105), for all supported modes, unsupported modes, Reserved

VHT-SIG-A Indication, invalid VHT-SIG-A CRC and invalid L-SIG Length field value. The L-SIG Length

field value of a VHT PPDU is invalid if it is not divisible by 3. Reserved VHT-SIG-A Indication is defined

as a VHT-SIG-A with Reserved bits equal to 0 or MU[u] NSTS fields (u = 0, 1, 2, 3) set to 5-7 or Short GI

field set to 0 and Short GI NSYM Disambiguation field set to 1, or a combination of VHT-MCS and N STS

not included in 21.5 (Parameters for VHT-MCSs) or any other VHT-SIG-A field bit combinations that do

not correspond to modes of PHY operation defined in Clause 21 (Very high throughput (VHT) PHY

specification). If the VHT-SIG-A indicates an unsupported mode, the PHY shall issue a PHY-

RXEND.indication(UnsupportedRate) primitive. If the VHT-SIG-A indicates an invalid CRC or Reserved

VHT-SIG-A Indication or if the L-SIG Length field is invalid, the PHY shall issue the error condition PHY-

RXEND.indication(FormatViolation) primitive.

After receiving a valid L-SIG and VHT-SIG-A indicating a supported mode, the PHY entity shall begin

receiving the VHT-STF, VHT-LTFs and VHT-SIG-B. If the received group ID in VHT-SIG-A has a value

indicating a VHT SU PPDU (see 10.19 (Group ID and partial AID in VHT and CMMG PPDUs)), the PHY

entity may choose not to decode VHT-SIG-B. If VHT-SIG-B is not decoded, subsequent to an indication of

a valid VHT-SIG-A CRC, a PHY-RXSTART.indication(RXVECTOR) primitive shall be issued.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1065 | 4285.00 | 27 | Comments on 11meD0.0 cleaned up usage of frame/packet in the PHY clauses, but this work has not yet been applied to HE | | Replace use of packet/frame by PSDU/PPDU (etc) as needed in clause 27. See 21/965 for past context. |
| 2275 | 4540.00 | 28.2.2 | | In clause 28 several times the term "frame" is used when it is a PPDU | Please review all occurences of frame in Clause 28 and replace with PPDU when PPDU is meant, e.g. P4540L39, P4622L59, P4623L42, P4686L46, P4687L11, L13, L14, L21, L25, P4728L26, L29 etc. |

# 1065 & 2275 Discussion (Resolved by r5)

Agreed with commenters. We should continue the work done on 11meD0.0 for the HE PHY to reserve “frame” for “MPDU”. As with the previous clean-up, names (and specifically “Packet extension”) are not changed.

**Proposed Resolution: CID 2275**

**Revised**.

**Note to Commenter:**

The commenter’s concerns are valid and are substantially addressed in 22/0576R<motionedRevision> under CID 1065.

**Instruction to Editor:**

No further change required beyond that agreed for CID 1065 in 22/0576R<motionedRevision>

**Proposed Resolution: CID 1065**

**Revised**.

**Note to Commenter:**

The commenter’s concerns are valid and are substantially addressed in 22/0576R<motionedRevision> under CID 1065.

**Instruction to Editor:**

Implement the proposed text updates listed under CID 1065 in 22/0576R<motionedRevision>

***TGme Editor, make the following changes to D1.0 shown by Word track changes under CID 1065***

7.2.1 Introduction

The PHY provides an interface to the MAC through an extension of the generic PHY service interface defined in 8.3.4 (Basic service and options). The interface includes TXVECTOR, RXVECTOR, PHYCONFIG\_VECTOR, and TRIG\_VECTOR.

The MAC uses the TXVECTOR to supply the PHY with per-PPDU transmit parameters. The PHY uses the RXVECTOR to inform the MAC of the received PPDU parameters. The MAC uses the PHYCONFIG\_VECTOR to configure the PHY for operation that is independent of PPDU transmission or reception. The MAC uses the TRIG\_VECTOR to configure the PHY to receive HE TB PPDUs over each assigned RU.

27.3.12.5.4 Encoding process for an HE MU PPDU

For an HE MU PPDU, all the users shall use a common pre-FEC padding factor value and a common N SYM value. The padding process is described as follows:

First compute initial pre-FEC padding factor value, a init,u , for each user u using Equation (27-61) and the initial number of OFDM symbols, N SYM,init,u , for each user u using Equation (27-64). Among all the users, derive the user index with the longest encoded duration, as in Equation (27-75).



27.3.19.4.4 Transmitter modulation accuracy (EVM) test

***TGme editor, at D1.0P4466L1:***

g) For each of the data OFDM symbols, transform the symbol into subcarrier received values, estimate the phase from the pilot subcarriers, compensate the subcarrier values according to the estimated

phase, group the results from all of the receiver chains in each subcarrier to a vector, and multiply the vector by a zero-forcing equalization matrix generated from the estimated channel.

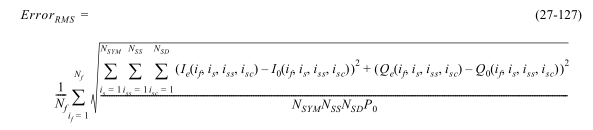
h) For each data-carrying subcarrier in each spatial stream of RU under test, find the closest

constellation point, and compute the Euclidean distance from it. If midambles are present in the Data

field of the PPDU, the midamble symbols shall not be used to compute the Euclidean distance.

i) Compute the average across PPDUs of the RMS of all errors per PPDU as given by

Equation (27-127).

where

I0(if , is , iss , isc) Q0(if , is , iss , isc)

denotes the ideal symbol point in the complex plane in data subcarrier isc of the RU under test,

spatial stream iss , and OFDM symbol is of PPDU if

Ie(if , is , iss , isc) Qe(if , is , iss , isc)

denotes the equalized observed symbol point in the complex plane of the data subcarrier isc of the

RU under test, spatial stream iss, and OFDM symbol is of PPDU if

P 0 is the average power of constellation

N f is the number of tested PPDUs

N SD is the number of data tones of the occupied RU. For an 80+80 MHz transmission, N SD is the total

number of data subcarriers in both 80 MHz frequency segments.

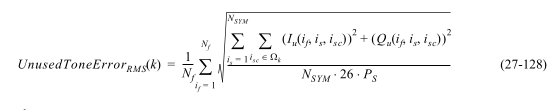
N SS is the number of spatial streams of the data OFDM symbols

N SYM is the number of data OFDM symbols

***TGme editor, at D1.0P4466L54***

e) For each of the data OFDM symbols, transform the symbol into subcarrier received values, and estimate the power of each subcarrier.

f) Compute the average unoccupied subcarrier error vector magnitude for each unoccupied 26-tone RU and average across PPDUs of the RMS of all errors per PPDU as given by Equation (27-128).



Where

Iu(if, is, isc) Qu(if, is, isc)

denotes unequalized observed symbol point in the complex plane in subcarrier isc of the

unoccupied 26-tone RU and OFDM symbol is of PPDU if

Ω k is a set of subcarriers for k th 26-tone RU as defined in Table 27-7 (Data and pilot subcar-

rier indices for RUs in a 20 MHz HE PPDU and in a non-OFDMA 20 MHz HE

PPDU(11ax)), Table 27-8 (Data and pilot subcarrier indices for RUs in a 40 MHz HE

PPDU and in a non-OFDMA 40 MHz HE PPDU(11ax)), and Table 27-9 (Data and pilot

subcarrier indices for RUs in an 80 MHz HE PPDU and in a non-OFDMA 80 MHz HE

PPDU(11ax))

P S is the average data subcarrier power of the occupied RU under test and is given by

Equation (27-129)

…

(27-129)

Nf is the number of tested PPDUs

N SYM is the number of data OFDM symbols

N SD is the number of data subcarriers in the occupied RU

27.3.20.2 Receiver minimum input level sensitivity(#256)

The PER shall be less than 10% for a PSDU with the rate-dependent input levels listed in

Table 27-51 (Receiver minimum input level sensitivity(11ax)). The PSDU length shall be 2048 octets for

BPSK modulation with DCM or 4096 octets for all other modulations.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1067 | 4359.00 | 27.3.10 | 1) alpha\_r cannot be known to the PHY. 2) This complicated definition of alpha is equivalent to alpha being between 0.707 and 1.414 else between 0.5 and 2 (as described in the associated MIB variable). | 1) Add POWER\_BOOST\_FACTOR as a new TXVECTOR parameter, with associated normative language in the MAC (and kept in the PHY but as informative text). 2) Simplify the definition of alpha. See 21/1538 for useful context and a prior example. |

# 1067 Discussion

Agreed with commenter. We should back-port the POWER\_BOOST\_FACTOR work from 11be to HE.

**Proposed Resolution: CID 1067**

**Revised**.

**Note to Commenter:**

The commenter’s concerns are valid and are substantially addressed in 22/0576R<motionedRevision> under CID 1067 following the changes in 22/1270r3.

**Instruction to Editor:**

Implement the proposed text updates listed under CID 1067 in 22/0576R<motionedRevision>

***TGme Editor, make the following changes to D1.0 shown by Word track changes under CID 1067***

***At D1.0P249L19:***

26.11.10 POWER\_BOOST\_FACTOR

For an OFDMA HE MU PPDU, the power boost factor POWER\_BOOST\_FACTOR for an occupied RU in the TXVECTOR shall be in the range [ ] if the Power Boost Factor Support subfield of the HE PHY Capabilities Information field in the HE Capabilities element from any recipient STA of the PPDU equals 0; otherwise the POWER\_BOOST\_FACTOR shall be in the range [, 2].

For an HE SU PPDU, non-OFDMA HE MU PPDU and HE ER SU PPDU, the POWER\_BOOST\_FACTOR in the TXVECTOR shall be set to 1.

NOTE—For an HE TB PPDU, the POWER\_BOOST\_FACTOR is not present in the TXVECTOR.

***At D1.0P4308L33 (e.g., penultimate row in table 27-1):***

Table 36-1—TXVECTOR and RXVECTOR parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | Condition | Value | TXVECTOR | RXVECTOR |
| … |  |  |  |  |
| POWER\_BOOST\_FACTOR | Format is HE SU, HE\_MU or HE ER SU | For an occupied RU, set to the power boost factor of the RU in the range of 0.5 to 2 (see 26.11.10 (POWER\_BOOST\_FACTOR)). | MR | N |
| Otherwise | Not present | N | N |
| … |  |  |  |  |
| NOTE 1—In the “TXVECTOR” and “RXVECTOR” columns, the following apply:  Y = Present.  N = Not present.  O = Optional.  MU indicates that the parameter is present once for an HE SU PPDU and HE ER SU PPDU and present per user  for an HE MU PPDU. For an HE TB PPDU, MU in the “TXVECTOR” column indicates that the parameter is  present once and MU in the “RXVECTOR” column indicates the parameter is not present (the receiver knows the  values since they were specified in the triggering PPDU). Parameters specified to be present per user are  conceptually supplied as an array of values indexed by u, where u takes values 0 to NUM\_USERS – 1.  MR indicates that the parameter is present once for an HE SU PPDU and HE ER SU PPDU and is present per RU  for an HE MU PPDU. Parameters specified to be present per RU are conceptually supplied as an array of values indexed by r, where r takes values 0 to the number of RUs minus 1. | | | | |

***At D1.0P4359L25 in 27.3.10 Mathematical description of signals:***

αr is the power boost factor of the rth occupied RU in an HE PPDU, and equals the associated POWER\_BOOST\_FACTOR parameter in the TXVECTOR.

NOTE - αr is constrained as defined in 26.11.10 (POWER\_BOOST\_FACTOR), i.e., for an HE MU PPDU, αr is in the range [ ] if the Power Boost Factor Support subfield of the HE PHY Capabilities Information field in the HE Capabilities element from any recipient STA of the PPDU equals 0; and otherwise αr is in the range [ ] ; further, for an HE SU PPDU, non-OFDMA HE MU PPDU and HE ER SU PPDU, αr is set to 1.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1072 | 4492.00 | 27.4.1 | HE lacks dot11HEChannelWidthOptionImplemented. Note: a STA could be capable (and signal itself accordingly) as 160M HE but 80M VHT or vice versa. | Add to Table 27-53 and Annex B |

# 1072 Discussion

Agreed with commenter. Another use case is a STA supports VHT at 80 MHz but supports HE at 160 MHz.

**Proposed Resolution: CID 1072**

**Revised**.

**Note to Commenter:**

The commenter’s concerns are valid and are substantially addressed in 22/0576R<motionedRevision> under CID 1072.

**Instruction to Editor:**

Implement the proposed text updates listed under CID 1072 in 22/0576R<motionedRevision>

***TGme Editor, make the following changes to D1.0 shown by Word track changes under CID 1072***

Table 27-53—HE PHY MIB attributes

dot11PHYHETable

…

|  |  |  |
| --- | --- | --- |
| Managed object | Default value/range | Operational semantics |
| dot11HEPartialBWERSUPayloadImplemented | false/Boolean | Static |
| dot11HEChannelWidthOptionImplemented | Implementation dependent | Static |

Dot11PhyHEEntry ::=

…

dot11HEPowerBoostFactorImplemented TruthValue,

dot11HEPartialBWERSUPayloadImplemented TruthValue,

dot11HEPuncturedSoundingOptionImplemented TruthValue,

dot11HEChannelWidthOptionImplemented INTEGER

}

***Then insert after dot11HEPuncturedSoundingOptionImplemented at P5648L14***:

dot11HEChannelWidthOptionImplemented OBJECT-TYPE

SYNTAX INTEGER { contiguous80(0), contiguous160(1), noncontiguous80plus80(2)

}

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This is a capability variable.

Its value is determined by device capabilities.

This attribute indicates the channel widths supported: 20/40/80 MHz, 20/

40/80/160 MHz or 20/40/80/160/80+80 MHz."

::= { dot11PhyHEEntry 25 }