IEEE P802.11
Wireless LANs

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| CR on TXTIME and PSDU\_LENGTH |
| Date: 2017-05-10 |
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 |

Abstract

This submission proposes resolutions for the following comments from the letter ballot on P802.11ax D1.0:

3441, 9490, 8566

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

**Revision History:**

R5: Version presented in March 2017 meeting. CID 3441 passed motion (motion #242 (PHY))

R6: Updated proposed resolutions for CIDs 9490 and 8566.

R7: Updated proposed resolutions for CIDs 9490 and 8566 based on discussion during meeting on 5/8/2017.

R8: Updated proposed resolutions for CIDs 9490 and 8566.

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| **CID** | **Commenter** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 3441 | Albert Petrick | 371.36 | 28.4.2 | Clarify "aSignalExtension" referenced from Table 19-25 | Add the following underlined text (without the underline):and is aSignalExtension (0us for 5 GHz band, 6us for 2.4 GHz band) |

**Discussion**

Corresponding text from D1.1 is the following (P381):

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From IEEE802.11-2016 P2426, aSignalExtension is defined as:

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The commenter is suggesting to reiterate within Clause 28 that aSignalExtension is 0 usec in the 5 GHz band, and 6 usec in the 2.4 GHz band. However, D1.1 clearly specifies that aSignalExtension is “*as defined in Table 19-25*”, where it is unambiguous that the aSignalExtension takes the values as proposed by the commenter.

However, there does seem to be an issue in referencing the TXVECTOR parameter NO\_SIG\_EXTN because the NO\_SIG\_EXTN parameter is not present for HE PPDUs according to D1.1 P225:

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As all HE PPDUs must “include” Signal Extension (including the case of adding 0 usec of Signal Extension in case of 5 GHz band), there is no need to reference the non-existent NO\_SIG\_EXTN parameter. I.e., a more proper definition of THE\_PREAMBLE would be:

|  |
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| * is defined as in
* and

, and *SignalExtension* takes the value of aSignalExtension as defined in Table 19-25 (HT PHY characteristics)  |

**Proposed Resolution: CID 3441**

**Revised**. Table 19-25 has the information the commenter is requesting to add. Rather than duplicating the information, it would be better to refer to Table 19-25. It is also noted that the reference to the TXVECTOR parameter NO\_SIG\_EXTN is incorrect as the parameter is not included for HE PPDUs (see Table 28-1). Hence, the proposed resolution updates the draft text to remove this error and clearly refer readers to Table 19-25 for the definition of aSignalExtension.

TGax editor: Replace the D1.1 P381L36-39 with “T\_{HE\_PREAMBLE} is defined as in Equation (28-116) and Equation (28-117), and *SignalExtension* takes the value of aSignalExtension as defined in Table 19-25”.

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| **CID** | **Commenter** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 9490 | Yan Zhang | 371.58 | 28.4.2 | "TPE is given by Equation (28-113)." quoted wrong equation. It should be Equation (28-117). | Replace (28-113) with (28-117) |

**Discussion:**

Corresponding text in D1.1 is the following (P381):

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| … |

where Equation (28-113) is the following (P347):

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This is applicable only for HE MU PPDU, thus the commenter is correct that the reference needs to be updated.

Note that the commenter is suggesting to replace the reference to Equation (28-117).

D1.1 P348:

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But Equation (28-117) is for the receiver side, thus is not the appropriate reference for TXTIME computation at the transmitter side.

Various PHY participants indicated desire to have the PE duration computation to be described within the PHY clause (clause 28), which means that the TXVECTOR should not pass the actual PE duration (except for the case of UMRS). The proposed resolution achieves this by moving portions of texts related to PE duration from MAC clause to PHY clause, with necessary updates to the TXVECTOR.

**Proposed Resolution: CID 9490**

**Revised.** The commenter is correct that Equation (28-113) is not the appropriate reference for T\_PE. However, Equation (28-117) is also not the appropriate reference as it is for computation at the RX side, while the comment was on the TXTIME computation at the TX side. The proposed text changes provide the correct reference for T\_PE.

TGax editor: Implement the text changes under the “Proposed Text Updates: CID 9490” section in 11-17/0465r8.

**Proposed Text Updates: CID 9490**

9.4.2.218.5 PPE Thresholds field

*TGax Editor: Update D1.2 P93L2 as shown below.*

The PPET8 for NSS*n* for RU*b* subfield and PPET16 for NSS*n* for RU*b* subfield values are combined to determine the Nominal Packet Padding (consisting of both post-FEC padding and packet extension) value for HE PPDUs that are transmitted to the STA sending this field and using NSS = *n* and an RU allocation corresponding to RU Allocation Index *b*, for each value of NSS and RU specified by the field. For all values of n and b for which PPET8 and PPET16 are not present, the Nominal Packet Padding value is 0 for HE PPDUs that are transmitted to the STA using NSS = *n* and an RU allocation corresponding to RU Allocation Index *b*. The value for each PPET8 for NSS*n* for RU*m* is always less than the value of PPET16 for NSS*n* for RU*m*. The encoding is described in Table 9-262ad (PPET8 and PPET16 encoding).

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| * PPET8 and PPET16 encoding
 |
| Result of comparison of the constellation index *x* of an HE PPDU with NSS value *n* and RU value Allocation size that corresponds to the RU Allocation index = (*b* + DCM) to the value in the PPET8 for NSS*n* for RU*m* subfield | Result of comparison of the constellation index of an HE PPDU with NSS value *n* and RU value Allocation size that corresponds to the RU Allocation index = value (*b* + DCM) to the value in the PPET16 for NSS*n* for RU*m* subfield | Nominal Packet Padding value for an HE PPDU transmitted to this STA using the constellation index = *x*, NSS = *n* and RU Allocation size that corresponds to the RU Allocation index = (*b* + DCM) |
| *x* greater than or equal to PPET8 | *x* less than PPET16 or PPET16 equal to None | 8 µs |
| *x* greater than PPET8 or PPET8 equal to None | *x* greater than equal to PPET16 | 16 µs |
| All other combinations not otherwise listed in this table | 0 |
| NOTE—DCM = 1 when the HE PPDU uses DCM; DCM = 0 otherwise. |

**27.5.2.3 STA behavior for UL MU operation**

*TGax Editor: Update D1.2 P181L5 as shown below.*

A non-AP HE STA transmitting an HE TB PPDU in response to a Trigger frame shall set the TXVECTOR parameters as follows:

* The FORMAT parameter is set to HE\_TRIG
* The TRIGGER\_METHOD parameter is set to TRIGGER\_FRAME
* The TXOP\_DURATION parameter is set as defined in 27.2.3 (Updating two NAVs)

*TGax Editor: Update D1.2 P182L24 as shown below.*

A STA transmitting an HE TB PPDU in response to a frame containing a UMRS Control field, shall set the TXVECTOR parameters as follows:

* The FORMAT parameter is set to HE\_TRIG
* The TRIGGER\_METHOD parameter is set to UMRS
* *NSYM* is set to *FVAL* + 1, where *FVAL* is the value of the UL PPDU Length subfield of the UMRS Control subfield
* The RU\_ALLOCATION and MCS parameters are set to the values of the RU Allocation and UL MCS subfields of the UMRS Control subfield, respectively.
* The CH\_BANDWITDTH parameter is set to the value of the RXVECTOR parameter CH\_BANDWIDTH of the soliciting DL MU PPDU
* The BSS\_COLOR and DCM parameters are set to the values of the RXVECTOR parameters BSS\_COLOR and DCM of the soliciting DL MU PPDU, respectively
* The HE\_LTF\_MODE, STBC, and NUM\_STS parameters are set to 0
* The CODING\_TYPE parameter is set to 0 if the RU Allocation subfield indicates less than 484-tone RU; otherwise set to 1
* The LDPC\_EXTRA\_SYMBOL parameter is not present if the RU Allocation subfield indicates less than a 484-tone RU; otherwise set to 1
* The SPATIAL\_REUSE parameter is set to SR\_Disallowed
* The DEFAULT\_PE\_DURATION parameter is set to the default PE duration value for UL MU response scheduling, which is indicated by the AP in the Default PE Duration subfield of the HE Operation element it transmits and the pre-FEC padding factor is set to 4 (see 28.3.12 (Packet extension))
* The TXOP\_DURATION parameter is set as defined in 27.2.3 (Updating two NAVs)
* The HE\_LTF\_TYPE parameter is set to 4x LTF for 3.2 s if the RXVECTOR parameter HE\_LTF\_TYPE is either 4x LTF for 3.2 s or 2x LTF for 1.6 s; otherwise it is set to 2x LTF for 1.6 s

**27.6.4 HE NDP transmission**

*TGax Editor: Delete the following bullet line from D1.2 P193L65.*

**28.2.2 TXVECTOR and RXVECTOR parameters**

*TGax Editor: Update D1.2 P252L3 as shown below.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NOMINAL\_PACKET\_PADDING | FORMAT is HE\_SU, HE\_MU or HE\_EXT\_SU. | The Nominal Packet Padding value as defined in 9.4.2.218.5.Possible values are 0 µs, 8 µs and 16 µs.If the PPDU contains at least one MPDU whose RA field is broadcast group address, then the value of NOMINAL\_PACKET\_PADDING is 16 µs. | MU | N |
| Otherwise | Not present | N | N |
| TRIGGER\_METHOD | FORMAT is HE\_TRIG | Indicates the method used to trigger this HE TB PPDU transmission.Enumerated type:TRIGGER\_FRAME for Trigger FrameUMRS for UMRS Control field | Y | N |
| Otherwise | Not present | N | N |
| DEFAULT\_PE\_DURATION | FORMAT is HE\_TRIG and TRIGGER\_METHOD is UMRS | Duration of the PE field to be transmitted (see 27.5.2.3). | Y | N |
| Otherwise | Not present | N | N |
| PE\_DURATION | FORMAT is HE\_SU, HE\_MU, HE\_EXT\_SU or HE\_TRIG. | Duration of the PE field in the received HE PPDU.Possible values are 0 µs, 4 µs, 8 µs, 12 µs and 16 µs.Enumerated type:PE0 for 0 µsPE1 for 4 µsPE2 for 8 µsPE3 for 12 µsPE4 for 16 µs | N | O |

**28.3.4 HE PPDU formats**

*TGax Editor: Update D1.2 P268L46 as shown below.*

The RL-SIG, HE-SIG-A, HE-SIG-B, HE-STF, HE-LTF, and PE fields exist only in HE PPDUs. The HESIGB field is present only in the HE MU PPDU. The duration of the PE field is given in 28.3.12.

*TGax Editor: Update D1.2 P365L40 as shown below.*

* Packet extension

An HE PPDU may have a Packet Extension (PE) field appended at the end of the PPDU, with possible durations being 0 µs, 4 µs, 8 µs, 12 µs, or 16 µs. The PE field provides additional receive processing time at the end of the HE PPDU. The PE field, when present, shall be transmitted with the same average power as the Data field, and its content is arbitrary.

Duration of the PE field for an HE SU, HE ER SU or HE MU PPDU is determined based on both the pre-FEC padding factor value in the last OFDM symbol(s) of the Data field, and the TXVECTOR parameter NOMINAL\_PACKET\_PADDING as described in this subclause.

For an HE SU or HE ER SU PPDU, the nominal *TPE* value (*TPE,nominal*) is given by Table 28-X1. In this case, *a* in Table 28-X1 is given by Equation (28-71) or (28-72).

For an HE MU PPDU, the nominal *TPE* value (*TPE,nominal*) is given by *TPE,nominal* = max*u* *TPE,nominal,u*, where *TPE,nominal,u* is the nominal *TPE* value for user *u* and is also given by Table 28-X1. In this case, *a* in Table 28-X1 is given by Equation (28-83) or (28-84).

Table 28-X1 – Nominal *TPE* value: *TPE,nominal* for HE SU or HE ER SU PPDU, *TPE,nominal,u* for HE MU PPDU.

|  |  |
| --- | --- |
|  | TXVECTOR parameter NOMINAL\_PACKET\_PADDING (HE SU or HE ER PPDU)or NOMINAL\_PACKET\_PADDING[*u*] (HE MU PPDU) |
| 0 µs | 8 µs | 16 µs |
| *a* = 1 | 0 µs | 0 µs | 4 µs |
| *a* = 2 | 0 µs | 0 µs | 8 µs |
| *a* = 3 | 0 µs | 4 µs | 12 µs |
| *a* = 4 | 0 µs | 8 µs | 16 µs |

Duration of the PE field, *TPE*, may take values of 0, 4, 8, 12 or 16 µs. *TPE* for an HE SU, HE ER SU or HE MU PPDU shall not be less than *TPE,nominal*. *TPE* for an HE SU, HE ER SU or HE MU PPDU should be equal to *TPE,nominal* to minimize the packet extension overhead. Figure 28-35 and 28-36 show examples of the PE field duration in an HE SU or HE SU ER PPDU where the TXVECTOR parameter NOMINAL\_PACKET\_PADDING has values of 8 µs and 16 µs, respectively, and *TPE* = *TPE,nominal*.

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| Figure 28-35 – PE field duration of an HE SU or HE ER SU PPDU when TXVECTOR parameter NOMINAL\_PACKET\_PADDING is 8 µs and *TPE* = *TPE,nominal*. |
|  |
| Figure 28-36 – PE field duration of an HE SU or HE ER SU PPDU when TXVECTOR parameter NOMINAL\_PACKET\_PADDING is 16 µs and *TPE* = *TPE,nominal*. |

*TPE* for an HE NDP is 4 µs.

When transmitting an HE TB PPDU for which the TXVECTOR parameter TRIGGER\_METHOD is TRIGGER\_FRAME, each transmitter of the HE TB PPDU shall append a PE field with the duration *TPE* calculated using Equation (28-112).

*TGax Editor: Add the following text at D1.2 P367L28.*

When transmitting an HE TB PPDU for which the TXVECTOR parameter TRIGGER\_METHOD is UMRS, each transmitter of the HE TB PPDU shall append a PE field with the duration *TPE* equal to the value specified in the TXVECTOR parameter DEFAULT\_PE\_DURATION.

*TGax Editor: Update D1.2 P402L29 as shown below.*

* TXTIME and PSDU\_LENGTH calculation

The value of the TXTIME parameter returned by the PLME-TXTIME.confirm primitive shall be calculated for an HE PPDU using

  (28-127)

where

 …

*TPE* is given in 28.3.12.

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| **CID** | **Commenter** | **Page** | **Clause** | **Comment** | **Proposed Change** |
| 8566 | ron porat | 372.00 | 28.4.2 | In an 11ac MU transmission with mixed BCC/LDPC users, the airtime for all the users was the same. However, the PSDU length as defined in 28-131 of 11ax D1.0 does not satisfy this property. In particular, for a mixture of BCC and LDPC users, when an LDPC extra symbol is added, BCC users' PSDU will not align with the rest | Ensure same airtime for all users, irrespective of coding. Update equation 28-131 as follows:a. Use two separate equations, one for the BCC and one for the LDPC case.b. Equation for LDPC case: same as equation 28-131, except that we omit the '-- N\_tail' at the endc. Equation for BCC case: same as equation 28-131, except that we use Nsym instead of Nsym,init, and NDBPS,last,u instead of NDBPS,last,init,u |

**Discussion:**

Following is the relevant text from D1.1 (P382):

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To illustrate the error in Equation (28-131), let us walk through the process of transmission up to the computation of PSDU\_LENGTH.

1. MAC uses the PLME-TXTIME.request primitive (IEEE802.11-2016 P614) to inform PHY how much payload MAC wishes to transmit per user (APEP\_LENGTH*u*).
2. PHY computes *Nsym,init* and *ainit*, which is common across all users (D1.1 P327).

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| … |

1. Based on *ainit*, PHY computes the initial number of (uncoded) data bits which can fit in the last OFDM symbol for each user.

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1. By default,

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But if any user employing LDPC requires extra LDPC symbol segment, then *a* is “incremented by 1”

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1. The number of *coded* bits which is transmited in the last OFDM symbol is then

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1. At this point, note that the coded bits (*NCBPS,last,u*) covers one more “symbol segment” than the uncoded bits (*NDBPS,last,init,u*) if an extra LDPC symbol segment was required in step #4 above.
	1. In case of LDPC users, the LDPC encoding scheme generates additional coded bits (by repeating coded bits if necessary) to ‘fill’ the extra symbol segment. Thus, there is no need to ‘increase’ the number of *uncoded* data bits to fill the extra symbol segment.
	2. In case of BCC users, however, there is no functionality within the BCC encoder which generates extra coded bits to fill the extra symbol segment. Hence, the number of *uncoded* data bits has to be increased to cover the extra symbol segment as well. This is done on D1.1 P329:

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1. MAC needs to be told of the ultimate PSDU size it is allowed to transmit (including any extra space created due to the extra symbol segment). This is the PSDU\_LENGTH returned from PHY to MAC via the PLME-TXTIME.confirm primitive. Unfortunately, Equation (28-131) does not reflect the potential increase in PSDU\_LENGTH for BCC users due to the extral symbol segment. This is the error the commenter is pointing out. The fix for this is mostly inline with the proposed resolution by the commenter.

During this review, however, more items requiring clarification have been found in the TX encoding parameter computation and encoding process. For example, the draft talks about MAC padding process being defined by Equation (28-89).

D1.1 P329

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But this process is defined in a lot of detail in 10.13.6 of IEEE802.11-2016 (referred from 27.10.2 of 11ax D1.1). Hence, we should put a note in the draft to clarify the pre-FEC MAC padding described in Clause 28 is not a “new” process for MAC. Rather, it is an existing behaviour in 11ac and 11ax MAC. While the discussion in this document has focused on HE MU PPDU, similar issue is present for HE SU PPDU descriptions as well. The proposed text updates in this document addresses both cases.

Another issue is that the PSDU\_LENGTH compute at the transmitter is used to populate the RXVECTOR.

D1.1 P382:

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In 11ac, the PSDU\_LENGTH computation for the RXVECTOR was described in the 21.3.20 PHY Receive Procedure subclause, but no such description is available in the TGax D1.1. Hence, the proposed resolution adds text to derive PSDU\_LENGTH at the receiver.

Note, however, that PSDU\_LENGTH computation for the RXVECTOR when receiving HE trigger based PPDU has not been addressed in the proposed resolution because there seems to be a more fundamental question of how does receiver is ‘told’ on the various parameter required for reception. E.g. how is the PHY told of the MCS, Nss, PSDU\_LENGTH, etc? Do we need to define a new PLME? Also, as the PHY is “somehow” told of all these parameters, does the PHY need to include them again in the RXVECTOR? This seems to be major topic on its own, deserving a separate contribution.

**Proposed Resolution: CID 8566**

**Revised**. The commenter is correct that Equation (28-131) is erroneous in computing the PSDU\_LENGTH. While updating the draft text to address the issue, various other issues related to the PSDU\_LENGTH was found in the draft. The proposed resolution addresses all these issues, except for the PSDU\_LENGTH computation when receiving an HE trigger based PPDU, which seems to require a separate contribution.

TGax editor: Implement the text changes under the “Proposed Text Updates: CID 8566” section in 11-17/0465r8.

**Proposed Text Updates: CID 8566**

*TGax Editor: Update Table 28-9 at D1.2 P286L30 as follows:*

|  |  |  |
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| *Ntail, Ntail,u* | 6 for BCC encoder, 0 for LDPC encoder | Number of tail bits per encoder (for user *u*) |

*TGax Editor: Update Table 28-17 at D1.2 P306L33 as follows:*

|  |  |  |  |  |
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|  | B11 | LPDC Extra Symbol Segment | 1 | Indication of the presence of the extra OFDM symbol segment for LDPC. |

*TGax Editor: Add the following NOTE after Equation (28-62) in D1.2 P345L60:*

 **** (28-62)

NOTE – *NPAD*,Pre-FEC,MAC is PSDU\_LENGTH – APEP\_LENGTH, where PSDU\_LENGTH is computed using Equation (28-128). The corresponding A-MPDU padding process is defined in 27.10.2.

*TGax Editor: Add equation number to the equation at D1.2 P350L18 as shown below:*

For the users with BCC encoding, update the *NDBPS* of the last symbol as



 (28-84a)

*TGax Editor: Edit D1.2 P350L50 as shown below:*

 (28-87)

 (28-98)

NOTE – *NPAD*,Pre-FEC,*MAC*,*u* is PSDU\_LENGTH*u* – APEP\_LENGTH*u*, where PSDU\_LENGTH*u* is computed using Equation (28-129) and (28-129a) for a user using BCC and LDPC encoding, respectively. The corresponding A-MPDU padding process is defined in 27.10.2.

*TGax Editor: Update D1.2 P402L50 as shown below:*

The value of the PSDU\_LENGTH parameter for user *u* returned in the PLME-TXTIME.confirm primitive for an HE MU PPDU is calculated using Equation (28-129) and Equation (28-129a) for users using BCC and LDPC encoding, respectively.

 (28-129)

 (28-129a)

where

*NSYM,init* is given by (28-76)

*NDBPS,last,u* is given by Equation (28-84a)

*NDBPS,last,init,u* is given by (28-77)

For HE SU or HE ER SU PPDUs, the value of the PSDU\_LENGTH parameter returned in the RXVECTOR is calculated using Equation (28-129b).

  (28-129b)

where *NSYM,RX* is given by Equation (28-129c)

 *mSTBC* is 1 if the STBC field in HE-SIG-A is 0, and 2 if the STBC field is 1

 *NDBPS,last,RX* is given by Equation (28-129d)

 *NDBPS* are defined in Table 28-12

 *Nservice, Ntail* are defined in Table 28-9

  (28-129c)

where *NSYM* is given by Equation (28-114)

  (28-129d)

where *aRX* is given by Equation (28-129e)

 *NSD,SHORT* is defined in Table 28-25

 *NSS, NBPSCS, R* are defined in Table 28-12

  (28-129e)

where *a* is the Pre-FEC Padding Factor value (ranging from 1~4) indicated in HE-SIG-A

For HE MU PPDUs, the value of the PSDU\_LENGTH parameter for user *u* returned in the RXVECTOR is calculated using Equation (28-129f).

  (28-129f)

where *NSYM,RX,u* is given by Equation (28-129g)

 *mSTBC* is 1 if the STBC field in HE-SIG-A is 0, and 2 if the STBC field is 1

 *NDBPS,last,RX,u* is given by Equation (28-129h)

 *NDBPS,u* is defined in Table 28-12

 *Nservice, Ntail* are defined in Table 28-9

  (28-129g)

where *NSYM* is given by Equation (28-114)

  (28-129h)

where *aRX,u* is given by Equation (28-129i)

 *NSD,SHORT,u* is the *NSD,SHORT* defined in Table 28-25 for user *u*

 *NSS,u, NBPSCS,u, Ru* are defined in Table 28-12

  (28-129i)

where *a* is the Pre-FEC Padding Factor value (ranging from 1~4) indicated in HE-SIG-A

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